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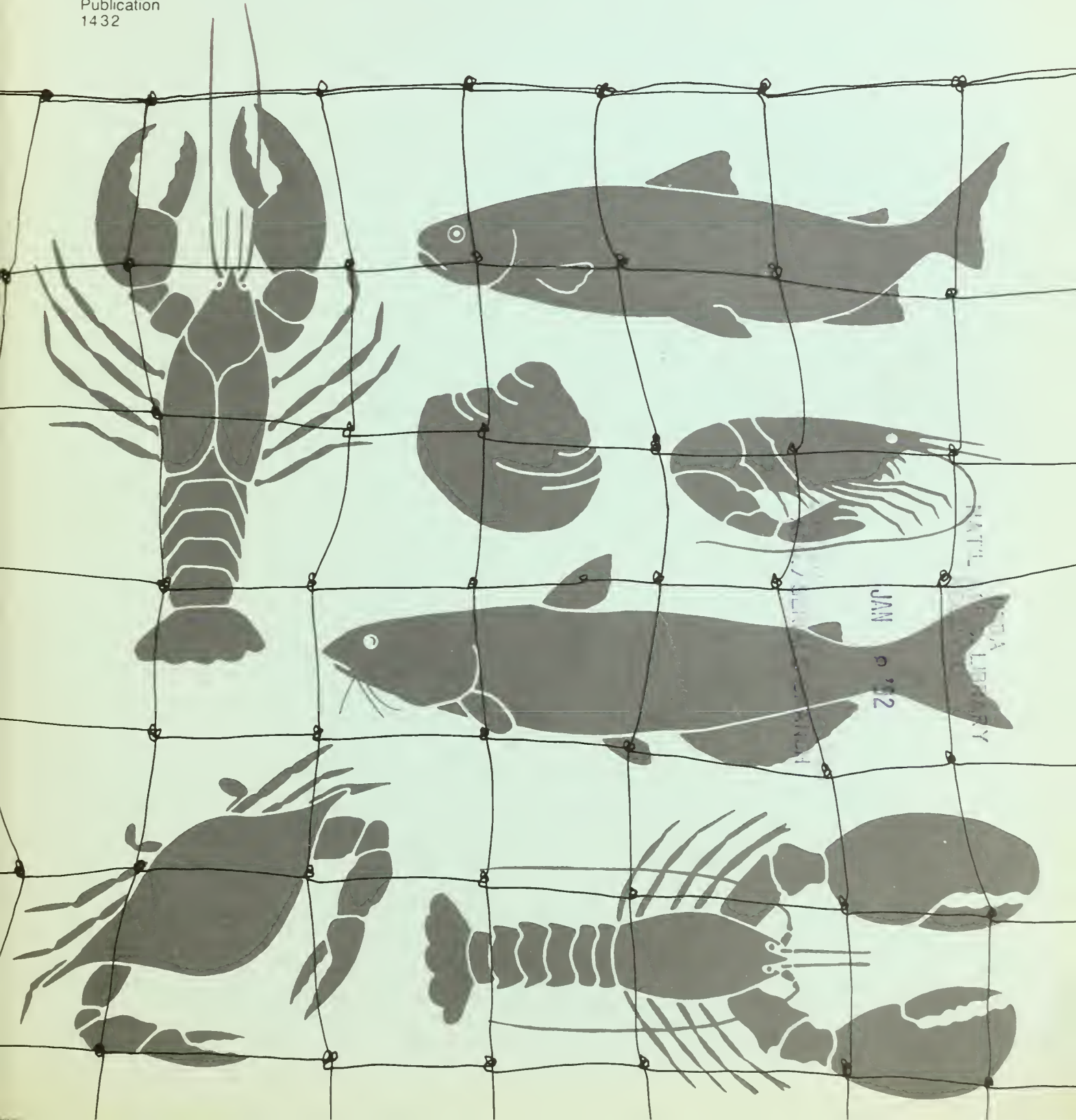
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Aquaculture Research

A Directory of USDA and State Projects in CRIS



Aquaculture Research

A Directory of USDA and State Projects in CRIS

Compiled by
Current Research Information System
Cooperative State Research Service
for
National Agricultural Library
U. S. Department of Agriculture

January 1983

PREFACE

This directory of aquaculture research was prepared in support of Departmental initiatives related to implementation of the National Aquaculture Act of 1980 (P.L. 96-362) and Subtitle L of the National Agricultural Research, Extension, and Teaching Policy Act of 1977, as amended by the Agriculture and Food Act of 1981 (P.L. 97-98). Specific reference in the legislation is made to the development and implementation of aquaculture research programs and the conduct of "...research and extension to facilitate or expand promising advances in the production and marketing of aquacultural food species and products." It is the intent of this directory to bring into sharper focus current aquaculture research activities of the Department and the States and to serve as a guide to the scope and direction of these efforts.

A second objective was to demonstrate the feasibility of and to develop the means for rapid and inexpensive preparation of classified and indexed listings of research projects in camera-ready format directly from the computer file of the Current Research Information System (CRIS). Initially targeted as a part of aquaculture program objectives of the Technical Information Systems (TIS), Science and Education Administration (SEA), this first directory is the product of a cooperative effort of the Current Research Information System, Cooperative State Research Service, and the Information Systems Division, National Agricultural Library.

Included here are ongoing and recently completed projects conducted or sponsored by agencies and institutions within the USDA-State agricultural research system. Components of the system are chiefly the USDA research agencies, the State agricultural experiment stations and land-grant colleges, Tuskegee Institute, State forestry schools, and other cooperating State institutions. The source of project information was the Current Research Information System, USDA's documentation and reporting system for publicly supported agricultural and forestry research. CRIS is operated by the Cooperative State Research Service, U. S. Department of Agriculture.

Projects listed are those contained in CRIS as of January 1982. Selection of projects was based on the presence of aquaculture as a major component of the research as determined from CRIS narrative project descriptions. Projects in related areas, such as those dealing with sedimentation and erosion, water quality, and pollution were generally not included unless aquaculture was clearly within the scope

of the objectives. Except for minor editing, information appearing on each project was taken directly from the research summary as received for entry in the CRIS system. Index terms listed in the Keyword/Title Index are the keywords assigned to the projects by CRIS staff for use in computer retrieval. They appear in the printed index as single or multiple-word terms and as originally assigned during indexing. Titles have been added to provide context. Chapter headings within the main entry section are based on internal CRIS special classifications for aquaculture research. In instances where a project was assigned more than one classification, the same project is repeated in all applicable chapters. Repeat entries are identified by an asterisk in both the main entry section and indexes. Arrangement of projects within chapters is by State, followed in order by performing institution, department, and investigator name.

Publication of this directory coincides with the compilation of (1) a directory of information resources in aquaculture, by contract with Aspen System Corporation, under direction of the National Agricultural Library, and (2) a directory of primary contacts at Federal, State, and county levels for assistance and information on programs for aquaculturists, being prepared in cooperation with Auburn University, Alabama. For information on these and other projects in support of the aquaculture effort, contact Wallace C. Olsen, Chief, Field and Special Programs Division, National Agricultural Library, Beltsville, Maryland 20705.

Camera-ready copy for this directory was compiled through use of the SAMANTHA software system. (SAMANTHA is a registered service mark of CORDATUM, Inc., Bethesda, Maryland.) CRIS project information in machine-readable form served as the sole source of input. Initially, CRIS projects were retrieved on computer magnetic tape through a search of the CRIS file on the DIALOG online retrieval system, operated by DIALOG Information Services, Inc., Palo Alto, California. From the DIALOG tape, an online working file was created at the USDA Washington Computer Center to provide capability for onling editing. The edited file was then read directly into SAMANTHA, which compiled both the main entry section and indexes in camera-ready format.

Special acknowledgment is due CRIS staff member Richard M. Sparks, who identified and performed the final selection, review, and editing of projects included in the directory, and Philip A. Turner and Edward A. Warnick of the National Agricultural Library, who designed and developed SAMANTHA application programs for executing format, sort, and print conventions on which this directory was based. Philip L. Dopkowski, Head, Technical Products and Services Unit, Current Research Information System, was responsible for overall direction, planning, and coordination of the project.

Comments on the content, format, and usefulness of this directory as well as suggestions of other topics for similar treatment are welcome and should be sent to: Current Research Information System, National Agricultural Library Building, Beltsville, Maryland 20705.

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January 1983

RESEARCH PROJECT DESCRIPTIONS

1. Biology and Behavior

001.001 CRIS0081713
NEURAL CONTROL OF SWIMMING IN CRAYFISHES

MULLONEY B; AGRI ZOOLOGY; UNIVERSITY OF CALIFORNIA,
DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-AZO-4013-B Project Type: HATCH
Agency ID: CSRS Period: 24 JUN 80 To 30 SEP 83

OBJECTIVES: Describe the structure and properties of the neurons that control the movements of crustacean swimmerets, describe and interpret their synaptic organization, examine the connections and modes of action of command fibers that either drive or inhibit these neurons and analyze the connections and dynamics of the proprioceptive sensory neurons which monitor the position of each swimmeret. The significance of this analysis may be profound for our understanding of many nervous systems which drive cyclic movements of limbs.

APPROACH: We will combine intracellular recording of synaptic activity from selected neurons with careful analysis of their structure and biophysical properties and with existing information about the dynamic performance of the entire system.

001.002 CRIS0081746
CHEMICALS THAT DIFFUSE FROM PREDATORY ASTEROIDS &
TRIGGER DEFENSIVE BEHAVIORS IN MARINE INVERTEBRATES

PHILLIPS D W; AGRI ZOOLOGY; UNIVERSITY OF CALIFORNIA,
DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-AZO-4005-B Project Type: HATCH
Agency ID: CSRS Period: 27 JUN 80 To 30 SEP 83

OBJECTIVES: To isolate and identify the chemicals that diffuse from predatory asteroids and trigger defensive behaviors in marine invertebrates.

APPROACH: Waterborne chemicals diffusing from living predatory asteroids will be isolated from seawater by adsorption on to a column of macroporous non-ionic exchange resin. After elution from the resin, the concentrated eluate will be tested for effectiveness in stimulating defensive behavior in molluscs and other marine invertebrates. Stimulatory chemicals will be purified and identified using standard techniques. The specificity of defensive responses will be examined by isolating waterborne chemicals diffusing from a variety of stimulatory and non-stimulatory asteroids.

PROGRESS: 80/06 TO 80/12. Steroid saponins have been proposed as the chemicals eliciting defensive behavior by the prey of seastars. Non-ionic exchange resin has been used to concentrate low levels of saponin directly from seawater surrounding living specimens of the seastars *Pycnopodia helianthoides* and *Patiria miniata*. The total amount of saponin released into the water by *Pycnopodia*, a seastar known to elicit defensive responses by many of its prey, and *Patiria*, a seastar which rarely elicits such responses, was similar. However, thin-layer chromatography revealed differences between the

steroids of the seastars. These differences may be the key to understanding the specificity of defensive responses--why responses are elicited by some species of seastar and not by others. Preliminary gel filtration experiments have been conducted on the chemical diffusing from *Pycnopodia* and eliciting defensive behavior by the sea urchin *Strongylocentrotus purpuratus*. The biologically active chemical elutes near the end of a column of Bio-Gel, P-6 (fractionation range 1000-6000MW), suggesting an active molecule on the order of 1500 MW.

PUBLICATIONS: 80/06 TO 80/12

MOITOZA, D.J. and PHILLIPS, D.W. 1979. Frey Defense, Predator Preference, and Nonrandom Diet: The Interactions Between *Pycnopodia helianthoides* and Two Species of Sea Urchins. *Marine Biology* 53:299-34.

PHILLIPS, D.W. 1980. Steroid Saponins Concentrated from Water Surrounding Living Specimens of the Seastars *Pycnopodia helianthoides* and *Patiria miniata*. *American Zoologist* 20:846.

FISHLYN, D.A. and PHILLIPS, D.W. 1980. Chemical Camouflaging and Behavioral Defenses Against a Predatory Seastar by Three Species of Gastropods from the Surfgrass *Phyllospadix* Community. *Biological Bulletin* 158:34-48.

001.003 CRIS0066346
OSMOREGULATORY RESPONSES OF DESERT PUPFISH: A STUDY
MODEL OF PHYSIOLOGICAL ADAPTATION TO ENVIRONMENT

BODA J M; ANIMAL PHYSIOLOGY; UNIVERSITY OF
CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-AFH-3225-B Project Type: HATCH
Agency ID: CSRS Period: 10 SEP 74 To 30 DEC 80

OBJECTIVES: Investigate the physiological mechanisms of adaptation by fishes with emphasis on the maintenance of osmotic and ionic balances.

APPROACH: Two species of desert pupfish, one adapted to extreme and variable conditions of environmental temperature and salinity (*C. macularius*), the other restricted to fresh waters (*C. radiosus*) will be employed as laboratory models. Initially, mechanistic differences in the abilities of the eggs and embryos of the two species to tolerate environmental extremes will be investigated in detail. Later, developing fry and adults will be studied.

PROGRESS: 74/10 TO 80/12. This project was terminated July 1979. The major results of this project include: Establishment of husbandry techniques and environmental requirements for the maintenance of two populations of desert pupfish (*Cyprinodon macularius* and *C. radiosus*) in a laboratory situation for several generations. *C. macularius* is a particularly suitable experimental animal model for the study of embryogenesis. *C. radiosus* is a difficult species to maintain in the lab because of low reproductive capacity. Comparisons of tolerances to environmental salinity and other environmental variables for the two species (and hybrids) have demonstrated such tolerances (or their lack) is inherent within the specific population as measured by the success and nature of embryogenesis and hatching of viable larvae. Environmental salinity, temperature, specific organic ions (especially sodium and calcium) have important influences on the rates of embryogenesis and the development of body form. There are interactions between these three environmental

variables and there are differences between the two species in their response to such factors. For example, the quantitative requirement for calcium ion is greater at high salinity, at excessively low salinity (near distilled water), at high temperature, and for *C. radiosus* for the several environmental conditions.

PUBLICATIONS: 74/10 TO 80/12
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

001.004 CEIS0078835
PHYSIOLOGY AND ECOLOGY OF THE ASIATIC CLAM, *Corbicula*
SP., IN THE SACRAMENTO-SAN JOAQUIN DELTA

BODA J M; ANIMAL PHYSIOLOGY; UNIVERSITY OF
CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-APH-3716 Project Type: STATE
Agency ID: SAES Period: 01 FEB 79 To 30 OCT 84

OBJECTIVES: Provide detailed physiological and
ecological information on the asiatic clam, *Corbicula*
sp., as a basis for management or economic
exploitation of the species.

APPROACH: Laboratory studies of individual changes of
body composition, growth, and metabolism and field
studies of population changes and productivity will
be used to evaluate the ecology of *Corbicula* in the
Sacramento-San Joaquin delta.

PROGRESS: 80/01 TO 80/12. Caged populations of
freshwater clams (*Corbicula manilensis*) consisting of
labeled individuals of known size and estimated
tissue composition (based upon tissue analysis of
other individuals collected at the same time and
location) have been placed in several
microenvironments of the San Joaquin Delta. Samples
of the caged populations, as well as clams from the
same areas, are being collected periodically
throughout the year for an evaluation of growth rates
and changes of tissue composition (wet and dry
weights, tissue calories, total nitrogen, glycogen
concentration). The purpose is to establish baseline
values and potentially useful procedures to allow the
use of these clams as bioindicators of the quality of
the Delta waters. Tissue composition of lyophilized
tissues collected from resident populations during
1978 and 1979 are being analyzed to establish
equations for the prediction of tissue compositions
from simple field measurements.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.005 CRIS0080277
MOLECULAR ENDOCRINOLOGY OF MOLTING AND REPRODUCTION
IN CRUSTACEANS

CHANG E S; ANIMAL SCIENCE; UNIVERSITY OF CALIFORNIA,
DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ASC-3896-B Project Type: HATCH
Agency ID: CSRS Period: 01 NOV 79 To 30 SEP 83

OBJECTIVES: Characterize hormone receptors in a
crustacean cell line; define the interactions between
molting and ovarian maturation at the molecular
level; purify and characterize hormones involved in
egg maturation and spawning; accurately measure the
titer of the molting hormone during the course of the
molt cycle in various crustacean species.

APPROACH: The establishment of a crustacean cell line
would involve classical tissue explantation and
dissociation methods. Once established, the cell line
would be examined for molting hormone (ecdysone)
receptors and cell-specific products.
Hormone-receptor interactions would be examined in
terms of nuclear translocation and differential gene
expression. Extracts of various tissues such as the
crustacean eyestalks would be tested for lipid
mobilization in the hepatopancreas and for
vitellogenesis in the ovary in the search for
gonadotrophic hormones. Extracts of tissues of
free-spawning penaeid shrimps will be examined for a
spawning factor. Various crustacean species will be

assayed for molting hormone titer using an existing
radio-immunoassay. Comparison of the resulting data
will permit the formulation of molt-stage criteria
based on hormonal titers.

PROGRESS: 80/01 TO 80/12. The objectives of this
project are to elucidate the endocrine events
involved in the processes of molting and reproduction
in crustacean species of aquaculture importance. By
means of a specific radio-immunoassay, the molting
hormone (ecdysteroid) titers have been determined
during the first three larval stages of the lobster,
Homarus americanus. Cyclic changes in the hormone
titers indicate that larval molting is most likely
under a hormonal control that is similar to that
operating in juvenile and adult animals. In addition,
this larval molting hormone has been identified as
20-hydroxyecdysone by means of thin-layer
chromatography. Studies are also continuing on the
effects of changes of the molting hormone titer on
reproduction in the female lobster. Samples of blood
are being collected to see if there is a correlation
between egg development, egg extrusion, and molting.

PUBLICATIONS: 80/01 TO 80/12
STEVENS J, J.R., ARMSTRONG, P.W., CHANG, E.S. and
O'CONNOR, J.D. 1979. Ecdysone Titers During the
Molt Cycle of the Crayfish *Orconectes sanborni*.
General and Comparative Endocrinology 39:20-25.
CHANG, E.S. and BRUCE, M.J. 1980. Ecdysteroid
Titers of Juvenile Lobsters Following Molt
Induction. Journal of Experimental Zoology
214:157-160.

001.006 CRIS0080242
PENAEIDAE GAMETES, THEIR STRUCTURE, ACTIVATION AND
FUSION

CLARK W H; ANIMAL SCIENCE; UNIVERSITY OF CALIFORNIA,
DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ASC-3852-H Project Type: HATCH
Agency ID: CSRS Period: 01 NOV 79 To 30 SEP 83

OBJECTIVES: Characterize the gametes, gamete
activation and gamete fusion in selected members of
Penaeidae. This work is prerequisite to the ultimate
goal--the development of in vitro fertilization
technique.

APPROACH: Using microscopic, histo- and cytochemical,
and biochemical techniques, gametogenesis, gamete
activation, and gamete fusion (fertilization) will be
studied in *Sicyonia* sp. and *Penaeus* sp. These studies
should define gamete stages capable of fertilization
and the microenvironment necessary for fertilization.
Using this information, in vitro fertilization
techniques will be developed.

PROGRESS: 80/01 TO 80/12. Control of Egg Extrusion
and Fertilization in Shrimp. We conducted preliminary
studies on the hormonal control of spawning in the
rock shrimp, *Sicyonia ingentis*. Initial experiments
indicate that eyestalk extracts may mediate the
breakdown of the germinal vesicle and release of the
eggs from their surrounding matrix of follicle cells.
Detailed studies of the fertilization process as well
as the male and female gametes have been carried out
over the last year in various species of shrimp.
Following egg extrusion in shrimp the next critical
event is the cortical reaction (jelly release) of the
eggs. This cortical reaction of the egg from both *S.*
ingentis and *Penaeus aztecus* has been morphologically
characterized, and we have biochemically identified
the jelly component produced during these reactions.
We have also made significant progress in
understanding the fertilization events associated
with the sperm. The acrosome of *Sicyonia ingentis*
sperm has been characterized, and the acrosomal
reaction has been successfully induced in vitro with
the ionophore A23187. We have sequenced and
characterized many of the events of fertilization in
S. ingentis. Other studies have shown that
Macrobrachium rosenbergii, the fresh water prawn,
possesses gametes identical to marine species of
Penaeus. This type of sperm has also been
structurally characterized, and the events of
fertilization in *M. rosenbergii* have been documented.

PUBLICATIONS: 80/01 TO 80/12

- WHEELER, R., YUDIN, A.I. and CLARK JR., W.H. 1979. Hatching Events in the Cysts of *Artemia salina*. *Aquaculture* 18:55-67.
- KLEVE, M.G. and CLARK JR., W.H. 1980. Association of Actin with Sperm Centrioles: Isolation of Centriolar Complexes and Immunofluorescent Localization of Actin. *Journal of Cell Biology* 56:87-95.
- KLEVE, M.G., YUDIN, A.I. and CLARK JR., W.H. 1980. Fine Structure of the Unistellate Sperm of the Shrimp, *Sicyonia ingentis* (Natantia). *Tissue and Cell* 12(1):29-45.
- CLARK JR., W.H., LYNN, J.W., YUDIN, A.I. and PERSYN, E.C. 1980. Morphology of the Cortical Reaction in the Eggs of *Penaeus aztecus*. *Biological Bulletin* 158:175-186.
- YUDIN, A.I., KLEVE, M.G. and CLARK JR., W.H. 1981. Sperm of the Ridgeback Prawn, *Sicyonia ingentis* (Natantia). In: *Advances in Invertebrate Reproduction*, Editors: Clark Jr., W.H. and Adams, T.S. Elsevier/North-Holland

001.007 CRIS0080268
SWIMBLADDER INFLATION IN LARVAE OF PHYSOCILISTOUS FISHES

DOBOSHOV S I; CLARK W H; ANIMAL SCIENCE; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ASC-3893-B Project Type: HATCH
Agency ID: CSRS Period: 01 NOV 79 To 30 SEP 83

OBJECTIVES: Determine the effect of oxygen tension and water temperature on the inflation of swimbladder in larvae of physoclistous fish; study the development and fine structure of larval swimbladder; increase survival rate in culture of physoclistous fish larvae.

APPROACH: Larvae of physoclistous species widely used in aquaculture (*Tilapia*, striped bass, mullet or croaker) will be tested for: Correlation between percentage and time of the initial swimbladder inflation and oxygen tension and temperature monitored in rearing containers; histological and fine structure of swimbladder development prior to, during and after initial inflation. This should elucidate a mechanism of larval swimbladder inflation and hydrostatic regulation of critical stage of development and provide a means of monitoring normal inflation and high survival rate in larvae culture technology.

PROGRESS: 80/01 TO 80/12. It has been shown that initial swim bladder inflation in physoclistous larvae, if delayed, is the major cause of hatchery mortality. Water quality conditions (e.g., dissolved oxygen and turbulence) have been correlated with both cytological changes in the primordial swim bladders epithelium and with embryonic and larval organogenesis. Two major mechanisms for bladder inflation have been proposed and are being examined for *Sarotherodon mossambicus* and *Morone saxatilis*. In recent experiments, we have found that water salinity is also a critical factor regulating swim bladder inflation and organogenesis in the pelagic estuarine larvae of striped bass. Larvae held for five days posthatch in brackish water (5-12 ppt) exhibit superior bladder inflation, more advanced development of the primordial swim bladder, higher efficiency of yolk sac utilization, and, in general greater survival as compared to larvae held in fresh water. This phenomenon is probably related to the specific patterns of larval osmoregulation which is under investigation at the present time.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.008 CRIS0076303
STUDIES OF RELATIONSHIPS BETWEEN MARINE AND TERRESTRIAL BACTERIA

EAMANN P; BACTERIOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-HAC-3642-B Project Type: HATCH
Agency ID: CSRS Period: 23 MAR 78 To 30 SEP 82

OBJECTIVES: Determination of relationships between marine and terrestrial bacteria by means of comparisons of glutamine synthetases from a number of marine and terrestrial species.

APPROACH: We propose to obtain purified glutamine synthetase, inject rabbits with this preparation and study relationships by means of the quantitative micro-complement fixation method. This technique gives an estimate of the % amino acid sequence difference between the studied proteins.

PROGRESS: 80/01 TO 80/12. We have completed studies of the evolution of alkaline phosphatase in species of *Vibrio* and the results have been submitted for publication. The amino acid sequence divergence of this enzyme confirmed and extended our past speculation. In addition we have completed our studies on the evaluation of glutamine synthetase in species of marine and terrestrial enterobacteria. The results of these studies have allowed a definition of *Vibrio* and *Photobacterium* based on evolutionary relationships. We are currently pursuing studies of evolution of superoxide dismutase in these two genera and have purified antigens from four reference strains and obtained antisera. At the present we are measuring the amino acid sequence divergence of the SCE from species of *Vibrio* and *Photobacterium* using the quantitative microcomplement fixation technique.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.009 CRIS0075881
ENVIRONMENTAL AND ECOLOGICAL INFLUENCES ON GENETIC VARIABILITY

FOIN T C; ECOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ECL-3669-B Project Type: HATCH
Agency ID: CSRS Period: 20 JUL 78 To 30 SEP 83

OBJECTIVES: This project is intended to identify the ecological and environmental correlates of genetic variability in grassland and marine ecosystems. This will help us to identify the role of genetic variation in mediating population response to environmental and ecological conditions. If the results are similar, analysis of two widely different to ecosystems should produce generalizations applicable both to agricultural and natural ecosystems.

APPROACH: In both systems we shall routinely measure levels of genetic variation in enzymes using gel electrophoresis; the ecological structure of the community; and relative environmental and trophic stability. With these data we can identify what conditions are most closely associated with high genetic variability. This long-term (several years) study is principally located in the northern California coastal grassland and in the tropical Pacific. The project is currently coordinated with personnel at the University of Hawaii, the University of Washington, and the Departments of Genetics and Agronomy and Range Science at U.C. Davis.

PROGRESS: 80/01 TO 80/12. This program currently consists of two parts. One is the direct measurement of genetic variability in a family of tropical marine gastropods. By and large, little work in research has been undertaken in this past year, although two manuscripts bearing on this work have been completed and submitted within the year. The other part of the program is the ecological assessment of a perennial grass species, *Anthoxanthum odoratum*. The program currently emphasizes the ecological aspects of increase of this species in a coastal grassland at Sea Ranch, Sonoma County, to define the limits of adaptability of a species well-known for its genetic variability. Three students are now working on this program: two abstracts and one paper have been produced in the past year. The principal result to

emerge is that Anthoxanthum is highly successful along the coast in a variety of environments. There appears to be a strong correlation between Anthoxanthum abundance and soil water availability, conditioned on the presence of other perennial species which are potential competitors.

PUBLICATIONS: 80/01 TO 80/12
NC PUBLICATIONS REPORTED THIS PERIOD.

001.010 CRIS0076425
EFFECTS OF STAMPEDE RESERVOIR ON UPSTREAM FISH
POPULATIONS OF SAGEHEN CREEK

BERMAN D C; FCREST RESEARCH UNIT; UNIVERSITY OF
CALIFORNIA, EERKELEY, CALIFORNIA. 94720.
Proj. No.: CA-F*-FRU-3649-B Project Type: BATCH
Agency ID: CSRS Period: 07 SEP 78 To 30 SEP 80

OBJECTIVES: Determine the cause of upstream movement of suckers in Sagehen Creek following impoundment and determine if other changes in fish composition are occurring, particularly trout populations in areas formerly uninhabited by suckers.

APPROACH: Seasonally, we will sample fish by electrofishing from the reservoir upstream. Density and standing crop estimates will be compared to pre-impoundment baselines data (1952 to 1961). Suckers will be tagged to determine movement patterns. Physiological condition will be assessed to see if upstream fish are under more stress than those downstream. An underwater observation tank will be used to observe behavior of trout and suckers in case suckers have an adverse effect on trout distribution.

PROGRESS: 80/01 TO 80/12. Tahoe sucker in Webber Lake were found in different depth and habitat zones depending on their size (age). They also fed on different benthic invertebrates depending on size. Juvenile sucker were gregarious by day in shallow water but at night fed as individuals. Adult fish lived in deep zones by day and migrated to shallow water at night to feed. Food of sucker in Webber Lake was mostly chironomid larvae, an amphipod and molluscs while in Stampede Reservoir they ate mostly chironomid larvae and pupae and some zooplankton (from the berthos). The difference in diet between systems was a function of differences in food availability. In Sagehen Creek, sucker confined to a section at the underwater observation tank fed actively only in mid afternoon. The action of their feeding cleared away fine sediment and organic matter from bottom substrates. Invertebrate drift seemed increased by their feeding although further tests are needed for verification.

PUBLICATIONS: 80/01 TO 80/12
MARRIN, D.L. 1980. Food Selectivity and Habitat Utilization by Introduced Trout and Native Non-game Fishes in Subalpine Lakes. M.S. Thesis.

001.011 CRIS0067534
THE EFFECT OF STREAM CURRENT UPON FISH BEHAVIOR,
GROWTH AND MICROHABITAT SELECTION

LI B W; WILDLIFE & FISHERIES BIOLOGY; UNIVERSITY OF
CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-WFB-3208-B Project Type: BATCH
Agency ID: CSRS Period: 18 MAR 75 To 31 DEC 78

OBJECTIVES: Determine the effect of stream current speed upon growth, habitat selection, aggressive behavior.

APPROACH: Laboratory streams were set at three speeds. Four replicates of four fish of each of the three species were tagged and placed into a stream of the appropriate current. Growth was measured, aggressive behavior recorded, and individual fish mapped.

PROGRESS: 78/01 TO 78/12. The work completed has four major findings: Broad distributional patterns of fishes living in streams are governed by physiological response to environmental gradients. Microhabitat selection and resource partitioning is

also affected by physiological capacities of individual species; optimal swimming speed was found to approximate twice the standard metabolic rate; habitat selection away from this optimum is explainable in terms of benefit-cost relationships; if the return in terms of reduced predation or greater forage is high enough fish will change their velocity preferences. Traditional models of behavioral regulation of body temperature are inadequate to explain habitat choice of stream fishes; fishes in Sagehen Creek experience a diel fluctuation of 15°C during the day; yet many of these fishes are highly territorial or they have very restricted and circumscribed home ranges. The interspecific aggressive interactions have been found to be more frequent in newly formed communities (i.e., experimental populations) than in those which have been observed in natural states. Thus in colonies which are being recolonized, interactions may be extremely important. Maintenance of the hierarchies both within and between populations may require less frequent displays in stable areas. Species examined in these studies are *Salmo gairdneri*, *Oncorhynchus tshawytscha*, *Mylopharyngodon conocephalus*, *Ptychocheilus grandis*, *Catostomus occidentalis*, *C. tahoensis*.

PUBLICATIONS: 78/01 TO 78/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.012 CRIS0067184
CLEAR LAKE ECOSYSTEM ANALYSIS: THE FISHES

LI B W; MOYLE P B; WILDLIFE & FISHERIES BIOLOGY;
UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-WFB-3205-B Project Type: BATCH
Agency ID: CSRS Period: 13 JAN 75 To 31 DEC 79

OBJECTIVES: Study the ecology of game and nongame fishes of Clear Lake, centering around the recently introduced *Menidia* and devise a fisheries management plan for the lake.

APPROACH: Determine the ecological significance of Clear Lake tributaries, especially ephemeral ones, by comparative population analyses. Production of *Menidia* will be estimated by the method of Hamilton (1969). The effectiveness of *Menidia* as a biocontrol agent will be evaluated by studying its prey electivity.

PROGRESS: 79/01 TO 79/12. This project was terminated this year, although analysis of data concerning the biology of the recently (1967) introduced Mississippi silversides in the lake is still proceeding by H. W. Li (now at Oregon State Univ.) and by W. W. Wurtsbaugh (Ph.D. thesis). Overall we have found that the silversides may be having some controlling impact on the populations of the pestiferous Clear Lake gnat but that its impact on gamefish populations and those of native nongame fishes has been negative or neutral. Similar effects, or worse, are expected in the Sacramento-San Joaquin Delta where the fish has just become established, and in numerous reservoirs.

PUBLICATIONS: 79/01 TO 79/12
MOYLE, PETER B. and N. J. ECLZHAUSEK. 1978. Effects of the introduction of Mississippi silverside (*Menidia aedeus*) and Florida largemouth bass (*Micropterus salmoides floridanus*).
BROADWAY, J.E. and P. B. MOYLE 1978. Aspects of the ecology of the prickly sculpin, *Cottus asper* Richardson, a persistent native species in Clear Lake, California. *Env. Biol. Fish.* 3(4):337-343.

001.013 CRIS0068125
INSTREAM FLOW REQUIREMENTS OF CALIFORNIA FISHES

MOYLE P B; WILDLIFE & FISHERIES BIOLOGY; UNIVERSITY OF
CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-WFB-3206-B Project Type: BATCH
Agency ID: CSRS Period: 23 JUN 75 To 30 SEP 84

OBJECTIVES: Determine the requirements of the different life history stages of California fishes in relation to water velocity, substrate and depth. Show how these requirements vary in different stream types and in relation to temperature regimes and other fish species present. Determine if squawfish predation on salmon is increased by changed flow regimes and erection of diversionary structures.

APPROACH: Following the USFWS-IFG methodology, representative sections of streams are selected and subjected to intensive hydrological studies that allow the section to be simulated on a computer. Measurements of depth, velocity, substrate and other variables are then recorded for individual fish of all species present. When the two sets of data are combined, predictions can be made as to how much suitable habitat is available to each species, under different flow regimes. Samples of squawfish collected at different localities, times of the year and habitats are being examined for food habits. The results will be used in conjunction with data collected.

PROGRESS: 79/01 TO 79/12. This project has been terminated in favor of the more specific project WFB 3884-H. Much of what was learned in this project is summarized in Moyle and Li (1979) and Moyle (in press). Essentially, these studies document the distribution patterns of freshwater fishes in major portions of the Sacramento-San Joaquin drainage system in relation to the changing patterns of water use by man. Specific studies have also concentrated on the unique trout fishery of the McCloud River (Sturgess and Moyle 1978, Tippetts and Moyle 1978) and on the threatened fishes of the Pit River system (Daniels and Moyle 1978; Daniels 1978).

PUBLICATIONS: 79/01 TO 79/12

MOYLE, P.B., 1980 (Ed.). Studies on the distribution and ecology of fishes of the Sacramento-San Joaquin drainage system. I. Fishes of the Pit River system (Moyle and Daniels). II. Fishes of the Pajaro River system (Smith). III. Stream

DANIELS, R.A. 1979. Distribution and status of crayfishes in the Pit River drainage, California. Crustaceana. 20:1-8.

STURGESS, J. and MOYLE, P.B. 1978. Biology of rainbow trout, brown trout and Interior Dolly Varden in the McCloud River, California, in relation to management. Cal-Neva Wildlife. pp. 232-250.

TIPPETTS, W.E. and MOYLE, P.B. 1978. Epibenthic feeding by rainbow trout (*Salmo gairdneri*) in the McCloud River, California. J. Anim. Ecol. 97:549-558.

DANIELS, R.A. and MOYLE, P.B. 1978. Biology, distribution and status of rough sculpin, *Cottus asperimus*, in the Pit River drainage, Northeastern California. Copeia. p. 673-678.

001.014 CFIS0079437
PRODUCTION OF IDENTIFICATION CIRCULARS ON THE LARVAE OF COLORADO FISHERS

CARLSON C A; FISBERRY & WILDLIFE BIOLOGY; COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO. 80523.
Proj. No.: CCL00062 Project Type: STATE
Agency ID: SABS Period: 01 JUL 79 To 30 JUN 82

OBJECTIVES: Determine and provide aquatic biologists with criteria for the identification of the larvae of Colorado's fishes and provide initial financial support for the research activities of CSU's Larval Fish Laboratory.

APPROACH: Specimens will be acquired, literature reviewed, and developmental series assembled for selected important species. Morphometric and meristic data will be summarized, and embryos, larvae and juveniles will be illustrated. Brief identification circulars will be prepared for each species for dissemination to aquatic biologists and assemblage in notebooks. Keys will be prepared for identification of larvae of Colorado Species.

PROGRESS: 80/01 TO 80/12. Preparation of larval fish Identification Circulars is underway for 16 species of Colorado's west-slope cyprinid and catostomid fishes, including three endangered forms. Eight of these species are also common to east-slope streams. Much of this information will appear in a Guide to the Cypriniform Fish Larvae of the Upper Colorado River System in Colorado. Identification Circulars for some of the 16 species will be published or at least ready for publication by the end of June 1981. The remainder will be completed and others initiated during the 1981 and 1982 fiscal years. As they represent the largest order of fishes in Colorado, emphasis will continue to be placed on the cypriniform fishes, but work on other groups will be initiated during the next few years, possibly even this spring. Numerous water-storage and transmountain and local water diversion projects, for agricultural and other purposes, are planned for west-slope streams. Accordingly, the identification aids being prepared are anxiously awaited by various government agencies, universities, and private firms concerned with impacts on fish reproduction, early life history, and spawning and nursery grounds. The information being assembled has already been applied by the CSU Larval Fish Laboratory and Colorado Division of Wildlife in fish distribution and habitat studies. As more east-slope species are covered, similar applications can be made there.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.015 CFIS0077533
ANALYSIS AND MODELING LAKE MICHIGAN FISH POPULATION

VANDYNE G; FISBERRY & WILDLIFE BIOLOGY; COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO. 80523.
Agency ID: CSVM05500 Period: 01 JAN 76 To 31 DEC 78

OBJECTIVES: Assessment of power plant effects such as entrainment, impingement and relatively small thermal increments on Lake Michigan implies a need for a systems analysis approach. Proposed is a modelling effort to examine and interrelate the data from the fishery and related investigations in the vicinity of the Donald C. Cook Nuclear Power Plant to determine power plant effluent pollution effects on commercial and sports fish in Lake Michigan.

APPROACH: The model will examine changes over time on a multispecies population sector. Climatic variables, plant operations and seasonal effects will be used as driving variables in the model to change the values of elements in the transition matrices. The model, after development and revisions, will be used to make predictions of impacts of alternative power plant operational stages on the population vector of the lake ecosystem.

001.016 CFIS0076759
ECOLOGY OF SALT MARSHES IN RELATION TO ESTUARIES AND ENERGY FLOW

SUBRAHMANYAM C B; BIOLOGY; FLORIDA AGRIC & MECH UNIVERSITY, TALLAHASSEE, FLORIDA. 32307.
Proj. No.: FLAX79004 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 78 To 30 SEP 83

OBJECTIVES: Study community structure and seasonal variations in marsh and estuaries; study breeding cycles of individual species; study nutritional needs of species in terms of caloric intake study energy utilization of species in terms of oxygen consumption; determine the energy content of species in terms of caloric values and study activity patterns in field and laboratory to understand movements of species.

APPROACH: Collect animals with trawl, plankton nets, corer and grabs. Sort and identify species. Follow the seasonal distribution of larvae in plankton to assess breeding patterns. Conduct feeding experiments in laboratory, and evaluate food intake and

assimilation. Study the oxygen consumption rates by continuous flow techniques, and determine diurnal and tidal rhythms of metabolism by 24-hr experiments. Burn the organisms in O₂gen bomb calorimeter and determine caloric values. Tag fish species in field and follow movements by recapture. Release tagged fish in enclosures and follow activity. Perform laboratory experiments.

PROGRESS: 79/09 TO 80/08. The abundance patterns of fish and invertebrates in St. Marks coastal estuarine-marsh system were summarized in a published paper. Preliminary experiments on the metabolism of estuarine fish showed that the two resident species, *Fundulus grandis* and *F. similis* consumed 0.036 - 0.047 ml O₂(2)/gm/hr, which was lower than 0.071 - 0.112 ml O₂(2)/gm/hr consumed by the migratory species *Leiostomus xanthurus* and *Lagodon rhomboides*. All the four species showed metabolism dependent on ambient oxygen tension in the range of 20 - 90 mmHg. Plankton collections and water quality study in St. Marks estuary and Apalachee Bay were started in April 1979 and will be completed in May 1981. Differences between surface and bottom salinity in one tidal cycle were as high as 5-8 p.p.t., but between surface and bottom oxygen (0.5-1.0 ml/l) and temperature (1-2 degrees C) were negligible. Summer temperatures were higher in contrast to salinities because of rainfall. Plankton volume varied from 5ml/tow (8 minutes) to 300 ml/tow between cool and warm months. Phytoplankton maxima were observed in fall and early winter, and zooplankton peaks in late spring and late summer. When stations are compared, Apalachee Bay stations generally showed larger volume of plankton, and mesohaline estuarine stations showed less. Crustacean larvae such as crab zoea and megalopa, peneid postlarvae, and fish larvae were abundant from spring through fall.

PUBLICATIONS: 79/09 TO 80/08

- SUBRAHMANYAM, C.E. Oxygen Consumption of Estuarine Fish in Relation to External Tension. Comparative Biochemistry and Physiology 67A:129-133.
- SUBRAHMANYAM, C.E. Studies on the Animal Communities in Two North Florida Salt Marshes. Pt. III. Seasonal Fluctuations of Fish and Macroinvertebrates. Bulletin of Marine Science 30:790-818.

001.017 CRIS0033144
PHOTOSYNTHESIS AND PHOTORESPIRATION IN AQUATIC PLANTS

BOWES G E; BCTANY; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: 7800459 Project Type: GRANT
Agency ID: CEGO Period: 11 SEP 78 To 30 SEP 80

OBJECTIVES: Identify the environmental factors that induce a change in the photosynthesis - photorespiration ratio; develop a biochemical explanation for the ratio change; identify major biochemical differences between marine and freshwater angiosperms; determine the role of dark CO(2) fixation in aquatic plants; determine if there is any compartmentation of function between different photosynthetic cell types.

APPROACH: Kinetic measurements of photosynthesis, photorespiration and respiration using infrared CO(2) gas exchange analysis, ¹⁴C(2) feeding, and C(2) electrode techniques; photosynthetic studies of isolated cells and chloroplasts; analyses of photosynthetic products; organic excretion studies; and kinetics and activity measurements of photosynthetic and photorespiratory enzymes.

PROGRESS: 79/09 TO 80/09. All submersed, freshwater macrophytes examined, including algae, bryophytes, and angiosperms, had the ability to alter their photosynthesis/photorespiration (PS/PR) ratio (as measured by several parameters including CO(2) compensation points or Gamma) in response to artificial and seasonal environmental changes. At 100 μ M CO(2), Hydrilla in the low, but not the intermediate to high, Gamma state was capable of net dark CO(2) uptake during the night period, but not during the day. In these plants PEP carboxylase and C(4) acids (malate and aspartate) predominated, but

in the high Gamma state RuBP carboxylase and sugar phosphates were predominant. Hydrilla was able to decarboxylate 14-C-malate in the light, which provides circumstantial evidence for the role of malate as a photosynthetic intermediate. Incubation in ethephon, an ethylene precursor, increased Gamma Hydrilla with high and low values. Whether ethylene has an in vivo role in regulating the PS/PR ratio is under investigation. Myriophyllum also exhibited variation in its PS/PR ratio, but RuBP carboxylase predominated even in the low Gamma state. A HCO(3)-pumping mechanism could not explain the low Gamma state, as it was measurable in air and at low pH, where HCO(3)- ions are virtually absent. This suggests that photorespiration may be reduced in certain angiosperms without resorting to increased PEP carboxylase activity. Whether submersed rice varieties exhibit similar characteristics to other aquatic plants is under study.

PUBLICATIONS: 79/09 TO 80/09

- BOWES, G., BOLADAY, A.S. and HALLER, W.T. 1979. Seasonal Variation in the Biomass, Tuber Density, and Photosynthetic Metabolism of Hydrilla in Three Florida Lakes. J. Aquat. Plant Manage. 17:61-65.
- BOLADAY, A.S. and BOWES, G. 1980. C(4) Acid Metabolism and Dark CO(2) Fixation in a Submerged Aquatic Macrophyte (*Hydrilla verticillata*). Plant Physiol. 65:331-335.
- BLICKENSTAFF, J. and BOWES, G. 1980. An Organic Acid Induced Efflux From Low Gamma Hydrilla Plants. Plant Physiol. 65:S86.
- SALVUCCI, M. and BOWES, G. 1980. Photosynthesis and Photorespiration in Amphibious Plants. Plant Physiol. 65:S86.
- SALVUCCI, M.E. 1980. Biochemical and Physiological Characteristics Associated With the Variable C(2) Compensation Points of Certain Aquatic Angiosperms. M.S. Thesis. Univ. Florida, Gainesville, 88 pp.

001.018 CRIS0068632
BASELINE STUDIES FOR EVALUATING THE RESPONSE OF AN ECOSYSTEM TO THE INTRODUCTION OF WHITE AMUR

EWEL E C; FOR RES 6 CONSERV; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-FY-01765 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 DEC 80

OBJECTIVES: Determine the forcing functions, main energy flows, and variations in the important components in an aquatic ecosystem; construct and simulate a model which will incorporate these variables and which will include the possible effects of the introduction of white amur to the ecosystem; monitor the changes that actually do take place in an ecosystem when the fish is introduced, revising the model until it is a reasonable generalization of the ecosystem.

APPROACH: Baseline ecological data will be collected by state agencies on a lake into which the white amur will be introduced in the second year of the study. Models incorporating these data will predict the effects of the fish, and these models will be verified by continued data collection.

PROGRESS: 80/01 TO 80/12. A model of Lake Conway, FL, was simulated with and without white amur present. If rates used in the model are accurate, the grazing food chain in this lake is slightly more important than the detritus food chain, and 10% of the gross primary productivity is grazed. One-quarter of the annual phosphorus input to the epilimnion comes from leaching and decay of submersed macrophytes. Simulated ranges of state variables were close to values measured in most cases. The model was stable during a simulation representing ten years. After two years, simulated addition of white amur (7000 fish, each weighting 458g) decreased submersed macrophyte biomass to 60% of its normal peak biomass. Water quality improved, gross primary productivity and community respiration decreased, and the relative importance of the grazing food chain increased. Biomass of benthic invertebrates and secondary predator fish increased. Addition of half as many

fish five years after the first introduction brought about the same degree of macrophyte control, but recovery was more rapid.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.019 CRIS0067503
BIOLOGICAL STUDIES OF THE SPINY LOBSTER IN SOUTH FLORIDA

LABISKY R F; COMBS C L; GREGORY D E; FORRES S
CONSERV; UNIVERSITY OF FLORIDA, KEY WEST, FLORIDA.
33040.

Proj. No.: FLA-FY-01745 Project Type: STATE
Agency ID: SAES Period: 01 JAN 75 To 31 DEC 80

OBJECTIVES: Determine distribution, abundance, and seasonal movements of juveniles and adults, and their relation to lobster fishery. Determine impact of harvest rates on populations. Develop monitoring procedures.

APPROACH: Field studies in the Florida Keys, and close coordination with other state and federal lobster studies and the fishing industry.

PROGRESS: 80/01 TO 80/12. No progress report this period.

PUBLICATIONS: 80/01 TO 80/12

GREGORY, D.E., JR. 1979. Reproductive dynamics of the spiny lobster, *Panulirus argus* (Latreille), in south Florida. Sea Grant '70's S(12):14-15.

GREGORY, D.E., JR. 1980. Reproductive dynamics of the spiny lobster, *Panulirus argus* (Latreille), in south Florida. M.S. Thesis. University of Florida, Gainesville. 50 pp.

LABISKY, R.F., GREGORY, D.E., JR., and J.A. CONTI. 1980. Florida's spiny lobster fishery: a historical perspective. Fisheries 5(4):28-37.

001.020 CRIS0065219
CHARACTERIZATION OF GONAD-STIMULATING SUBSTANCES IN MARINE ANIMALS

CARDEILHAC P T; VETERINARY SCIENCE; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-VY-01673 Project Type: STATE
Agency ID: SAES Period: 14 MAR 74 To 31 DEC 80

OBJECTIVES: Develop assay for gonad-stimulating substances. Isolate and characterize substances involved in the regulation of spawning and gamete maturation. Identify and characterize neuroendocrine mechanisms involved in spawning and gamete maturation. Determine patterns of similarity among gonad-stimulating substances from different animals.

APPROACH: An assay system for gonadotrophins, similar to the one used for starfish, will be developed. Purification of the gonadotrophin will be accomplished by chromatography. The mechanism of action will be studied using purified substances. Patterns of similarity among isolated gonadotrophins will be investigated by determining amino acid sequences, physical and chemical properties and mode of action.

PROGRESS: 74/03 TO 80/12. Warm water marine teleosts which lay pelagic eggs, (snapper, grouper, mackerel, trout, drum, etc.), are a group of fish of major importance to mariculture, sport fishing and commercial fisheries. The pinfish, *Lagodon rhomboides*, was selected from this group as a model for the study of toxins, hormones, etc. which effect gamete maturation and spawning. Photoperiod and several mammalian hormones were found to be highly stimulatory. The development of mature oocytes to ripe eggs could be induced, stripped from the fish, fertilized and normal yolk-sac larvae produced. Culture of ovarian follicles and follicle cells in vitro was investigated to determine the action of hormones and toxins directly on the ovary. A defined medium was developed to further simplify these studies and reduce complex interactions and metabolic

conversions. Stem cells in the follicle appear to differentiate to oocytes following LH stimulation. Estradiol-17- β is the primary stimulator for vitellogenin production, and a primary and secondary response to estrogen was independent of salinity but dependent on water temperature. Toxicity of copper to the fish and the reproductive process was investigated because of the hazard presented by environmental copper poisoning and the importance of copper in disease control. A potassium intoxication follows copper poisoning caused by cell damage and failure of osmoregulation by the gills and kidneys.

PUBLICATIONS: 74/03 TO 80/12

YOSHA, S. 1980. Detection and Induction of Estrogen Effects in the Marine Teleost. Ph.D. Thesis. University of Florida, Gainesville, FL. 185 pp.

CARDEILHAC, P.T. 1980. Mechanisms of Copper Toxicity to Marine Fish in Aquatic Animal Medicine: A State of the Art. Florida Sea Grant Report 32:101. Jenkins, R.L. and Belusky, J.G. (Eds.).

CARDEILHAC, P.T., SIMPSON, C.F., LOVELOCK, E.L., YOSHA, S.F., CALDERWOOD, H.W. and GUDAT, J.C. 1979. Failure of Osmoregulation With Apparent Potassium Intoxication in Marine Teleosts: A Primary Toxic Effect of Copper.

WILEY, A.A. and CARDEILHAC, P.T. 1977. Possible Mammalian Induced Differentiation of Follicle Cells to Oocytes. The Physiologist 20(4):102.

CARDEILHAC, P.T. 1976. Induced Maturation and Development of Pinfish Eggs. Aquaculture 8:389-393.

001.021 CRIS0059266
MORPHOLOGY AND TAXONOMY OF NEMATODES

TARJAN A C; UNIVERSITY OF FLORIDA, LAKE ALFRED, FLORIDA. 33850.

Proj. No.: FLA-CS-01532 Project Type: STATE
Agency ID: SAES Period: 09 OCT 70 To 31 DEC 80

OBJECTIVES: To collect, mount, and identify plant, soil, and aquatic nematodes. To study nematode morphology for determining possible strain and population differences. To describe new taxa of nematodes.

APPROACH: To collect specimens by culture in greenhouse or external acquisition. To prepare specimens for microscopic study using a variety of techniques. To study such preparations under the compound microscope, employing the camera lucida and photomicrography. To store prepared specimens in slide file cabinets. To accumulate taxonomic data from these studies; such data to be used in the preparation of taxonomic revisions. Finally, to prepare publications of a morphological and taxonomic nature.

PROGRESS: 80/01 TO 80/12. Meloidogyne cruciansi garcia-martinez N. sp. is from tomato roots in the U.S. Virgin Islands. The new species is distinguished from other species by having punctations around the female anus and by juveniles possessing extremely long tri-lobed esophageal glands. During the ten years this project has been active, three compendia were published dealing with the genera monochoides, tylenchorhynchus and xiphinema. One methods paper concerned the preparation of permanent nematode slides, while another described a new xiphinema species. Two publications have been on morphological variations occurring with pratylenchus coffeae and P. brachyurus, and with xiphinema krugi. A book "nomenclatorial compilation of plant and soil nematodes" and the 1972 and 1973 supplements to the book also were published. The most recent publication has been "an illustrated guide to the marine nematodes." In all, the project has produced 2 books, 13 articles, and 4 abstracts. Although this project is terminated with this report, a replacement project, EY-02024 "Taxonomy and Morphology of Nematodes" has been started.

PUBLICATIONS: 80/01 TO 80/12

TARJAN, A.C. 1980. An Illustrated Guide to the Marine Nematodes. Inst. Food Agr. Sci., Univ. Florida, 212 pp.

BARTCN, J.S. and TARJAN, A.C. 1980. A Taxonomic Survey of Marine Nematodes in Coastal Waters of the Lower Florida Keys. (Abstr.). Nematologica 10(2):64.

001.022 CRIS0081957
IMMUNOLOGIC RESPONSE OF CHANNEL CATFISH, Ictalurus punctatus, TO HETEROLOGOUS ANTIPROTOZOAN IMMUNIZATION

DAWE D L; GRATZKE J H; VETERINARY MEDICAL RESEARCH INSTITUTE; UNIVERSITY OF GEORGIA, ATHENS, GEORGIA. 30602.

Proj. No.: GEO-V-X103 Project Type: GRANT
Agency ID: CSRS Period: 01 JUL 80 To 30 JUN 83

OBJECTIVES: To determine whether immunization of channel catfish with cilia of *Tetrahymena pyriformis*, cilia administered orally or topically, can induce protection against infection by *Ichthyophthirius multifiliis*. To determine duration of immunity induced by heterologous immunization by various routes of administration. To determine the nature of the immune response of fish to the ciliary antigen.

APPROACH: Channel catfish will be immunized with *T. pyriformis* cilia by injection, oral drench and immersion. Groups of fish will be challenged at various time intervals with *I. multifiliis*. Mucus, serum, and anterior kidney cells will be collected from immunized fish and tested for presence of antibody and cell mediated immune response. Cell populations in the immune response will be studied by double fluorescent antibody staining.

001.023 CRIS0083102
GENETIC ASSESSMENT OF MACROBRACHIUM ON GUAM

MATLOCK D B; AGRIC & LIFE SCIENCES; UNIVERSITY OF GUAM, AGANA, GUAM. 96913.

Proj. No.: GLA00032 Project Type: HATCH
Agency ID: CSRS Period: 17 NOV 80 To 30 SEP 83

OBJECTIVES: To identify and characterize isozymes from *Macrobrachium* for use as genetic markers: To assess the intraspecific and interspecific variability of isolated populations of *M. lar* and *M. rosenbergii* on Guam: To attempt hybridization of *M. lar* and *M. rosenbergii*: To determine if there has been a loss of genetic variability in stocks of *M. rosenbergii*.

APPROACH: Electrophoretic mobility of various isozymes will be used as genetic markers. Between 50 and 100 prawns from each location will be screened for all markers. Allelic frequencies will be recorded and genetic variability calculated as the index of heterozygosity across all loci. Hybridization of *M. rosenbergii* and *M. lar* will be attempted by natural mating and artificial insemination.

001.024 CRIS0069627
CARRYING CAPACITY OF STREAMS FOR REARING SALMONIDS AS AFFECTED BY SEDIMENT & OTHER COMPONENTS

HJORN T C; FOREST WILDLIFE & RANGE EXP ST; UNIVERSITY OF IDAHO, MCSCOW, IDAHO. 83843.

Proj. No.: IDA-CFU-0031 Project Type: STATE
Agency ID: OCI Period: 01 JUN 74 To 30 SEP 78

OBJECTIVES: Assess the density (#/m²) of juvenile anadromous salmonids in selected forest streams of central Idaho; relate stream morphology, cover, temperature, insect drift, numbers of cohabiting fish species, seeding rates (stock recruitment), and fish growth to numbers of juvenile anadromous salmonids; determine effects of a point influx of sediment on fish density; evaluate the usefulness of fall weir

counts in determination of fish abundance.

APPROACH: Artificial channels will be employed in assessing the effect of seeding rate on salmonid abundance. Estimation of stream variables and fish abundance and growth will be made on Marsh Creek, Cape Horn Creek, Knapp Creek and Middle Fork on the Salmon River. Models for explaining fish abundance will be formulated and tested.

PROGRESS: 80/01 TO 80/12. During 1974, 1975, and 1976, we sampled Beaver, Cape Horn, Elk, Knapp and Marsh Creeks in the Central Idaho batholith and conducted experiments in artificial stream channels at Bayden Creek Research Station, Idaho, to determine their carrying capacity for rearing juvenile spring chinook salmon (*Oncorhynchus tshawytscha*) and related factors. We utilized a transect method to measure stream physical parameters, snorkeling gear to facilitate counting of fish, fish weirs to enumerate pre-smolt chinook migrating downstream, and 30 m³ of granitic sand dumped into Knapp Creek to assess sediment effects on fish abundance. We released juvenile chinook from Rapid River Hatchery into Cape Horn, Knapp, and Marsh creeks after various treatments of predator and resident chinook population removal to help define carrying capacity. We also placed chinook population removal to help define carrying capacity. We also placed chinook fry into artificial stream channels to help assess the effects of weeding rate (egg deposition or juvenile plants) and water temperature on fish abundance. Numerical and biomass densities of age 0 chinook salmon in stream sites averaged 0.42 fish/m² and 1.51 g/m². The maximum average densities observed in naturally seeded streams were 0.48 fish/m² and 2.29 g/m², compared to 1.38 fish/m² and 5.42 g/m² in sites of Cape Horn Creek, where I stocked juvenile chinook salmon.

PUBLICATIONS: 80/01 TO 80/12

SEKULICH, P.T. 1980. The Carrying Capacity of Infertile Forest Streams for Rearing Juvenile Chinook Salmon. University of Idaho. Ph.D. Dissertation, 156 pp.

SEKULICH, P.T. and HJORN, T.C. 1977. The Carrying Capacity of Streams for Rearing Salmonids as Affected by Components of the Habitat. Completion Report to Memo of Understanding No. 12-11-204-11 to U.S. Forest Service, 78 pp.

001.025 CRIS0074675
EVALUATION OF VARIOUS HATCHERY REARING CONDITIONS ON SEAWARD MIGRATION OF STEELHEAD TROUT

HJORN T C; FOREST WILDLIFE & RANGE EXP ST; UNIVERSITY OF IDAHO, MCSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0054 Project Type: STATE
Agency ID: OCI Period: 01 SEP 76 To 31 DEC 80

OBJECTIVES: Evaluate the seaward migration (and eventual adult return for some groups) of steelhead trout at Dworshak National Fish Hatchery. The following variables are to be evaluated: diets, cool water conditioning prior to release, length of rearing for fish from late egg takes, size of smolt, location of release, method of release, date of release, and pond and water reuse system at Dworshak National Fish Hatchery.

APPROACH: We will mark 10,000 fish with brands in each test group which will be monitored only as smolts at the dams. Sixty thousand fish will be marked with brand, adipose clip and wire nose tags in each group that will be monitored at dams as smolts and returning adults. Only 30,000 fish will be marked in groups hauled to estuary. The seaward migration and quality of steelhead smolts produced at Dworshak National Fish Hatchery will be evaluated as to fish health assessment at hatchery prior to release by hatchery staff; voluntary migration from ponds; recovery of marked smolts at Snake and Columbia River dams and recovery of marked adults from sport and commercial fisheries in Columbia drainage and at hatchery when they return to spawn.

PROGRESS: 80/01 TO 80/12. Selected procedures for rearing and releasing steelhead trout (*Salmo gairdneri*) at Dworshak National Fish Hatchery (DNFH) were evaluated in 1977. Initial evaluation entailed recapturing branded fish from each test group at Lower Granite Dam. Final evaluation will occur when binary coded nose tags are removed from returning adults captured in the fisheries and at the hatchery. Length at release was tested again in 1977 but results were inconsistent. Conditioning fish in cold water (less than 10C) for up to 12 weeks appeared to have some benefits, but again the results are questionable because of the fish health problems. Seaward migration of hatchery steelhead occurred from early April to early June in 1977. A significant proportion of the smolts were ready to migrate seaward by mid-April. Smaller fish did not migrate in large numbers until May. Salt treatment before release did not result in more migrants reaching Lower Granite Dam, but malachite treatment after handling and marking did improve a fish's chance of migrating successfully. Steelhead trout reared for two years and released in 1977 were better smolts than the one-year old fish released in 1977. More of the two-year fish were recaptured at the dam and they had a lower fungus infection rate than the one-year fish. Many Snake River drainage steelhead (wild and hatchery) were not ready to live in seawater in April or early May even though they were migrating seaward.

PUBLICATIONS: 80/01 TO 80/12

BJOENN, I.C., HIEBERT, P. and RINGE, R.E. 1979. Seaward Migration of Dworshak Hatchery Steelhead Trout in 1977 as Related to Rearing History. Completion Report Contract No. 14-16-0001-2144, Dworshak National Fish Hatchery,

001.026

CRIS0082659

WILD VERSUS HATCHERY TROUT

BJOENN I C; FOREST WILDLIFE & RANGE EXP ST; UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843. Proj. No.: IDA-CFU-0066 Project Type: STATE Agency ID: OCI Period: 01 JAN 79 To 30 JUN 81

OBJECTIVES: Determine effect of stocking catchable-size trout on the abundance of wild trout. Investigate competition and survival under predation of wild and hatchery fry, over-winter survival and behavior and length of hatchery experience required to alter fry behavior.

APPROACH: Plants of rainbow trout will be made for 2 years into several sections of a stream and wild trout abundance and movement will be assessed. Short-term abundance and behavior of wild and hatchery trout will be observed in a second stream. Experiments with fry will be conducted in artificial stream channels.

PROGRESS: 80/01 TO 80/12. For the past two years we have been studying interactions of wild and hatchery trout in two Idaho streams; the infertile St. Joe River and the productive Big Spring Creek, tributary to the Lemhi River. To date, we have found no evidence that single plants of hatchery-reared, catchable-size rainbow trout displace wild reared trout. Study of effects of repeated plants is in progress. Behavioral differences of wild and hatchery rainbow trout are being studied in experimental stream channels.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

001.027

CRIS0084239

HABITAT SELECTION AND SPECIES INTERACTIONS OF JUVENILE TROUT IN FLATHEAD RIVER TRIBUTARIES

BJOENN I C; FOREST WILDLIFE & RANGE EXP ST; UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843. Proj. No.: IDA-CFU-0079 Project Type: STATE Agency ID: OCI Period: 01 MAY 80 To 30 JUN 82

OBJECTIVES: Determine habitat utilized by juvenile bull trout and cutthroat trout. Evaluate species interactions between juvenile bull trout and cutthroat trout.

APPROACH: Utilized habitat will be quantified at 2 levels, macro and micro. Macro refers to the habitat unit, pool riffle or run, that juvenile fish are using. Micro refers to the exact location within the habitat unit an individual fish has chosen. Habitat units will be examined in large and small streams. Allopatric and sympatric situations will be sought.

PROGRESS: 80/01 TO 80/12. Migratory populations of cutthroat and bull trout utilize the upper portion of the Flathead River drainage for spawning and rearing. Many of the major tributaries to the upper forks of the river drain National Forest or British Columbia forest lands. These public lands are being investigated for coal, oil, and gas development. The potential impacts of these developments on the adjacent waters and ensuing effects on the Flathead fishery is of concern to the Montana Dept. of Fish, Wildlife and Parks. Although habitat assessments, fish distribution and fish abundance data is available, the question of habitat selection remains unclear. The study is being conducted to better define the habitat selection of cutthroat and bull trout. Study has not been completed nor has data been compiled and processed.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

001.028

CRIS0084240

ROLE OF SHORT DISTANCE MIGRATION OF THE HOMING OF SALMON AND STEELHEAD

BJOENN I C; FOREST WILDLIFE & RANGE EXP ST; UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843. Proj. No.: IDA-CFU-0080 Project Type: STATE Agency ID: OCI Period: 01 AUG 80 To 31 DEC 80

OBJECTIVES: To determine if a short distance voluntary migration prior to transport to the lower Columbia River will increase the homing of salmon and steelhead.

APPROACH: Salmon and steelhead trout smolts were marked and released to migrate normally to the ocean (control groups) or were allowed to migrate a short distance (a few meters to 5 km) before being collected and transported to the lower Columbia River via truck or barge.

PROGRESS: 80/01 TO 80/12. Eight groups of salmon and steelhead smolts were marked and released in 1980 to evaluate the effect of a short distance seaward migration on homing. Four of the groups migrated normally from their respective hatcheries or usual release points and the other four were allowed to voluntarily migrate a short distance from the hatchery ponds before being collected, marked (if not already) and transported to the lower Columbia River. The shortest distance voluntary migration amounted to merely migrating out of a raceway at Lower Granite Dam. Other groups migrated across the hatcheries in discharge flumes and then entered traps. The Rapid River chinook migrated out of the hatchery ponds and down Rapid River about three miles before they were trapped, marked, and transported. More of the short distance migration-transport fish of all stocks were recaptured by national marine Fisheries Service personnel near the estuary compared to the normal migration fish. Fish were collected near the estuary by purse and beach seining. Adult returns from the 1980 and prior year releases will be monitored through 1984 to evaluate the number of adults produced and the ability of those adults to return to their natal area. Downriver fisheries, Idaho sport fisheries and returns to hatcheries or dams will be monitored for marked adult fish.

PUBLICATIONS: 80/01 TO 80/12

BJOENN, I.C., R.E. RINGE, and J. KING. 1981. Role of short distance migration on the homing of salmon and steelhead. Completion report to National marine Fisheries Service on contract

001.025 CRIS0074676
 FISH AND AQUATIC MACROINVERTEBRATE FAUNA IN SCUTE
 FORK BOISE RIVER BELOW ANDERSON RANCH DAM

WHITE R G; FOREST WILDLIFE & RANGE EXP ST; UNIVERSITY
 OF IDAHO, MOSCOW, IDAHO. 83843.
 Proj. No.: IIA-CFU-0055 Project Type: STATE
 Agency ID: OCI Period: 01 SEP 76 To 31 DEC 78

OBJECTIVES: Evaluate the status of fish populations in the South Fork of the Boise River below Anderson Ranch Dam by assessing species composition, relative abundance, age structure, distribution, movement, food habits; evaluate the status of aquatic macroinvertebrate populations by assessing generic composition, relative abundance, distribution and availability to the fish populations; assess spawning and rearing habitat for rainbow trout and mountain whitefish.

APPROACH: We will assess species composition, relative abundance and distribution of fish by use of electrofishing gear and/or angling. We will assess aquatic macroinvertebrate populations seasonally by use of artificial substrate samplers. We will determine approximate spawning period of mountain whitefish collected by electrofishing and/or angling.

PROGRESS: 79/01 TO 79/12. Data were analyzed and a report is in progress. The aquatic insects in the South Fork Boise River, Idaho, serve as the food base for a trophy rainbow trout, *Salmo gairdneri* Richardson, fishery. A series of test flows were conducted below Anderson Ranch Dam in the winters of 1977 and 1978 to determine the impact of fluctuating hydro-electric flows on that food supply. Immature aquatic insect samples were collected with modified Hess and drift net samplers. Catastrophic insect drift was correlated with increased discharge and occurred irrespective of the timing of higher flows. The Diptera Chironomidae and the mayflies Ephemerella spp. and Baetis spp. were the major contributors to catastrophic drift. There was no statistical difference in benthic insect standing crop before and after fluctuating flows. Behavioral drift after high flows is hypothesized as a compensating mechanism to counteract displacement during catastrophic drift. A final report and master's thesis will be completed in 1980.

PUBLICATIONS: 79/01 TO 79/12
 NO PUBLICATIONS REPORTED THIS PERIOD.

001.030 CRIS0072914
 EVALUATION OF JUVENILE SALMON AND STEELHEAD DENSITY AS RELATED TO DENSITY OF SPAWNERS AND FRY RELEASE

BJOENN T C; FORESTRY & WILDLIFE; UNIVERSITY OF IDAHO,
 MOSCOW, IDAHO. 83843.
 Proj. No.: IIA-CFU-0047 Project Type: STATE
 Agency ID: OCI Period: 01 JAN 77 To 30 MAY 78

OBJECTIVES: Evaluate data collected on the density of juvenile salmon and steelhead in good and marginal nursery streams following small spawning escapements (such as 1974, 1975, and 1976) and with larger escapements. Evaluate data on the impacts and success of releasing large numbers of steelhead fry into nursery streams and compare with survival obtained in other streams.

APPROACH: Select transect areas in good and marginal areas were counted in 1975 and 1976 with snorkel gear. The data was analyzed and a report is in preparation. Steelhead fry were released in selected study streams to evaluate movements, growth, survival, competition with natural fry. Data on this segment of study will be analyzed and a report prepared.

PROGRESS: 80/01 TO 80/12. Juvenile steelhead densities decreased from 1975-77 and increased in 1978. Age I and 0 steelhead densities for the four years correlated ($r = .62$ to $.99$) with the respective

adult escapements. Densities of fry in tributaries in August ranged from 0.0 to 92.0/100 m². Streams that did not receive hatchery fry had the largest (92.0 fry/100 m²) and also the smallest densities (0.0 fry/100 m²). Highest mean densities (44.1 fry/100 m²) were associated with streams that had both hatchery and wild fry. Streams with only wild fry had mean densities of 33.8 fry/100 m² and streams (2) that had only hatchery fry had densities of 7.3 fry/100 m². Steelhead fry densities of 20-40/100 m² and probably higher may be expected in fully seeded rearing areas. Tributaries in 1978 that had hatchery fry introduction of 520 fry/100 m² were below fry densities needed to fully seed the rearing areas. If steelhead fry are available, stocking at a rate of 100 fry/100 m² may be needed to insure full seeding of the rearing areas. Fish movement through traps in Post Office and Weir Creeks, 1977-78, was highest when traps were installed in early July, then decreased near the end of July and through August. Nearly all movement of age I and older steelhead ceased in August with the exception of fish movement associated with freshets.

PUBLICATIONS: 80/01 TO 80/12
 MABOTT, L. BRENT. 1981. Density and habitat of wild and introduced juvenile steelhead trout in the Lochsa River Drainage, Idaho. Masters Thesis. University of Idaho. 94 pp.

001.031 CRIS0073360
 INVESTIGATION OF AQUATIC ECOSYSTEMS IN SMALL PONDS

LIBEY G S; FORESTRY & NATURAL RESOURCES; PURDUE
 UNIVERSITY, LAFAYETTE, INDIANA. 47907.
 Proj. No.: IND059044 Project Type: HATCH
 Agency ID: CSRS Period: 01 OCT 77 To 30 SEP 82

OBJECTIVES: Determine the interactions in the Plankton community of small impoundments; investigate the relationship of plankton to young fish; evaluate the effect on fish populations of ecosystem changes.

APPROACH: Ecosystem measurements will be made in the field. A time series of population data will be used to evaluate interactions in the plankton community. Fish population on plankton will be determined by comparing populations from ponds containing no fish with populations from ponds with young fish. Adult fish populations status will be monitored and changes resulting from natural or induced disruptions measured.

PROGRESS: 80/01 TO 80/12. The farm pond is an important aquatic ecosystem in the midwestern United States. Fish population imbalances in ponds are often caused by wide variations in the size of predator or prey year classes. These variations can be the result of fluctuations in larval mortality. Food availability and competition for food are the primary determinants of larval mortality and growth. Experiments conducted at various prey levels showed survival as a function of prey density was different for bluegill, green sunfish, and large mouth bass. Green sunfish survival was superior to either bluegill or bass. Bluegill survival improved as prey density increased, but bass had a low survival at most prey levels. The influence of competition between bluegill and green sunfish on their natural diet was investigated in a series of partitioned areas in a local pond. The presence of interspecific competition did not alter the diet of either species, but competition with older individuals produced major dietary shifts. In a study on the genetics of channel catfish, triploidy was induced by cold-shocking fertilized eggs. The triploid catfish are as viable as their diploid full sibs and tolerate the polyploidy condition well. Evidence for an increased growth rate due to triploidy and due to the lack of sexual maturation in sterile triploids was noted.

PUBLICATIONS: 80/01 TO 80/12
 HOLLAND, L.E. and LIBEY, G.S. 1980. Inexpensive Egg-Hatching Jar. Prog. Fish-Cult. 42(2):112.
 LIBEY, G.S. and BELIZ, J.R. 1980. Method for Monitoring Downstream-Migrating Alewives. Prog. Fish-Cult. 42(3):172-173.

LIBBY, G.S. and BOLLAND, L.E. 1980. The Use of Periodic Light Applications of Rotenone as a Management Technique for Small Impoundments. Purdue Univ., Water Resources Research Center, Tech. Report No. 132. 30 pp.

001.032 CRIS0074624
THE USE OF FISH BEHAVIOR IN TOXICITY TESTING

ATCHISON G J; ANIMAL ECOLOGY; ICWA STATE UNIVERSITY, AMES, ICWA. 50011.
Proj. No.: ICW02284 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 82

OBJECTIVES: Determine the relative sensitivities of a variety of behaviors of fish (such as coughing, feeding, mating and hierarchy formation) to toxic substances. Determine the effect of a variety of toxic substances on specific behavior patterns of fish. Compare the utility of behavioral toxicity tests and standard EPA chronic exposure tests in establishing safe levels of toxicants in aquatic ecosystems.

APPROACH: Observe and quantify the behavior patterns of fish exposed to varying levels of toxicants compared to the behavior patterns of control fish.

PROGRESS: 80/01 TO 80/12. Research this past year centered on the effects of copper and methyl parathion on bluegill behavior. The methyl parathion tests are completed, except for statistical analysis. The copper work will continue through this spring and early summer. Eight populations of five bluegill (ranging from 11.5 to 14.0 cm in total length) were maintained in separate 315 liter flow through aquaria. After an acclimation period of sufficient time to allow establishment of stable social hierarchies and territories, nine behaviors were monitored for 86 hours before treatment and 96 hours during exposure to methyl parathion. Treatments consisted of two replicates of a control tank and tanks receiving 0.35, 0.035, and 0.0035 mg/l methyl parathion. Statistically, unanalyzed trends from these two runs of the experiment indicate that low levels of methyl parathion increased the frequency of "flinches" and "fin flickering," both of which are maintenance behaviors and behavioral manifestations of nervous system effects. General activity levels appeared to become elevated during the early stages of toxicant administration and were followed by subsequent increases in aggression. After approximately 15 hours these increased activity levels began to subside in all but the lowest exposure concentration. Feeding behavior was also affected by methyl parathion. Dominant individual feeding success rates dropped as these fish became less successful at capturing the fathead minnows that were used as prey.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.033 CRIS0064201
ORGANIZATION AND RETRIEVAL OF FRESHWATER FISHERY DATA

CARLANDER K D; ANIMAL ECOLOGY; IOWA STATE UNIVERSITY, AMES, ICWA. 50011.
Proj. No.: ICW02002 Project Type: STATE
Agency ID: SAES Period: 01 JUL 73 To 30 JUN 79

OBJECTIVES: Compile all available data on life histories of freshwater fishes for United States and Canada; coordinate for comparison; publish summaries; maintain bibliography, cross-indexed.

APPROACH: A cross-indexed filing system and standardized tabulation have been developed. Much of the data have to be transformed to metric system and uniform definition of parameters. Manuscript summaries will be made available in special order as they are prepared for publication in Volume II of "Handbook of Freshwater Fisheries Biology".

PROGRESS: 73/07 TO 79/06. Volume II of Handbook of Freshwater Fishery Biology. Life History data of the centrarchid fishes of United States and Canada was published by Iowa State University Press in 1977, and 1955 copies had been sold as of April 30, 1979. The Handbook is frequently cited in publication and reportedly is widely used as a reference, saving much research time and permitting more effective use of the data. Prior to publication, sections of the manuscript were provided upon request and payment of expenses of copying to other scientists for use on on-going projects or on environmental impact studies. The cross-indexed library is used quite extensively by the graduate students and staff of Iowa State University in their research. Data on species other than centrarchid fishes have been cross-indexed for use in Volume III, and in possible future revisions or supplements. The new literature on the species covered in Volume I is probably at least one-third that covered in the 1969 publication.

PUBLICATIONS: 73/07 TO 79/06
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

001.034 CRIS0081304
ADULT PADDLEFISH MOVEMENT IN POOL 13, UPPER MISSISSIPPI RIVER

HUBERT W A; ANIMAL ECOLOGY; ICWA STATE UNIVERSITY, AMES, ICWA. 50011.
Proj. No.: IOW02421 Project Type: STATE
Agency ID: SAES Period: 01 MAR 80 To 28 FEB 82

OBJECTIVES: Determine the spring and summer movement patterns of sexually mature paddlefish. Identify staging areas, spawning sites and post-spawning dispersal of sexually mature paddlefish. Describe the physical characteristics of habitat utilized by paddlefish. Identify the associations of paddlefish with specific types of habitat or navigation improvement structures.

APPROACH: Radio telemetry will be utilized to monitor the movement of sexually mature fish from mid-March through August. Selected physical features of the areas where paddlefish are located will be described. Indirect identification of spawning sites will be achieved by the location of paddlefish when environmental conditions associated with spawning occur in Pool 13.

PROGRESS: 80/03 TO 80/12. The paddlefish is an important commercial and sport species in the Mississippi River drainage, but many aspects of its biology are unknown. Effective management of paddlefish requires investigation into the behavior and habitat requirements of the animal. A radio telemetry study was initiated in 1980 to determine movement patterns, habitat characteristics, and spawning sites. Radio transmitters were surgically implanted in the body cavities of seven fish in 1980. The fish were monitored daily throughout the summer and several physical parameters were measured. Ten sexually mature paddlefish will be tagged prior to spawning in 1981.

PUBLICATIONS: 80/03 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.035 CRIS0082516
FISH MOVEMENT IN POOL 9, UPPER MISSISSIPPI RIVER

HUBERT W A; ANIMAL ECOLOGY; ICWA STATE UNIVERSITY, AMES, ICWA. 50011.
Proj. No.: IOW02458 Project Type: STATE
Agency ID: SAES Period: 01 JUN 80 To 01 OCT 82

OBJECTIVES: To define the fish community of the main channel and to select two species for study. To determine the movement of the two study species in response to passage of vessels. To define the association of the two study species with definable habitat types.

APPROACH: Traditional fish sampling gears will be used to describe the community. Radiotelemetry will be employed to monitor fish movement.

PROGRESS: 80/11 TO 81/01. Literature review of the influence of water level fluctuations on littoral plant and fish communities was initiated. Procurement of equipment and supplies for the 1981 field season was initiated.

PUBLICATIONS: 80/11 TO 81/01
NO PUBLICATIONS REPORTED THIS PERIOD.

001.036 CRIS0073086
BEHAVIOR OF IOWA SPORT FISHES

MENZEL B W; ANIMAL ECOLOGY; ICWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: ICW02236 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 82

OBJECTIVES: The research program will involve long term behavioral studies of Iowa sport fishes in nature using ultrasonic tagging techniques. For each species studied, the major objectives shall be: Determine size and nature of home ranges, including physical features of the preferred habitat, determine daily and seasonal activity patterns and effects of natural environmental variation upon these patterns, and ascertain the effects of human influences upon behavior.

APPROACH: Ultrasonic transmitters will be surgically implanted into the abdominal cavity of experimental fish. The fish will be released into nature and tracked using a boat-mounted hydrophone and receiver. Observation locations will be determined by triangulation and plotted on a map. Fish movements will be compared with habitat features and other environmental parameters.

PROGRESS: 80/01 TO 80/12. During 1980, data were analysed from a 2 year telemetry study of the movements and behavior of adult muskellunge in Lake West Okoboji, Iowa. These analyses confirm the preliminary findings reported last year. The basic elements of the populations' seasonal behavioral patterns are: reproductive activities along shallow shoreline areas in early spring, active foraging in pelagic areas during late spring and early summer, feeding as ambush predators in the outer littoral zone in late summer and early fall, overwintering in deeper areas. During the growing season, the fish occupy well-defined home ranges averaging about 10% of the lake's surface area. Some fish maintain two disjunct home areas and travel back and forth between them. There is no evidence of territorial behavior, however. Throughout this time, the fish are primarily suspended in the upper and middle portions of the water column. All 9 study fish exhibited these general behavioral patterns although there were individual differences in home ranges and timing of the major behavioral shifts. Because of the seasonally changing fish behaviors, there is a marked seasonality in angling success for muskellunge in the lake. A M.S. thesis on the research will be completed in spring 1981.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.037 CRIS0073088
GENETICS OF NATURAL FISH POPULATIONS

MENZEL B W; ANIMAL ECOLOGY; IOWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: ICW02235 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 82

OBJECTIVES: Develop biochemical/genetic approaches to fish taxonomy and to certain problems of fisheries management by electrophoresis of body tissue proteins. Several subprograms are recognized. Survey and compare natural populations of fishes with respect to levels of electrophoretically detectable genetic diversity, determine taxonomic relationships

of selected fish species on the basis of biochemical/genetic characters, compare wild and hatchery stocks of sport fishes on a genetic basis in order to evaluate the genetic impact of stocking programs.

APPROACH: Fish populations will be sampled by seines, nets and electrofishing, as appropriate. Blood and tissue samples will be analyzed by starch and acrylamide gel electrophoresis. Histochemical staining procedures will be used to identify specific proteins. Protein patterns will be analyzed and qualitatively and quantitatively, based on allelic frequencies of polymorphic loci.

PROGRESS: 78/01 TO 78/12. Two manuscripts were prepared on an investigation of the genetic impact of stocking upon wild brook trout populations. Wild trout were collected from nine streams in central Wisconsin and domesticated fish were sampled from the Osceola State Trout Hatchery, Wisconsin. Over many years, the study streams had variably received light to heavy stocking of Osceola trout. Blood plasma and whole-eye homogenate samples from the trout were analyzed electrophoretically for genetic variation in the transferrin and lactate dehydrogenase systems. The hatchery stock was genetically distinctive from most wild populations at two genetic loci. There were significant correlations between stream stocking histories and allelic frequencies at the Ldh-B(2) locus, the wild type allele decreasing in frequency as stocking intensity increased. This relationship does not seem to reflect interbreeding between wild and hatchery trout, however. Rather, it may indicate alteration of selective pressures induced by ecological interactions between the two stocks.

PUBLICATIONS: 78/01 TO 78/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.038 CRIS0073106
ECOLOGY OF LARVAL STREAM FISHES

MENZEL B W; ANIMAL ECOLOGY; ICWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: IOW02234 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 79

OBJECTIVES: Develop methods for collecting larval fishes in Iowa warmwater streams and rivers, develop procedures for the identification of such larval fishes, determine species composition, distribution, and abundance of larval fishes in selected rivers, and compare the above parameters with reference to various forms of habitat, stream alteration and water use.

APPROACH: Larval stream fishes will be collected by drift nets and a water pumping apparatus. Collecting will be done at several stations in a stream which represent different habitat conditions and at various times of day. Species identification will be accomplished by standard morphological methods and by electrophoresis of tissue proteins.

PROGRESS: 77/07 TO 79/06. A study was completed on the taxonomy and ecology of drifting larval fishes in the upper Skunk River, Iowa. Collections were made in Spring 1977 using stationary drift nets at eight river stations in the vicinity of Ames. Larvae of more than 20 fish species were collected, minnows (Cyprinidae) being the most abundant group. Taxonomic descriptions were made for larvae of nine minnow species: stoneroller, brassy minnow, common shiner, bigmouth shiner, red shiner, sand shiner, bluntnose minnow, fathead minnow and creek chub. Larval fish drift was greatest at night and consisted primarily of prolarval and early post-larval stages. Numbers of drifting larvae were not associated with either river discharge or turbidity. Occurrence and abundance of larvae was similar over the 30 km length of river sampled and was not related to local habitat characteristics. Phenological patterns of larvae abundance exhibited a close correlation with the known spawning periodicity of Skunk River fishes. A purpose of drifting behavior may be to transport larvae from low order spawning streams to higher order streams where planktonic food organisms are

more abundant.

PUBLICATIONS: 77/07 TO 79/06

PERRY, L.G. 1979. I. Identification of nine larval cyprinids inhabiting small northern rivers. II. Spatial and temporal patterns of larval fish drift in the upper Skunk River. M.S. Thesis. Iowa State University, Ames. 73 pp.

PERRY, L.G. and MENZEL, E.W. 1979. Identification of nine larval cyprinids inhabiting small northern rivers, pp. 141-173. In: Wallus, R. and Voightlander (eds.), Proceedings of a workshop on freshwater larval fishes, Tennessee Valley

001.039

CRIS0072499

FACTORS AFFECTING FISH POPULATIONS OF IOWA STREAMS

MUNCY R J; BULKLEY R V; ANIMAL ECOLOGY; IOWA STATE UNIVERSITY, AMES, IOWA. 50011.

Proj. No.: ICW02225

Project Type: STATE

Agency ID: SAES

Period: 01 MAR 77 To 30 JUN 80

OBJECTIVES: Determine fluctuations in abundance of selected populations of stream fishes and factors affecting these fluctuations. Identify man-made habitat alterations that can enhance environmental conditions for aquatic life. Increase knowledge of environmental pollutants transport and dynamics in flowing and impounded waters.

APPROACH: Research will consist of field investigation on length, weight and distribution of fish species in several Iowa rivers in relation to selected environmental parameters. Data on pesticide and polychlorinated biphenyls concentration in muscle tissue will be obtained by gas chromatography on fish inhabiting the Des Moines River and Red Rock Lake.

PROGRESS: 77/03 TO 80/06. Common carp were used to monitor organochlorine pesticide residues in fish from the Des Moines River. Residues were below U.S. Food and Drug Administration allowable levels in food fish. Reservoir sampling locations, Red Rock and Saylorville, tended to have higher dieldrin levels than riverine locations. This trend was not observed for DDT residues. Missouri river environmental gap evaluation--notches cut in rock revetments to increase habitat density were evaluated. Species composition and sizes of fish associated with notches were described. Smallmouth bass in the Skunk River--during the 1976-77 drought, the population was decimated by winter kill. Survival, growth, production, movement, and habitat associations of fingerlings stocked following the drought was assessed.

PUBLICATIONS: 77/03 TO 80/06

HUBERT, W.A. 1980. Aldrin and DDT Residues in Carp from Impounded and Riverine Segments of the Des Moines River, 1979. In: Proceedings of the Seminar on the Water Quality in the Corps of Engineers' Reservoirs in Iowa. U.S. Army Corps

001.04C

CRIS0082533

FACTORS AFFECTING FISH POPULATIONS IN IOWA WATERS

NICKUM J G; HUBERT W A; ANIMAL ECOLOGY; IOWA STATE UNIVERSITY, AMES, IOWA. 50011.

Proj. No.: ICW02465

Project Type: STATE

Agency ID: SAES

Period: 31 JUL 80 To 30 SEP 85

OBJECTIVES: To determine the factors influencing fluctuations in abundance of selected populations. To identify man-made habitat alterations that impact or enhance environmental conditions for aquatic life. To increase understanding of environmental contaminants transport and dynamics. To evaluate fishery management techniques aimed at enhancing fishery quality or productivity.

APPROACH: Research will consist of field and laboratory studies on the life history, environmental requirements, and population dynamics of fish species in Iowa waters. Data on environmental contaminants in fish and their habitats will be obtained by standard analytical procedures. Established methods for

population assessment will be used to determine the effects of various management techniques.

PROGRESS: 80/07 TO 80/12. Two individual studies were conducted within the scope of this project: one dealing with pesticide residues in the Des Moines River and another concerned with the propagation of walleyes, *Stizostedion vitreum*, (propagated walleyes may be stocked so as to manipulate resident fish populations). Concentrations of dieldrin and DDT in muscle tissue of carp, *Cyprinus carpio*, from the Des Moines River, Iowa, were compared relative to month of collection, age of fish, and sampling location. Statistically significant differences were observed for all three factors. Expression of pesticide levels on the basis of wet weight of flesh often produced different results than when comparisons were made on a fat basis. Samples from reservoir locations tended to have higher dieldrin levels than samples from riverine locations. However, no similar trend was detected for DDT levels. Walleye fry fed a mixture of a diatom (*Melosira* sp.), decapsulated brine shrimp eggs, and dry feed (W-7) exhibited higher survival rates than those fed any of these items alone or in pairs. Walleye fingerlings were reared in ponds to a length of 35 mm and successfully transferred to hatchery production units. Substantial mortality occurred later, apparently due to stress from subsequent handling. Acceptance of dry feed by walleye fingerlings was highest in those rearing units in which water flow patterns held the feed in suspension for the longest times. Research in the coming year will proceed along similar lines for each study.

PUBLICATIONS: 80/07 TO 80/12

HUBERT, W.A. 1980. Aldrin and DDT Residues in Carp from Impounded and Riverine Segments of the Des Moines River 1979. In: Proceedings of a Seminar on the Water Quality in Corps of Engineers Reservoirs in Iowa. U.S. Army Corps of

001.041

CRIS0078926

THE ROLE OF SILTS AND CLAYS IN THE NUTRITION OF ZOOPLANKTON

MARZOLF G R; BIOLOGY; KANSAS STATE UNIVERSITY, MANHATTAN, KANSAS. 66506.

Proj. No.: KAN-05-691

Project Type: STATE

Agency ID: SAES

Period: 15 JAN 79 To 30 JUN 80

OBJECTIVES: Evaluate role of suspended silts and clays in zooplankton nutrition and filter feeding zooplankton in fate of particulate materials exported by rivers into reservoirs. Present knowledge of organic matter synthesis and downstream material export by river ecosystems (particularly in the Grand Plains rivers U.S. Present understanding of dissolved and particulate detritus in lakes, importance of resource utilization in controlling composition of zooplankton communities. Influence of impoundment on biological processing of suspended materials is little known but present knowledge of zooplankton feeding and production can be brought to bear on several aspects of the fate of these particles.

APPROACH: Laboratory experiments to identify causal relationships between particulate food and zooplankton responses to it; ascertain which elements of resource control zooplankton filtering rates. Observe specific field conditions with more refined measurements than was used before; e.g., in situ filtering rate measurements, specific identification, birth rate estimation, size frequency measurement of filter feeding zooplankton and more precise evaluation of resource quality and quantity two. Evaluation of resource quality and quantity. Evaluate assimilation of potential food resources by investigating growth, survivorship and egg production of laboratory populations.

ECOLOGICAL STUDIES WITH RED SWAMP CRAWFISH AND WHITE RIVER CRAWFISH

AVAULT J W; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, EATON ROUGE, LOUISIANA. 70803.

Proj. No.: LAB01192

Project Type: STATE

Agency ID: SAES

Period: 11 AUG 64 To 31 OCT 80

OBJECTIVES: Study factors influencing ecology of crawfish, such as temperature, season, water quality and depth, vegetation, soil type, and agricultural practices, in relation to feeding, growth, reproduction, behavior, populations, diseases, predators, and competitors.

APPROACH: Experiments will be set up in aquaria to determine temperature tolerance of crawfish. Past crawfish production records for certain areas will be compared to weather records. Small ponds will be stocked with crawfish and effects of water level fluctuations studied. Crawfish movements will be studied in laboratory and in the field. Methods for food habits studies will be developed and applied in the laboratory. Water from natural crawfish habitats will be analyzed. Natural crawfish populations will be studied in relation to soil fertility. Population dynamics of crawfish will be studied, including mortality and predators. Crawfish carrying capacity will be determined from small ponds.

PROGRESS: 80/01 TO 80/10. Studies conducted during reporting period on influence of pesticides, rice residue, and planted rice on crawfish production indicated: No differences in growth, survival and yield of crawfish in tanks planted with untreated rice, planted with untreated rice, or planted with treated rice plus receiving Propanil, Ordram and Furadan. No pesticide residues were detected in flesh. In lab studies, a combination of Propanil, Ordram and Furadan was more toxic to crawfish than any single pesticide. After rice was harvested in crawfish ponds the stubble was left standing (S), baled (B) and added back to ponds periodically, or disked (D) into the soil. Half the ponds were flooded early (E), Sept. 20, and half late (L), Oct. 10. Crawfish in S, B and D ponds grew to 19, 18, and 17 g respectively. Crawfish in E and L flooded ponds grew to 92 and 83 mm in length, respectively. Rice straw decomposed fastest in B ponds, followed by S and D ponds, with weight loss of 77, 67, and 49%, respectively, after 5-months. Dissolved oxygen was consistently higher in E flooded ponds than in L flooded ponds; 18 weeks after flooding, periphyton in g/m² was E 337, L 216, S 358, B 333, D 307. Ponds containing crawfish were planted with or without rice. Ponds with no rice receiving range pellets (crude protein 9.0%) from Sept. 25 to May 3 produced 881 kg of crawfish/ha. Ponds with rice receiving range pellets from March 1 through May 3 produced 2016 kg.

PUBLICATIONS: 80/01 TO 80/10

WITZIG, J.F. 1980. Spatial and Temporal Patterns of Macroinvertebrate Communities in a Small Crawfish Pond. M.S. Thesis. LSU, 113 pp.

CHIEN, Y.H. 1980. Effects of Flooding Dates and Disposal of Rice Straw on Crawfish, *Procambarus clarkii* (Girard), Culture in Rice Fields. Ph.D. Dissert. LSU, 120 pp.

WITZIG, J.F., AVAULT JR., J.W. and CONNER, J.V. 1980. Insect Dynamics in a Crawfish Pond with Emphasis on Predaceous Insects (Abstract Only). In Abstr. of Fish Culture Sect. of the Amer. Fish. Soc. 14.

CHIEN, Y.H. and AVAULT JR., J.W. 1980. Effects of Flooding Dates and Type Disposal of Rice *Oryza sativa*, Straw on the Crawfish, *Procambarus clarkii* (Girard), Culture in Rice Fields. In: Abstr. of Fish Culture Sect. of the

JOHNSON, W.B. and AVAULT JR., J.W. 1980. Some Effects of Poultry Manures Supplementation to Rice/Crawfish Experimental Earthen Ponds. In Abstr. of Fish Culture Sect. of the Amer. Fish. Soc. 15. (Abstract Only).

UTILIZATION OF AQUATIC PLANTS FOR WASTE TREATMENT AND ANIMAL FEEDS

CULLEY D D JR; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, EATON ROUGE, LOUISIANA. 70803.

Proj. No.: LAB01559

Project Type: STATE

Agency ID: SAES

Period: 01 FEB 71 To 15 MAR 80

OBJECTIVES: To determine the feasibility of utilizing aquatic plants for treatment of agricultural and domestic waste by removing nitrogen compounds, phosphates, and various inorganic salts. To determine if plants grown on waste waters have sufficient nutrient value and can be produced in large enough quantities to warrant use as a feed supplement for poultry, swine, cattle, catfish, etc.

APPROACH: Nutrient value will be determined for various aquatic plants growing under natural conditions. Plants of acceptable nutrient levels will be fed to poultry, swine, catfish, etc. to check for toxic as well as growth responses. Plants that show no signs of toxicity will be placed on water containing agricultural and domestic sewage to see if they will grow. Nutrient analysis will be made for any plants that do grow, and the plants will again be fed to domestic animals (5-10% of regular rations), to determine if the plants are usable as a food supplement. Water quality changes will be recorded and related to the usefulness of aquatic plants to reduce pollution levels in waste waters.

PROGRESS: 71/02 TO 80/03. Clones of duckweed *Spirodela polyrrhiza*, *S. punctata*, *Lemna gibba* and *Wolffia columbiana* cultured on dairy waste lagoon gave a mean yield of 23,310 kg/ha/yr dry weight when harvested daily, or 2.3 kg/m²/yr. Maximum yields obtained outdoors in .14 m² tanks was 44,330 kg/ha (4.4m²/yr) dry wt. Daily harvests (25-35% removed/day) gave higher yields than weekly harvests (50% removal). Optimum standing crop density was about 500g/m². Loading rate of fresh manure 10 to 20g/l of water gave maximum growth and highest proximate analysis in the plants. Mixed duckweed cultures gave higher yields than monocultures due to seasonality of growth. Crude protein averaged 38% dry wt. with a maximum value of over 44%; fat 3-6%, NFE 25-35%, fiber 7-13%, P 2%, K 2.5-5%, Ca 1-2%. The amino acid content was equal or superior to most high protein crops. Annual removal (kg/ha) of plant nutrients by duckweed from waste lagoon was: N, 1379; P, 347; K, 441. Removal efficiency was greater in shallow lagoons. 5.3 ha of duckweed would provide total protein requirements of 200 lactating cows. Preliminary studies on feeding cows (up to 75% of diet) and swine (up to 25% of diet) showed no adverse effects of duckweed, wet or dry. Feeding of poultry broilers and layers showed no adverse effects, equal or improved growth, meat and egg color, and egg production and quality. In vitro digestibility ranged from 70 to 97%.

PUBLICATIONS: 71/02 TO 80/03

TRAUX, R.E., D.D. Culley, Jr., M. GRIFFITH, W.A. JOHNSON, and J.P. WOOD. 1972. Duckweed for chick feed. Louisiana Agriculture 16(1):8-9.

CULLEY, D.D., Jr. and E.A. Epps. 1973. Use of duckweed for waste treatment and animal feed. Journal Water Pollution Control 45(2):337-347.

LAWSON, T.B., B.J. BRAUD, and F.T. BRATTEN. 1974.

Methods of drying duckweed, Lemnaceae. In American Society of Agricultural Engineers. Paper No. 74-3531.

CULLEY, D.D., Jr., J.B. GHOLSON, T.S. CHISHOLM, L.C. STANDIFEE, and E.A. EPPS. 1978. Water quality renovation of animal waste lagoon utilizing aquatic plants. U.S. EPA Off. Res. & Dev. EPA-600/2-78-153.

THE RELATIONSHIP OF SALINITY AND DISTANCE FROM THE SEA, TO THE DISTRIBUTION OF JUVENILE FISHES

BERKE W H; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB02008 Project Type: STATE
Agency ID: SAES Period: 01 AUG 78 To 31 DEC 80

OBJECTIVES: Determine how far inland the young menhaden, genus *Brevoortia*, Atlantic croaker, *Micropogon undulatus*, and spot, *Leiostomus xanthurus*, move in the Barataria Bay drainage. Correlate their abundance and size with the salinities, and the location, where they are caught.

APPROACH: A transect about 75 km long contains 15 sample sites. Salinity declines in a northerly direction, from saline or brackish to pure fresh water. Samples will be taken every 2 weeks with a 4.9-m otter trawl. On alternate trips each site will also be sampled with Surface trawl and high speed sampler, or 1.8-m beam trawl and plankton net. Salinity, temperature & water depth will be recorded for each sample. Total biomass, total number, and length of individuals will be recorded for every sample, for menhaden, spot and croaker. Length-frequencies will be analyzed. Abundance at the stations will be analyzed to determine the inland extent of penetration of each species.

PROGRESS: 78/01 TO 80/12. Inshore shrimp trawling was the primary cause for a rapid decline in abundance of Atlantic croaker, *Micropogon undulatus*, after May. No relationship between salinity and croaker size was found. Trawl catches of croaker were an order of magnitude greater at night than during the day. Gulf menhaden, *Brevoortia patronus*, and blue crabs, *Callinectes sapidus*, were also taken in significantly greater numbers in nighttime trawls. The surface trawl was more efficient on 5-25 mm crabs than the otter trawl; researchers on small crabs should consider its use. Menhaden and crabs were taken in greater numbers in shallow, protected waters than in larger, open waters within the marsh. All three species were taken well above the brackish/freshwater line; menhaden were taken in numbers at several stations 20 km above. The entire coastal marsh, including the freshwater zone, is an important nursery and should be protected from environmental degradation.

PUBLICATIONS: 78/01 TO 80/12

- ROGERS, B.D. 1978. The Spatial and Temporal Distribution of Atlantic Croaker, *Micropogon undulatus*, and Spot, *Leiostomus xanthurus*, in the Upper Drainage Basin of Barataria Bay, Louisiana, M.S. Thesis, La. State Univ., Baton Rouge
- SIMONEAUX, L.F. 1979. The Distribution of Menhaden, Genus *Brevoortia*, with respect to Salinity, in the Upper Drainage Basin of Barataria Bay, Louisiana. M.S. Thesis, La. State Univ., Baton Rouge, 96 pp.
- DAUD, N.M. 1979. Distribution and Recruitment of Juvenile Blue Crabs, *Callinectes sapidus*, in a Louisiana Estuarine System. M.S. Thesis, La. State Univ., Baton Rouge, 83 pp.

001.045 CRIS0080171
PRESENCE, ABUNDANCE, MOVEMENTS, AND HABITAT USAGE OF ESTUARINE-DEPENDENT FISHES AND CRUSTACEANS.

BERKE W H; ROGERS E D; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB02076 Project Type: STATE
Agency ID: SAES Period: 20 AUG 79 To 15 AUG 83

OBJECTIVES: To determine: seasonal presence and relative abundance of important larval and juvenile organisms entering and leaving Sabine National Wildlife Refuge; their ingress and egress routes; the relative use made of several habitat types, and to search literature for allied information.

APPROACH: Traps and plankton nets will be fished 1 to 3 times/week on all (6) major possible migration channels for 3 years. The shallow habitat within the Refuge will be sampled monthly using an airboat for transportation, and whatever gear can be found to work satisfactorily in very shallow water. (Gear type to be determined in preliminary work.) Movements will

be studied using fluorescent marking techniques. All catches will be recorded by species, numbers, lengths, and habitat types, and searched for marks.

PROGRESS: 80/01 TO 80/12. Field work began in March 1980. Twenty-six traps have been installed and are now in operation. Trapping and trawling is being conducted on established schedules. Nearly 1/2 million organisms were processed by end of July; about 1/2 were fishes (39 families, 88 species) and the rest were crustaceans (5 families, 10 species). Ingress and egress appears to be mainly from Calcasieu Lake side. Much of the marsh was used as nursery at different times.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED IBI PERIOD.

001.046 CRIS0058808
EARLY LIFE HISTORY ECOLOGY AND GROWTH OF THE RIVER SHRIMP *MACROBRACHIUM OHIONE* IN LOUISIANA

TRUESDALE F M; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB01542 Project Type: STATE
Agency ID: SAES Period: 01 SEP 70 To 30 JUN 81

OBJECTIVES: Describe larval development and post-embryonic growth and molting frequency of river shrimp. Investigate importance of river shrimp in river plankton, as food for human consumption, as fish bait, and as forage.

APPROACH: Shrimp larvae will be picked from monthly plankton samples taken in the Mississippi and Atchafalaya Rivers. Descriptions will be made of developmental stages. River shrimp will be reared from eggs through postlarvae in the laboratory under controlled conditions. Representatives of developmental instars will be described and compared with shrimp larvae from plankton. Data will be gathered on molting frequency and growth. Juvenile river shrimp from the wild will be stocked in laboratory aquaria and monitored under controlled conditions. A shrimp landing census of Louisiana shrimpers and fish markets will be conducted.

PROGRESS: 75/01 TO 81/06. *Macrobrachium ohione*, *M. acanthurus* and *M. ciferrii*, were reared from egg through postlarva in the laboratory. Eggs were obtained from females which mated and spawned in laboratory aquaria. All three species carried their eggs for 14-17 days before hatching and, eggs of each hatched successfully in freshwater but survival past zoeal stage I occurred only in salinities greater than 5 ppt. Larvae were reared in individual containers, in various salinities and temperatures under a photoperiod of 12 hours daylight. Larvae were fed fresh brine shrimp nauplii. For all species survival to premetamorphic stage was high (40%) but through metamorphosis less than 10% survived. One lab-batched male and female *M. acanthurus* survived to maturity and mated. The egg to egg time for the female was 11 months. A field survey of river shrimp (*M. ohione*) in the Mississippi River from Baton Rouge to St. Francisville, Louisiana yielded data on river shrimp ecology consistent with our data on the species from the Atchafalaya River basin. River shrimp are most abundant in the late summer and early fall (August, September, October). Length frequency data over 13 months indicated that one year old female and male shrimp were 65-70 mm total length (TL) and 40-55 mm TL respectively. Total counts of eggs on ovigerous females ranged from 6,300-24,800. Only the first stage larvae and juvenile river shrimp have been taken in plankton collections in the Mississippi and Atchafalaya rivers.

PUBLICATIONS: 75/01 TO 81/06
MERMILLICD, W.J. and TRUESDALE, F.M. 1976. River shrimp something special. *Aquaculture* 5(3):3-4.
MERMILLICD, W.J. 1976. Life history and ecology of the large river shrimp *macrobrachium ohione* (Smith). M.S. thesis. Louisiana State University, Baton Rouge. 87 pp.

TRUESDALE, F.M. and MERMILLICD, W.J. 1977. Some observations on the host-parasite relationship of *Macrobrachium ohione* (Decapoda palaemonidae) and *Probopyrus bithynis* (Isopoda, Bopyridae). *Crustaceana* 32(2):216-220.

TRUESDALE, F.M. and MERMILLICD, W.J. 1979. The river shrimp *Macrobrachium ohione* (Decapoda, Palaemonidae): Its abundance, reproduction and growth in the Atchafalaya River Basin of Louisiana. *Crustaceana*. 1979. 36(1):61-73.

WALKER, R.J., and F.M. TRUESDALE. 1979. Ichthyoplankton survey of nearshore Gulf waters off southeastern Louisiana, July, August, and December, 1973. *ASB Bull.* 26(2):67 (Abstr.)

FRUGE, E.J. and F.M. TRUESDALE. 1978. Comparative larval development of *Micropogon undulatus* and *Leiostomus xanthurus* (Pisces: Sciaenidae) from the northern Gulf of Mexico. *Copeia* 1978. (4):643-648.

001.047 CRIS0067236
 SURVEY OF LARVAL FISHES IN THE NEARSHORE GULF WATERS OF LOUISIANA

TRUESDALE F M; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
 Proj. No.: LAE01728 Project Type: STATE
 Agency ID: SAES Period: 01 JAN 75 To 30 JUN 80

OBJECTIVES: Determine seasonal species composition of the ichthyoplankton. Determine seasonal, temporal and spatial distribution of eggs and larvae of commercial Sciaenidae particularly croaker. Determine probable areas of major croaker spawning activity and transport routes of croaker larvae. Relate abundances of fish eggs and larvae and selected invertebrate plankters to hydrographic variables.

APPROACH: Plankton samples will be taken seasonally on transects off the Louisiana coast. Standard collecting gear and techniques will be employed. Fish eggs and larvae will be sorted from the samples, identified, and enumerated. Select invertebrate plankters will also be identified and counted. Catches will be expressed as number of organisms under 1 M² of sea surface. Correlations will be sought between organismal abundances and hydrographic variables.

PROGRESS: 75/01 TO 80/06. Bongo net (0.505mm) samples were collected on 9 cruises of National Marine Fisheries Service research vessel Oregon II. Collections were made on continental shelf between Mobile Bay and Atchafalaya Bay, Louisiana. Winter (Jan, Feb, Mar) collections yielded more than 38 kinds. Early life history stages of croaker, spot, spotted seatrout and sand seatrout were described. November was the peak spawning month for croaker. Approximately the same number of croaker larvae (1500) were taken in Nov 1974, as in Nov 1975 although only half as many samples were taken in 1975. During both years croaker larvae 2.00-3.99mm standard length (SL) were most abundant approximately 30 km SW of Southwest Pass of the Mississippi River. Larger larvae 4.00-6.99mm SL were most abundant nearer the Louisiana coast during both years. Sand seatrout larvae and two specimens of silver seatrout were taken in a survey of waters 5-74 km from shore during July 1976; spotted seatrout larvae were probably concentrated in unsampled zone within 5km of shore. Larval flatfishes were surveyed during Nov. 1974, Nov. 1975, Jan. 1976, and July 1976. Flatfish larvae occurred at 72% of the stations, but comprised a small portion, from less than 1.0% to 4.1% of the total numbers of ichthyoplankton. Larval reptant decapod crustaceans were surveyed in July 1976. From 33 stations, 60 kinds of sacurans, anomurans and brachyurans representing at least 20 families were recorded.

PUBLICATIONS: 75/01 TO 80/06
 ANDRYSZAK, B.L. 1979. Abundance, distribution, and partial description of reptant decapod crustacean larvae collected from neritic Louisiana waters in July, 1976. M.S. Thesis La. State Univ. Baton Rouge. 102 p.
 ANDRYSZAK, B.L. and F.M. TRUESDALE. 1979. Abundance and distribution of larval reptant decapod crustaceans in neritic waters of the northern Gulf of Mexico, July 1976. *ASB Bull.* 26(2):54(Abstr.).
 KUHN, N.A. 1979. Occurrence and distribution of larval flatfish (Pleuronectiformes) off the southeastern Louisiana coast during four cruises including brief desc. of larval stages. M.S. Thesis, La. State Univ. B.R.

001.048 CRIS0083515
 LABORATORY CULTURE FOR RESEARCH PURPOSES OF ESTUARINE AND MARINE LOBSTERS, CRABS AND SHRIMPS

TRUESDALE P M; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
 Proj. No.: LAB02159 Project Type: STATE
 Agency ID: SAES Period: 01 MAR 81 To 30 JUN 82

OBJECTIVES: Rear decapod larvae (lobsters, crabs and shrimps) of as many Louisiana species as possible, from egg through postlarval stages under defined laboratory conditions. Describe and illustrate the developmental stages of each species reared. Compare laboratory reared larvae with corresponding larvae taken in the plankton.

APPROACH: Egg-bearing crabs and shrimps will be collected at coast-wide Louisiana sites. In the laboratory most specimens will be isolated in aquaria under simulated field conditions until eggs hatch; for large species eggs will be removed and hatched in vitro. Rearing procedures will allow the developmental sequence of each larva to be traced; this will entail isolating individual larvae within plastic tray compartments and examining each daily for evidence of molting. Enough larvae will be reared to investigate three salinity/temperature combinations with replication. Daily data on survival, molting, behavior and morphology will be recorded. Larvae will be transferred to compartments with clean water and fresh food (*Artemia* nauplii) each day. Detailed descriptions and drawings of each developmental stage will be made. Comparative descriptions of closely related species will be made to elucidate difference. Laboratory-reared specimens will be compared with plankton-caught larvae in order to develop diagnostic guides for fishery researchers.

001.049 CRIS0078594
 MOVEMENTS OF SONIC-TAGGED FISHES IN RELATION TO WATER QUALITY IN LOWER ATCHAFALAYA RIVER BASIN

BRYAN C F; RANGE SCIENCE; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
 Proj. No.: LAB02023 Project Type: STATE
 Agency ID: SAES Period: 01 NOV 78 To 31 DEC 82

OBJECTIVES: To develop, from the diversity of systems available, a radio tracking system suitable for the study of largemouth bass, *Micropogonias salmoides* (Lacepede), black drappie, *Pomoxis nigromaculatus* (Lesueur) and white crappie, *Pomoxis annularis* Rafinesque. To relate movements of largemouth bass and crappies to changes in physicochemical characteristics of water and hydrographic regime in lower Basin habitats. To compare home range dimensions of the largemouth bass and crappies in various habitats. To gain insight into seasonal and diel patterns of movements of the above sport fishes insofar as these movements may be related to water quality variations in the annual hydrographic cycle.

APPROACH: Bass will be electrofished from at least two habitat types in the Atchafalaya River Basin. Radio tags will be implanted surgically and fish will be released immediately. Fish and a physicochemical description of their home ranges will be monitored on a diel and seasonal basis, to gain insight into possible relationships between a changing water quality and fish movements.

PROGRESS: 80/01 TO 80/12. The role of water quality in selection of microhabitats and home ranges of sport fishes has been inferred from laboratory experiments wherein most variables (except one) are held constant. However, a better way to gain insight into water quality preferences may be to follow fishes tagged with telemetry devices while monitoring the water quality in their natural habitat. We surgically implanted radio transmitters in 15 largemouth bass in the Atchafalaya River Basin and tracked them for as many as 117 days. Water temperature, dissolved oxygen, pH, specific conductance, and oxidation-reduction potential were recorded at each release site and subsequently, at the previous, and at each new location for each tracking day until the fish was no longer detected. We found that bass preferred a water temperature of 27 degrees C and made significantly more movements toward increasing dissolved oxygen. Other water quality characteristics measured did not appear to influence movements. Most locations of bass were made near shore in water less than 1.5 m deep and neither movements nor home range sizes were associated with river stage unless stages were sufficiently high to inundate the swamp floor.

PUBLICATIONS: 80/01 TO 80/12

DOERZEACBER, J.F. 1980. Movement and Home Range of Largemouth Bass (*Micropterus salmoides*) in Relation to Water Quality of the Atchafalaya River Basin, Louisiana. M.S. Thesis, La. State Univ., Baton Rouge, Louisiana.

001.050 CRIS00E2633
CRAWFISH CULTURE STUDIES IN SMALL PONDS: BUREAWING, POLYCULTURE AND NATURAL POND FLOODING

HUNER J V; COLLEGE OF AGRICULTURE; SOUTHERN UNIVERSITY, EATON HODGE, LOUISIANA. 70E13.
Proj. No.: LA.X-81-2005-2044 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 80 TO 30 SEP 85

OBJECTIVES: Determine the spatial and seasonal burrowing patterns of crawfish in small, open crawfish ponds. Assess the effectiveness of various techniques for facilitating successful burrowing of crawfish in crawfish ponds. Determine the effects of soil tilling practices on crawfish burrows in crawfish ponds. Determine the commercial feasibility of cultivating channel catfish and crawfish together in small, open south Louisiana crawfish ponds. Determine the commercial feasibility of using rainfall to flood crawfish ponds in south Louisiana.

APPROACH: Objectives 1, 2, 4 and 5 will be pursued in the four, one acre crawfish ponds located at Southern University. Objective 3 will be pursued in a nearby commercial pond. During the first two years, burrows will be marked and mapped on a biweekly basis and several types of materials will be tested to determine their effectiveness as burrowing facilitators. Also, during the first two years, marked burrows will be subjected to disking and tractor-bush hog compaction early and late during the dry season to determine their impact on the occupants. In years 2 and 3, channel catfish will be stocked in test ponds after they have been filled with water in the fall. Catfish production and catfish impact on crawfish production will be recorded. In years 4 and 5, test ponds will be permitted to fill naturally in the fall and winter. The impact on this action on crawfish production will be measured.

001.051 CRIS0060712
METABOLISM AND FUNCTION OF CELLULAR LIPIDS

DESIEVO A J; AGRICULTURAL EXPER. STATION; UNIVERSITY OF MAINE, CECNC, MAINE. 04469.
Proj. No.: ME08752 Project Type: BAICB
Agency ID: CSRS Period: 01 FEB 78 TO 30 SEP 86

OBJECTIVES: Analysis of lipid and lipid enzymes in detergent-resistant and pigmentation mutants of *M. lysodeikticus*. Studies of lipid composition and lipid identification in marine caulobacter species. The effect of herpesvirus infection on the lipid metabolism of cultured animal and human cells.

APPROACH: Comparative studies between wild-type and detergent resistant mutants are planned to elucidate the mechanism of resistance and the relationship between resistance and the lipid composition by analyzing the changes in lipid composition during growth in the presence of different levels of detergent. Pigmentation mutants will be compared with respect to lipid composition and fatty acid analysis. Evidence has accumulated which indicates that Caulobacter halobacteroides and other marine caulobacters have an unusual lipid composition. We propose to identify the glycolipids of these organisms, analyze isolated membranes, and determine if typical phospholipid biosynthetic pathways play a role in the metabolism of these organisms. A study of the effects of MDV infection on cellular lipid composition and the breakdown and synthesis of cholesterol ester in an in vitro, primary cell system is planned. Vascular smooth muscle and cardiac muscle cell cultures will be infected with MDV and HVI cell-associated viruses.

PROGRESS: 80/01 TO 80/12. In studies of Triton X-100 (TX) resistant mutants of *M. lysodeikticus*, a comparison of the release of label from wild-type and mutant cells suggested that it was not the penetration of the detergent through the cell walls that was responsible for resistance. The lipid compositions of the wild-type and mutant were different when grown in the absence of TX. The lipid alterations during growth of the mutant in the presence and absence of TX were significantly different, indicating that the presence of TX does affect the regulation of lipid composition and metabolism. Experiments designed to determine differences between two pigmented mutants and the wild-type of *M. lysodeikticus* were undertaken. The wild-type contains derivatives of the yellow carotenoid, neurosporene; the pink mutant was shown to have large amounts of lycopene; and the white mutants has only trace amounts of visible pigments. Since it had been suggested that carotenoids may act to reinforce the membrane bilayer, we compared the growth rates of these three cultures at different temperatures. All three cultures had the same optimal growth temperature, 35C. The pink mutants, however, had a more narrow temperature growth range. Studies of the lipid composition of the marine bacterium, Caulobacter halobacteroides, indicate that this organism contains little, if any, phospholipid; most of the extractable lipid being glycolipid. The nature of this glycolipid is currently being investigated.

PUBLICATIONS: 80/01 TO 80/12

DE SIERVO, A.J. and BOMCLA, A.D. 1980. Analysis of Caulobacter crescentus Lipids. J. Bacteriol. 143:1215-1222.

DE SIERVO, A.J. and BOMCLA, A.D. 1980. Growth and Lipid Changes of Detergent Resistant Isolates of Micrococcus lysodeikticus. Abt. Ann. Mtg. Amer. Soc. Microbiol. K217:162.

001.052 CRIS0064835
DISTRIBUTION, ABUNDANCE AND ECOLOGY OF ASCOPYLLUM NODOSUM (1) LE JOIS

VADAS R L; BCTANY & PLANT PATHOLOGY; UNIVERSITY OF MAINE, ORONO, MAINE. C4469.
Proj. No.: ME08459 Project Type: BAICB
Agency ID: CSRS Period: 13 FEB 74 TO 30 SEP 82

OBJECTIVES: Determine: Distribution and abundance patterns of *A. nodosum* in Maine, growth, reproductive, age and biomass patterns on exposed, semi-exposed and sheltered shores; biomass of *Fucus* spp., value of aerial photography and infrared film for *A. nodosum* surveys; methods to enhance colonization of *A. nodosum*; harvestable yields of *A. nodosum*.

APPROACH: Ferment and radnomly selected sites will be utilized to survey the algal resource and study growth patterns. Samples will be taken seasonally. Experimental studies on colonization will be conducted in situ and in simulated tide cycles in running seawater tanks.

PROGRESS: 80/01 TO 80/12. Four study areas were established in 1980 making a total of six in two major areas (Northeast and Southeast) of the coast. The percent cover and biomass of *Ascophyllum* and *Fucus* spp. were determined in belt transects and in 10 x 100 cm quadrats, respectively. Samples were stratified by intertidal height. Biomass and growth and density of plants and apical growing points were measured to determine growth and productivity potentials. Reproductive output was measured in Fall 1980 for plants at the six sites. Data measurements are nearly complete for these sites (through Fall 1980). Computer programming and analysis will be initiated in spring 1981. Field colonization studies involving *Ascophyllum* during 1980 were not successful. Only a few recruits developed (to 2-5 mm) from approximately 130 experimental plots involving millions of fertilized eggs. Some promising leads will be followed up during 1981. Colonization experiments in running sea water from these same eggs showed excellent growth and survival for 1 to 2 months until adversely affected by sedimentation.

PUBLICATIONS: 80/01 TO 80/12

LARSON, B. E., VADAS, R. L. and KESEB, M. 1980. Feeding and Nutritional Ecology of the Sea Urchin *Strongylocentrotus brachchiensis* in Maine, USA. Mar. Biol. 59:49-62.
KESER, M., VADAS, R. L. and LARSON, B. E. 1981. Regrowth of *Ascophyllum nodosum* and *Fucus vesiculosus* Under Harvesting Regimes in Maine, USA. Bot. Mar. 24:29-38.

001.053 CRIS0074202
MATHEMATICAL MODEL OF OYSTER POPULATION IN THE
CHESAPEAKE BAY

WHEATON F W; CABRAAL A; AGRIC ENGINEERING; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MD-k-057 Project Type: HAICB
Agency ID: CSRS Period: 01 OCT 77 To 30 SEP 80

OBJECTIVES: Develop a bank of pertinent data to study oyster productivity in the Maryland portion of the Chesapeake Bay. Develop a mathematical model for describing the production function of oysters, this model will incorporate economic and management factors affecting the productivity of an oyster bar. Evaluate the effectiveness of the oyster repletion program in Maryland and suggest means of optimizing the operator.

APPROACH: A data bank will be established incorporating oyster catch, effort and spatfall data, and seed and shell planting data. This data will be stored on computer tape and coded so data is available by bar and is accessible by river basin code, oyster bar code, Davis code, NCAA code, by latitude and longitude or by official or common bar name. This and other data will be used to develop an oyster demand equation, catch effort equation and production function. The effects of existing catch limits will be determined. Existing oyster population size will be estimated and management alternatives determined.

PROGRESS: 77/11 TO 80/09. A computerized data bank was developed which contains Maryland oyster seed and shell plantings by bar from 1964 to 1975, natural oyster spatfall for 1955 to 1975, harvest and effort for 1964 to 1975 and several more general economic statistics such as ex-vessel price of oysters. The Maryland portion of the Chesapeake Bay was divided into 6 general areas. Production functions relating catch to effort, lagged spatfall, seed and shell plantings, were developed for each area. Fresh shell was the most successful cultch material with dredge shell being less efficient in catching spat. Seed plantings produced 12 to 19 bushels of marketable oysters per 100 bushels of seed planted depending on the area planted. The State run oyster repletion

program returned about 300,000 bushels of marketable oysters per year for the approximately \$1,000,000 annual expenditure. Estimates of oyster population were made for each of the six areas for the beginning of the 1975-76 harvest year using the Leslie and DeLury equations. Calculated rates of resource exploitation varied from 17 to 31 percent, depending on the area. Demand equations developed indicated oysters had an unitary demand elasticity. Effort equations developed showed that the boat-days of harvesting effort were stable over time for most river systems.

PUBLICATIONS: 77/11 TO 80/09

CABRAAL, E.A. 1978. Systems Analysis of the Maryland Oyster Fishery: Production Management and Economics. Ph.D. Thesis. University of Maryland, College Park. 318 pp.
CABRAAL, E.A. and WHEATON, F.W. 1978. A Predictor Model for Chesapeake Bay Oyster Productivity. Paper No. 78-5036. American Society of Agricultural Engineers. St. Joseph, Michigan.

001.054 CRIS0067887
PHYSIOLOGY OF CHESAPEAKE BAY PHYTOPLANKTON

KARLANDER E P; BOTANY; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MD-K-013 Project Type: STATE
Agency ID: SAES Period: 01 MAY 75 To 30 SEP 80

OBJECTIVES: Characterization of the major food and oxygen producing plants supporting the seafood industry of Maryland is the major objective. Environmental factors including light, nutrients, temperature, energy, and interspecific interactions will be measured.

APPROACH: The research will be carried out primarily from the University of Maryland. Some work on the Chesapeake Bay will be necessary to obtain samples. Controlled natural, and possible variations in the environment will be introduced in naturally occurring and cultured communities. Initial investigations will concentrate on growth, production, and pigmentation. Absorbance, spectrophotometry, oxygen determination, and carbon uptake techniques will be used with cultured phytoplankton.

PROGRESS: 75/05 TO 80/09. Three algae from the Chesapeake Bay were characterized in terms of their gravel rate response to various environmental conditions of light, temperature, nutrition and salinity. The effects of grazing at various phases of growth was measured in a fourth algae. Results of the grazing work showed that as net primary production decreased from exponential phase to declining phase to stationary phase that an equal level of grazing removed an increasing proportion of net primary production from each phase. The golden-brown planktivorous alga, *Pseudopedinella pyriforme* grew best between 2 1/2 and 5 g/kg salinity. *Mycozastes ruminatus*, a unicellular alga grew best between 10 and 20 g/kg salinity at 0.78 m W/cm white light, and 25C. The phytoplankton, *Nannochloris oculata* had a maximal growth rate at 30 C, 15 g/kg salinity, and 1.35 m W/cm white light on ammonium. The nitrogen source showing the best growth was dependent on interactions among the physical parameters of the environment. It is concluded that the production of Chesapeake Bay and the species composition of the primary plants will depend on the management of the environmental parameters affected by nutritional pollution, sedimentation, temperature manipulation and salinity control.

PUBLICATIONS: 75/05 TO 80/09

OSTROFF, C.R., KARLANDER, E. P., VAN VALENBURG, S.D. 1980. Growth rates of *Pseudopedinella pyriforme* (Chrysophyceae) in response to 75 combinations of light, temperature, and salinity. J. Phycol. 16:421-423.
TERLIZZI, D.E. and E.P. KARLANDER. 1979. The role of light, temperature, salinity, and nitrogen source, in factorial combination on the growth of *Nannochloris oculata* Droop. Paper 42 Ann. Mtg. Am. Soc. Limnol. Oceanogr.

TERLIZZI, L. E. and E.P. KARLANDER. 1979. Soil algae from a Maryland Serpentine Formation. Soil Biol. Biochem. 11:205-207.
SPEARING, J.M. and E.P. KARLANDER. 1979. Effects of light on the low temperature autotrophic metabolism of *Chlorella sorokiniana*. Shihira and Krauss. Environ. Exptl. Botany 19:237-243.
SIMPSON, P.D., KARLANDER, E.P., and S.D. VAN VALKENBURG. 1978. The growth rate of *Mychonastes ruminatus* Simpson et Van Valkenburg under various light, temperature and salinity regimes. Er. Phycol. J. 13:291-298.

001.055 CRIS0083163
BIOSYNTHESIS OF STEROLS IN THE OYSTER AND CORRELATION OF STEROL COMPOSITION TO OYSTER PRODUCTIVITY

PATTERSON G W; BOTANY; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: ME-J-114 Project Type: HAICE
Agency ID: CSFS Period: 01 JAN 81 To 31 DEC 81

OBJECTIVES: Data from several sources indicate that oysters synthesize only a fraction of their total sterol. Analysis of fast growing oysters from Cape Batteras indicates that the Chesapeake Bay oyster could, in some cases, be deficient in total sterol composition. Inadequate algae or the wrong kind of algae in the diet could cause this deficiency. The extent of sterol biosynthesis in the oyster will be determined. Oysters from different bars with different degrees of success will be compared with respect to their sterol content. "Good food" algae will also be examined to determine which sterols they contribute to the oyster's diet.

APPROACH: Oyster samples will be analyzed by standard methods for sterol composition. These samples will be taken from oyster bars showing a great diversity of characteristics with respect to growth rate, spat set, shell growth, and general health of the oyster. An attempt will be made to correlate sterol composition with these characteristics. To determine if the oyster can synthesize sterols, oyster tissue cultures will be incubated with labeled acetate and the sterols isolated and examined. Algae will be examined for sterol composition to determine if sterols correlate with the desirability of certain algae as oyster food.

001.056 CRIS0073934
MORPHOLOGICAL, ULTRASTRUCTURAL, AND BIOCHEMICAL CHARACTERIZATION OF NAUPLANKTON FROM CHESAPEAKE BAY

PATTERSON G W; VAN VALKENBURG S D; BOTANY; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MD-K-016 Project Type: STATE
Agency ID: SAES Period: 01 OCT 77 To 30 SEP 80

OBJECTIVES: Screen various nanoplankton organisms already brought into culture from the Chesapeake Bay, in order to select for "new" organisms--those which cannot be identified through use of standard keys. Study in detail the morphology and microanatomy of the organisms selected as above in order to determine their taxonomic affinities. Characterize the photosynthetic pigments of these organisms, particularly the chlorophylls, the presence or absence of phycobilins, and the xanthophylls, in order to determine their taxonomic affinities. Characterize the biochemical composition of these organisms, especially the protein and lipid composition, in order to evaluate the organism as food for Chesapeake Bay shellfish.

APPROACH: Screening procedures involve morphological description by light microscopy, a scan of the major pigments by acetone-extraction techniques and a cursory examination by transmission electron microscopy, sufficient to determine the basic cytological condition of the organism. In-depth studies by light, scanning electron and transmission electron microscopy will be done in order to produce definitive descriptions of these organisms. Pigments

will be studied by photospectrophometric scanning of acetone extract, and by both thin layer and column separation and extraction procedures. Total protein composition will be determined by Kjeldahl analysis and lipid analysis will be performed by standard extraction methods followed by thin layer and gas chromatography.

PROGRESS: 77/10 TO 80/09. Over thirty species of *Chlorella* have been examined for sterol and fatty acid composition. The major fatty acids were palmitic, oleic, linoleic and linolenic. Some strains had major quantities of palmitoleic as well as di- and triunsaturated sixteen carbon acids. Tetra-unsaturated acids with 16 and 18 carbons were found in a few strains. *Chlorella* could be divided into 3 major groups based on sterol compositions: Delta 5-sterols, Delta 7-sterols, Delta 5, 7-sterols. One strain contained Delta 5, 8-sterols, which are extremely rare in living organisms. These lipid constituents show promise as biochemical markers for taxonomic groupings. Most of the *Chlorella* species and strains would appear to be unlikely as oyster food based on their sterol composition and that of the oyster. Several diatoms which are of the proper size for ingestion by the oyster, appear to have the same sterol composition as the oyster, indicating that they could be the oyster's food source.

PUBLICATIONS: 77/10 TO 80/09
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

001.057 CRIS0064213
ACTIVITY RHYTHMS OF THE NORTHERN ROCK CRAB IN RELATION TO ENVIRONMENTAL AND SOCIAL FACTORS

REBECH S; UNIVERSITY OF MARYLAND EASTERN SHORE, PRINCESS ANN, MARYLAND. 21853.
Proj. No.: MDX-PR-0001-URP31/73 Project Type: GRANT
Agency ID: CSRS Period: 25 MAY 73 To 24 MAY 78

OBJECTIVES: Develop a simple and accurate way to measure activity rhythms in *Cancer borealis* and determine the importance and effect of photoperiod, tidal cycle, temperature, salinity, age, sex and stage of the reproductive and molting cycles on its activity and movements.

APPROACH: Crabs will be maintained under varying regimes of temperature, salinity, photoperiod and tidal cycle. The crabs will be tested in aquaria utilizing photocells connected to a recording device to measure activity under these different conditions. Observations will be made on crabs of both sexes, various ages and different physiological states, such as molt phase and reproductive condition, determine how these factors effect responses to solar and lunar rhythms. A knowledge of these factors and periods of optimum activity should provide basic information to the crabbing industry in relation to the timing and techniques of harvesting this species. This study might also lead to the ability to advance the reproductive season or increase the number of annual reproductive periods in *C. borealis* and, therefore, make commercial aquaculture of crabs a profitable venture.

PROGRESS: 79/01 TO 79/12. Data obtained from measurements of locomotor activity of *Cancer irroratus* held under varying photoperiods is presently being reanalyzed to determine if size or stage of the molt cycle influenced the amplitude or periodicity of activity.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.058 CRIS0075003
BEHAVIOR ECOLOGY AND RHYTHMICITY IN THE ROCK CRABS, *CANCER IRRORATUS* AND *CANCER ECREALIS*, PHASE II

REBECH S; UNIVERSITY OF MARYLAND EASTERN SHORE, PRINCESS ANN, MARYLAND. 21853.

Proj. No.: MDX-PR-0001-URP53 Project Type: GRANT
Agency ID: CSRS Period: 27 FEB 78 To 26 FEB 83

OBJECTIVES: Determine influence of tidal and/or geophysical rhythms or activity of rock crabs. Determine relative influences of photophase & scotophase on molting of rock crabs. Determine effect of short & long day photoperiods on growth, molting & reproduction. Record seasonal distribution of age classes, sexes & molt stage individuals. Develop optimum diet for growth & maintenance & develop a delivery system for diet.

APPROACH: Encourage local utilization of rock crab as an alternate or supplement to blue crab. Correlate observed activity rhythms with tidal, barometric, humidity, magnetic flux cycles. Varying length & proportions of light & dark periods to determine influence on molting. Utilizing less than or greater than 24 hour days in laboratory environment. Utilizing tag and recapture studies at monthly intervals aboard a coastal vessel. Automated system for delivery of optimum protein, fiber & mineral content of presently used nutritional pellets will be developed. Interviews, free samples & information on location & abundance of rock crabs might increase local utilization of rock crab meat.

PROGRESS: 80/01 TO 80/12. Previous work (Rebach, 1977, and in preparation) indicates that length of photoperiod and light:dark ratios are controlling factors in courtship, reproduction and molting of the rock crab, *Cancer irroratus*. The newly opened Crab Lab, a converted 70 foot house trailer, has a water treatment facility and 5 laboratories with running seawater and computer-controlled photoperiods. Tanks and electronic instrumentation have been designed, constructed and tested to allow the test animal to select the duration of light and dark in one laboratory. Total hours of light and dark and light:dark ratios are monitored. Another laboratory allows the animal to control the intensity of illumination. In 1980, after correcting many problems and improving the water delivery and treatment facilities (to produce adequate flow rates to maintain the animals), we were able to introduce our first group of animals. Pilot studies led to further refinement of light control mechanisms in the test tanks. These studies indicated that the animals were able to control the photoperiod and intensity in their respective laboratories. We are now ready to initiate full-scale testing. In order to determine the locations of marketable numbers of animals, a tag-recapture program is planned. However, spaghetti tags injected into the crabs' muscle resulted in a 40% mortality rate in the laboratory. This level is too high for a successful tag and recapture program.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.059 CRIS0070148
BEHAVIOR, ECOLOGY AND RHYTHMICITY IN THE COMMON ROCK CRAB

REBEACH S.; NATURAL RESOURCES; UNIVERSITY OF MARYLAND EASTERN SHORE, PRINCESS ANN, MARYLAND, 21853.
Proj. No.: MDI-PR-0001-URP49 Project Type: GRANT
Agency ID: CSRS Period: 15 MAR 76 To 14 DEC 80

OBJECTIVES: Develop a method to maintain crabs under laboratory conditions for prolonged periods. Develop a simple and accurate method to measure activity rhythms. Determine the importance and effect of photoperiod, tidal cycle, temperature, salinity, age, sex and stage of reproductive and molt cycles on activity and movement. Study population structure and the distribution of *Cancer irroratus*. Determine the nutritional requirements of experimental animals.

APPROACH: Design and construct a recirculating, temperature-controlled activity testing facility. Design infrared photoelectric cell sensors, amplify signal, record and collect data. Measure activity rhythms under varying conditions of photoperiod, tidal cycle, temperature, salinity, age, sex, reproductive and molt cycles. Develop a high-protein pelletized diet and compare to other feeds that might

be used in commercial mariculture of crustacea. Analyze population structure utilizing catch data on size, sex ratio, and distribution in various local areas.

PROGRESS: 80/01 TO 80/12. In studies of the ecology and behavior of the common rock crab (*Cancer irroratus*) (Rebach, 1977, 1978) conducted in the laboratory, it was necessary to maintain 20 to 50 animals for periods in excess of one year. A pelletized diet developed by the principal investigator was compared to other diets fed to the crabs and resulted in greater weight gain, lower mortality and greater molt success in the laboratory. The high levels of calcium and phosphate may be a diet may contribute to molt success and survival. It has been hypothesized that the physical form and high water stability of the pellets were especially suited to benthic decapod crustaceans. The pellets can be stored in the laboratory for indefinite periods, are easy to handle and can be adapted to mechanical delivery systems.

PUBLICATIONS: 80/01 TO 80/12
REBACH, S. 1981. A Pelletized Diet for Captive Benthic Crustaceans. See Grant Publication UM-SG-IS-81-01. 8 pp.

001.060 CRIS0075621
ECOLOGY OF FISHES AND LIMNOLOGY OF UPPER GREAT LAKES AND TRIBUTARIES IN RELATION TO ENVIRONMENTAL IMPACTS

LISTON C R; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: MICH01312 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 78 To 30 JUN 83

OBJECTIVES: Understand the biology and ecology of fishes in near-shore waters of Lake Michigan near Ludington, Michigan, and in selected tributaries of Lake Michigan. Examine limnological aspects in these waters including temperature, water transparency, turbidity, dissolved oxygen, and benthos. Relate findings to impacts of resource utilization, and to agencies responsible for the management of important sport and commercial fish species.

APPROACH: Sample adult, juvenile, and larval fishes using standard gill nets, trawls, seivee, and meter nets during ice-free periods. Identify species and record total numbers and weights for each method. Record length, weight, sex and age for individuals of all species and determine food habits and fecundity for selected species. Determine limnological parameters at location of fish sampling sites.

PROGRESS: 80/01 TO 80/12. Studies continued in four areas: impacts on Lake Michigan fisheries from the Ludington Pumped Storage Power Plant; ecology of connecting waters between Lakes Superior and Huron (St. Mary's River) in relation to winter navigation; fish stock assessment in Whitefish Bay, Lake Superior; ecology of fish in the Red Cedar River. Losses of larval, juvenile, and adult fishes (mainly alewives, smelt, and salmonids) were greater at Ludington than for any other existing power plants on Lake Michigan. Regulatory agencies are now using results to determine a mitigation policy for Michigan. Forty-seven fish species use the St. Mary's River, and young of important sport fish depend upon aquatic plants in shallow water for food and protection. Shallow areas are most likely to be impacted from winter shipping. Adult fish were dominated by lake herring, yellow perch, smelt, northern pike, and white sucker. At least 18 species spawn successfully in the St. Mary's River. Commercial catches of whitefish in Whitefish Bay were comprised mainly of Ages V, VI, and VII fish. Average catch was 69.7 kg. Results are used by the U.S. Department of Interior to assess stock size.

PUBLICATIONS: 80/01 TO 80/12
LISTON, C.R., BRAZO, D.C., BOHR, J., LIGMAN, R., ONEAL, R. and PETERSON, G. 1980. Studies of Entrapment of Fish and Invertebrates, Turbine Mortalities, Netting and Hydroacoustic Surveys, and Water Currents at the Ludington Pumped

BOHR, J.R. 1980. Abundance, Distribution and Community Interactions of Demersal Fishes Inhabiting a new Pumped Storage Reservoir on Lake Michigan M.S. Thesis, Mich. State Univ. 62 pp.
LISTON, C.E., DUFFY, W., ASHCIN, D., MCNAEE, C. and Evaluation of the St. Mary's River KEEBLEE, F. 1980. Environmental Baseline and Evaluation of the St. Mary's River Dredging. Mich. State Univ. Dept. Fish Wildl., Rep to U.S. Fish. Wildl. Service. 295 pp.
PETERSON, G.P., ERAZO, D.C. and IISTIC, C.F. 1980. Food Habits of Predatory Fish in Lake Michigan Near the Tailrace of the Ludington Pumped Storage Power Plant. Mich. Acad. Sci., Arts, Letters. Vol. 10.

APPROACH: Test tissue fixation techniques to obtain higher quality photomicrographs and extend studies of the ultrastructure of the chroidal rete to species other than rainbow trout. Develop an assay for superoxide dismutase (SCD) in poikilothermic ocular tissues and investigate the influence of hypertaric oxygen on Na-K-Mg ATPase activity from retinal hcnogenates and determine the effect of altred respiratory perfusion on the maculamocular PO(2) generated in vivo and the critical PO(2) necessary to maintain the EsG of in vitro retinal preparations.

PROGRESS: 80/01 IC 80/12. The overall objectives for the total project are as follows: (a) identify cellular and metabolic sites of oxygen toxicity in the retina, (b) identify mechanisms of protection against oxygen toxicity, and (c) continue studies on the intraocular oxygen gradients in the teleost. A comparative study of the distribution of superoxide dismutase (SOD) as it relates to oxygen partial pressure and oxidative metabolism of retinal tissue will allow us to speculate on the importance of this enzyme in protection against oxygen toxicity. In order to correlate the Na-K-Mg ATPase and SCD data, precise intraretinal oxygen profiles will have to be determined. To further verify the role of SCD as a protective agent against C(2) toxicity studies on enzyme induction in retinal tissue following hyperbaric oxygen exposure will be undertaken. Photoinduced free radical formation has been implicated in cataractogenesis in some species. A comparative study of the effects of sunlight on lens function and metabolism will be undertaken, with specific emphasis on the role of superoxide free radicals. Recent evidence links organophosphate defoliants to lenticular dysfunction and other neuropathies. The exact nature and pharmacological mechanism of this toxicity is unknown and will be investigated.

PUBLICATIONS: 80/01 IC 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.061 CRIS0064874
ECOLOGICAL AND MANAGEMENT OF STREAM AND STREAM FISHES

WHITE E J; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: MICL01169 Project Type: EATCB
Agency ID: CSRS Period: 24 JAN 74 To 23 JAN 84

OBJECTIVES: Identify physical features of microhabitat for stream dwelling fishes, e.g. trout, salmon, smallmouth bass and various forage fishes. Test microhabitat selection by stream fishes. Analyze effects of channel morphometry and stream flow on carrying capacity and production of fish. Develop information on the relationship of habitat heterogeneity and biotic diversity in flowing water environments. Analyze and publish stream research data collected during the last 19 years.

APPROACH: Physical and biotic measurements will be conducted on natural streams. Artificial channels will be built and in them the results from natural streams tested under controlled conditions.

PROGRESS: 80/01 TO 80/12. In a study of competition between juvenile salmonids for stream microhabitat, we tested the relationship between water velocity differential (difference in velocity the fish faces and the greatest velocity within 60 cm) and body growth for coho salmon. The relation was linear. By modeling energy needs for maintaining position at various water velocities and energy available as invertebrate food at various surrounding water velocities, we found that abundance of drifting food affects position quality. Therefore, experiments to measure net energy gain were done separately for coho salmon and brown trout by comparing positions held by the fish in terms of water velocity differential, abundance of drifting food, and body growth. The results will provide a basis for three sets of ecological-release experiments involving pairs of species (coho-brown, coho-brook, brook-brown). In a study of the effects of suddenly and massively increasing instream cover for brook trout by felling brush into five 200m test sections in a stream, physical measurements showed channel narrowing of 11-35% (n=10 subsections), 5.8% avg increase in water depth, 25% avg increase in water velocity, and substantial scouring of sand off of streambed gravel. The effects on the trout population are being monitored. A study of effects of installing simple overhead covers on another trout stream is also being done.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.062 CRIS0076400
COMPARATIVE PHYSIOLOGICAL STUDIES OF VERTEBRATE EYES

BOFFERT J R; PHYSIOLOGY; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Agency ID: CSVMV-0012 Period: 01 DEC 77 To 30 NOV 82

OBJECTIVES: Provide an anatomical description of the teleost chroidal rete mirabile, to determine the influence of hyper- and hypobaric oxygen tensions on teleost retinas and investigate the regulation of the countercurrent multiplier, and investigate the phenomenon of oxygen toxicity.

001.063 CRIS0080081
ECOLOGY, POPULATION DYNAMICS AND MANAGEMENT OF MULTI-SPECIES FISH RESOURCES OF LARGE LAKES

SPANGLER G R; ENTOMOLOGY, FISHERIES & WILDLIFE; UNIVERSITY OF MINNESOTA, ST PAUL, MINNESOTA. 55108.
Proj. No.: MIN-17-077 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 79 To 30 SEP 82

OBJECTIVES: To develop an improved biological basis for the management of the fish communities of large lakes through an increased understanding of interspecific relationships; analysis of the role of fishery exploitation in the dynamics of fish communities; and use of simulation modeling to explore the impact of management measures on the structure and productivity of fish communities.

APPROACH: The response of lake whitefish to predation by sea lampreys will be estimated by analysis of stock dynamics prevailing during the years preceding and following lamprey control. The role of fishery exploitation will be examined with respect to its effects in competition with lamprey for available whitefish and as a singular force of mortality on smelt. Results of these studies will be synthesized into simulation models for the exploration of management strategies appropriate to multi-species fish communities.

PROGRESS: 80/01 TO 80/12. During 1980 the biological basis for management of lake whitefish (Coregonus clupeaformis) was examined with respect to stock discreteness in Canadian waters of Lake Huron. Data from tagging studies together with electrophoretic, morphometric and meristic data were analyzed to determine the utility of these approaches in defining stock discreteness. Recoveries of tagged fish indicated the existence of at least 11 stocks differing sufficiently in their population characteristics that yield to the fishery could be significantly influenced by stock-specific management. Electrophoretic analyses indicated that genetic differences between Lake Huron stocks were fewer than those detected between Lake Huron and

inland lake populations. Morphological characteristics were relatively insensitive indicators of stock discreteness. Estimates of the influence of lamprey predation on one of these stocks and a preliminary analysis of lamprey stock structure in the Great Lakes were published in 1980. An analysis of the effects of exploitation on smelt (*Osmerus moroax*) was initiated in 1980 with an examination of gillnet selectivity. Comparison of length distribution from graded mesh experimental nets indicated that mesh sizes greater than 38 cm. (stretched measure) were relatively unselective with respect to smelt size. Tabulation of historical data and verification of ages from scale samples will be completed in 1981.

PUBLICATIONS: 80/01 TO 80/12

- SPANGLER, G.R. and CCLINNS, J.J. 1980. Response of Lake Whitefish (*Coregonus clupeaformis*) to the Control of Sea Lamprey (*Petromyzon marinus*) in Lake Huron. Can. J. Fish. Aquat. Sci. 37(11):2039-2046.
- SPANGLER, G.R., SOBSCN, D.S and REGIER, H.A. 1980. Estimates of Lamprey-Induced Mortality in Lake Whitefish, *Coregonus clupeaformis*. Can. J. Fish. Aquat. Sci. 37(11):2146-2150.
- WALTERS, C.J., STEER, G. and SPANGLER, G. 1980. Responses of Lake Trout (*Salvelinus namaycush*) to Harvesting, Stocking, and Lamprey Reduction. Can. J. Fish. Aquat. Sci. 37(11):2133-2145.
- KRUEGER, C.C. 1980. Detection of Variability at Isozyme loci in Sea Lamprey, *Petromyzon marinus*. Can. J. Fish. Aquat. Sci. 37(11):1630-1634.

001.064

CRIS0075751

LIFE HISTORY AND POPULATION DYNAMICS OF TILEFISH, *LOPHOLATILUS CHAMAELEONTICUS*

GRIMES C; ABLE K; ENVIRONMENTAL RESOURCES; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ12403 Project Type: STATE
Agency ID: SAES Period: 01 MAR 78 To 30 JUN 83

OBJECTIVES: Develop the biological basis for management of the tilefish *Lopholatilus chamaeleonticeps*.

APPROACH: We will identify stocks and study life history of populations of the Middle Atlantic Bight and determine population dynamics. Specimens will be obtained from the New Jersey recreational and commercial fisheries and research cruises. Electrophoretic examination of eye, liver and muscle proteins and meristic and morphometric data will be used to delineate stocks. scales, otoliths, vertebrae and fin spines will be used for studies of age and growth. Length frequency data from the commercial fishery and derived age/length keys will be used to construct catch curves and estimate mortality rates. Catch and angler effort data for the New Jersey recreational fishery will be obtained from vessel operators. Gonad samples for studies of reproduction will be collected from the commercial and recreational fishery.

PROGRESS: 80/01 TO 80/12. We have completed the basic analysis of age and growth. The maximum age of females was 36 years for an 87 cm individual, while the oldest male was 28 years of age at 108 cm. The largest female was 95 cm at 29 years, and the largest male was 112 cm at 22 years. Growth of approximately 10 cm per year was observed for the first five years, after which it slowed. An investigation of most aspects of reproduction was initiated. Analysis of visual maturity staging, ovum diameter distributions and gonosomatic indices indicate that serial spawning occurs from May to October. Ova are matured (1.30 mm diameter) and released in several hatches per season; a typical (600 mm) female may release 1-2 million ova per year. Large numbers of small developing ova have been observed in the ovary after final spawning. Most females mature at 520-570 mm, while most males reach 620-710 mm before maturing. Sex distribution is skewed toward males at large size, apparently due to early maturation and subsequent slowing of growth by females, but sex ratio does not differ from 1:1 for the population. Predorsal adipose flap size becomes sexually dimorphic in adult fish, with mature males

developing enlarged flaps.

PUBLICATIONS: 80/01 TO 80/12

- KATZ, S.J., GRIMES, C.B. and ABLE, K.W. 1979. Identification of Tilefish Stocks, *Lopholatilus chamaeleonticeps*, Along the U.S. East Coast. Bull. New Jersey Acad. Sci. 24(2):99-100. (abstract).
- GRIMES, C.B., ABLE, K.W., TURNER, S.C. and KATZ, S.J. 1980. Tilefish and Their Coter Continental Shelf Habitat. Underwater Naturalist 12(4):34-39.

001.065

CRIS0079854

FEEDING ECOLOGY OF FISHES UTILIZING MARSHES ALTERED FOR CONTROL OF SALT MARSH MOSQUITOES

SHISLER J; MOSQUITO RES & CONTROL; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ40503 Project Type: STATE
Agency ID: SAES Period: 01 JUL 70 To 30 JUN 80

OBJECTIVES: To study the feeding ecology of salt marsh fishes with emphasis on their role as mosquito predators.

APPROACH: Survey of fishes utilizing salt marsh altered for mosquito control. Study the food habits of the dominant species as determined from the survey in order to determine the most effective mosquito predator. Identification of larval fishes which occur in mosquito breeding areas because these may be important predators on the early mosquito instars.

PROGRESS: 80/01 TO 80/12. Fish populations were sampled throughout the year in both natural marshes and marshes that have been altered for mosquito control. Fish species composition varied between study sites with a typical freshwater assemblage common at sites with freshwater or lower salinities and typical estuarine assemblage at high salinities. *Fundulus heteroclitus*, *F. luciae* and *Cyprinodon variegatus* were dominant estuarine fish while freshwater dominate species were *F. daphanus*, *Gambusia affinis*, *Lepomis gibbosus* and *Notemigonus crysoleucas*. Seasonal changes in both salinity and faunal populations were noted in impoundments.

PUBLICATIONS: 80/01 TO 80/12

- ABLE, K.W., SHISLER, J.K. and TALBOT, C.W. 1979. Preliminary Survey of Fishes Utilizing New Jersey Marshes Altered for Control of Salt Marsh Mosquitoes. Proc. N.J. Mosq. Control Assoc. 66:103-115.
- TALBOT, C.W., ABLE, K.W., SHISLER, J.K. and COOREY, D. 1980. Seasonal Variation in Composition of Fresh and Brackish Water Fishes of New Jersey Mosquito Control Impoundments. Proc. N.J. Mosq. Control Assoc. 67:50-63.

001.066

CRIS0078908

OVERBOARD DISPOSAL STUDY

BASKIN B B; DURAND J; OYSTER CULTURE; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ32501 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 82

OBJECTIVES: Determine the effects of overboard disposal of dredge spoil on the benthic macroinvertebrate community with particular emphasis on the hard clam, *Mercenaria mercenaria*.

APPROACH: In Ahsecon Creek, where channel dredging is required for navigation purposes, two study areas have been selected. Following an initial baseline study of both areas, one area has been partially covered by dredge spoil; the second has been held largely undisturbed as a control area. Follow-up studies will be centered largely on recolonization of the spoil area. At selected stations a minimum of 7 Peterson or ponar grabs will be taken and sieved. All +1 mm organisms will be sorted out, identified and counted to enable description of community structure, diversity and biomass. Complete sampling of all areas will be done quarterly. Experimental plantings of small clams before and periodically after dredging

will permit detailed studies of the effect of dredging on mollusks, growth and condition. Invertebrate data will be supplemented by water quality studies and geological studies designed to determine effects of dredging disturbance on nutrient releases from the bottom and stability of bottom as it affects survival and growth of clam.

PROGRESS: 80/01 TO 80/12. Overboard disposal of dredge spoil has resulted in a dramatic effect on benthic infaunal polychaetes. Water chemistry (nutrients), benthic nutrient cycling, sediment structure, and benthic invertebrate communities all were affected. Some effects were transitory. Effects upon nutrient regeneration from bottom sediments, structure of bottom sediments, and benthic invertebrates in the dredge spoil have persisted. The Control Site and the Dredged Channel Site showed marked differences in nutrient cycling and in the benthic invertebrate community following dredging. Both have since returned to pre-dredge levels. The Dredge Spoil Site remains in a disturbed condition with respect to the sediments, nutrient cycling, and the invertebrate community. Regeneration of ammonium-N from bottom muds is suppressed below the rates observed in the Control Site and in the Dredged Channel Site. Counts of benthic invertebrates remain high and the dominant organisms exhibit both wide fluctuations in numbers and higher counts than during the pre-dredge time. Species make-up at the Dredge Spoil Site is unstable. Different species have shown explosive growth in numbers at different times but not according to a particular sequence. At this time it is not possible to estimate when stability will be reached.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.067 CRIS0061951
A MULTI-INSTITUTIONAL APPROACH TO THE IDENTIFICATION OF BIVALVE LARVAE

LUTZ E A; OYSTER CULTURE; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ32401 Project Type: STATE
Agency ID: SAES Period: 01 MAY 80 To 30 JUN 81

OBJECTIVES: Publish a comprehensive scientific monograph/practical manual for the identification of bivalve larvae (through routine optical microscopic examination of the larval hinge apparatus) in estuaries and coastal marine waters of the North Atlantic.

APPROACH: Bivalve larvae will be reared in the laboratory. Specimens will be sacrificed daily during all stages of larval and early post-larval development. Detailed photographic sequences of larval hinge development will be prepared using optical and scanning electron microscopic techniques.

PROGRESS: 80/01 TO 80/12. Samples of bivalve larvae cultured under hatchery conditions have been obtained for the following species: the American oyster, *Crassostrea virginica*, the hard clam, *Mercenaria mercenaria*, the ocean quahog, *Arctica islandica*, and the ribbed mussel, *Geukensia demissa*. We are presently in the process of mounting these larval specimens on platforms for scanning electron microscopic examination. Complete photographic growth sequences of these are being assembled and will be included in the larval identification manual which we are proposing to prepare. A formal proposal entitled Identification of Bivalve Larvae: A Multi-Institutional Approach has been prepared and submitted to the Office of Sea Grant for funding commencing May 1, 1981. Cooperative efforts have been initiated with Dr. Roger Mann of Woods Hole Oceanographic Institution and Mr. Michael Castagna of the Virginia Institute of Marine Science. We are working closely with these individuals in our larval rearing work and will continue to obtain larval specimens of various species from their hatchery and laboratory culture operations.

PUBLICATIONS: 80/01 TO 80/12

JABLONSKI, D. and LUTZ, R.A. 1980. Molluscan Larval Shell Morphology: Ecological and Paleontological Applications. In: Skeletal Growth of Aquatic Organisms (Eds. Rhoads, D.C. and Lutz, R.A.). pp. 323-377. Plenum Press: New

001.068 CRIS0068014
AGE AND GROWTH OF FISH; A FIELD AND LABORATORY APPROACH

BROTHERS E B; ECOLOGY AND SYSTEMATICS SEC; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-163312 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 SEP 78

OBJECTIVES: Develop and refine an improved technique to analyze the growth history of larval and adult fish; and secondly apply this method in studies of the life history and population ecology of fish.

APPROACH: Examine the fine structure of fish otoliths; i.e. for daily growth increments. The approach will include a detailed study of the mechanics of otolith growth, using histological preparations, the scanning electron microscope, and chemical analysis. The second aspect of the project will compare results from natural populations and laboratory reared individuals maintained in a variety of photoperiod, thermal, and feeding regimes.

PROGRESS: 80/01 TO 80/12. Age and growth data derived from measurements of otolith microstructure have been applied in the following studies: Spawning and recruitment periodicity was studied in the french grunt (*Haemulon flavolineatum*) in St. Croix, U.S.V.I. Daily otolith ages of post-larval grunts revealed a distinct lunar periodicity for spawning and the early life history. These data are to be compared with detailed recruitment surveys carried out by Dr. William McFarland (Cornell Univ.) Age determination of newly recruiting sirago gobies (*Sicydium plumieri*) to Puerto Rican rivers has demonstrated spawning periodicity tightly synchronized with the occurrence of the full and new moon. Larvae spawned in the rivers then spend 50 to over 80 days at sea before mass migrating upstream (with Dr. Donald Erdman, Univ. of Puerto Rico). An age and growth study of Lake Ontario freshwater eels was completed with S. Pearse and new studies were initiated on Georgia eels (with Dr. Gene Helfman, Univ. of Georgia). Processing of tropical marine fish larvae and juveniles continued in ongoing studies of reproductive biology. Additional samples of larval and juvenile gag (*Mycteroperca microlepis*) were processed to complete data collection and analysis. A paper is in preparation describing the early growth, reproductive timing and juvenile ecology of this species (with D. Johnson, Institute of Marine Resources, and M. Leiby, Florida Dept. of Nat. Resources).

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.069 CRIS0069991
THE FINE STRUCTURE OF FISH OTOLITHS: ENDOGENOUS AND ENVIRONMENTAL FACTORS

BROTHERS E B; ECOLOGY AND SYSTEMATICS SEC; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-183409 Project Type: MATCH
Agency ID: CSRS Period: 10 MAR 76 To 30 SEP 80

OBJECTIVES: Examine the fine structure of fish otoliths, particularly for larvae and juveniles; determine the internal and external factors controlling the pattern of daily growth increment formation, and develop methods for collecting data on the early life history of fish by means of otolith examination. This combined laboratory and field approach will provide important insight into a critical aspect of fisheries management.

APPROACH: See Item No. 24.

PROGRESS: 80/01 TO 80/12. Studies of otolith microstructure have been applied in several studies of natural populations. These studies attempt to relate laboratory findings on the effects to endogenous factors, such as temperature, to observed otolith growth patterns. The data are analyzed to obtain information on small and large scale movements of the fish during their life history. Salmonid fishes from controlled flow, bottom-release reservoir fed rivers were examined to determine the effects of "unnatural" water temperature on these fishes. It was found that the human controlled temperature regime made a clear imprint on otolith microstructure, and that resident fishes versus those migratory from feeder streams could be distinguished. Otolith microstructure was examined for a series of tidepool populations of the three spine stickleback (*Gasterosteus aculeatus*) on Appledore Island, Maine. Temperature of these highly variable pools was monitored and initial laboratory work is attempting to correlate subdaily microstructure patterns between individual fish and with patterns of eeler warming and tidal inundation. Preliminary surveys of Pacific coast salmon (genus *Oncorhynchus*) is attempting to relate otolith microstructure to stock identification of natural and stocked fishes. Preliminary results have demonstrated our ability to determine time and age at stocking for silver salmon.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

001.070 CRIS0081838
APPLICATION OF OTOLITH MICROSTRUCTURAL DATA TO
STUDIES OF THE EARLY LIFE HISTORY OF FISHES

BROTHERS E B; ECOLOGY AND SYSTEMATICS SEC; CORNELL
UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-183416 Project Type: HATCH
Agency ID: CSWS Period: 01 JUL 80 To 30 SEP 83

OBJECTIVES: To analyze and determine the significance of subdaily growth increments in the otoliths of larval and juvenile fishes; to apply this knowledge to understanding the ecology and behavior of these early life stages; to describe and interpret the microstructural otolith patterns with respect to age, growth history, and timing of reproduction and recruitment in coral reef fishes.

APPROACH: Correlation of microscopic examination of otoliths with direct observation, environmental measurement, and laboratory manipulation of larval and juvenile fishes.

001.071 CRIS0068972
FUNCTIONAL MORPHOLOGY OF INVERTEBRATE ORGAN SYSTEMS

ANDERSON J M; FACTOR J R; GENETICS DEV AND PHYSIOL
SEC; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-185315 Project Type: STATE
Agency ID: SAES Period: 01 OCT 75 To 30 SEP 79

OBJECTIVES: Elucidation of the relationship of structure to function in various organ-systems of selected invertebrate animals; supply structural details basic to an understanding of fundamental biological processes in poorly-studied groups.

APPROACH: Anatomical, histological, and electron microscopical techniques are applied as appropriate in moving from the gross, through the microscopical, to the ultrastructural level, and structural details so revealed are correlated with functional aspects where these are known. Subjects in which such an approach has been used include feeding and digestion in several species of seastars (asteroidea), and the reproductive system in several other asteroids; a further current project involves study of progressive changes in feeding and digestive organs through several successive early larval stages of lobsters.

PROGRESS: 79/01 TO 79/09. See star digestive systems: This study involved an examination of functional anatomy in the digestive system of the large tropical sea-star *Cresaster reticulatus*, not previously studied from this standpoint. The gross structure of all the component organs was described in detail and compared with that of other species in related families. The general features suggest adaptation to a variety of feeding techniques, including collection of suspended particulate matter as well as extra- and intra-corporeal digestion of macroscopic food. Histological and histochemical studies concentrating on characteristics of the lining epithelium in all parts other than the cardiac stomach revealed specific, consistent patterns in the distribution of various types of secretory cells that tended to confirm functional conclusions based on comparative studies of gross morphology. Larval lobsters. Detailed studies, involving light and scanning electron microscopy, produced a painstaking description of change in the mouth-parts of the 1st 4 stages of *Borarrus americanus*. Structural changes in these external feeding appendages, especially alterations in the types and distribution of the several types of setae, could in general be seen as correlated with change in habitat and types of food during development from stage to stage.

PUBLICATIONS: 79/01 TO 79/09

ANDERSON, J. M. 1978. Histological studies on the pyloric stomach and its appendages in *Cresaster reticulatus* (L) (Asteroidea). Biol. Bull. 156: 1-19.

FACTOR, J.R. 1978. Preliminary report on the development of the digestive system in larval lobsters, *Borarrus americanus*. Amer. Zool., 18: 586 (Abstract).

001.072 CRIS0076313
ANTIBACTERIAL MECHANISMS IN CLAMS; CONTRIBUTION OF THE
WATER STREAM

TIMONEY J F; MICROBIOLOGY; CORNELL UNIVERSITY,
ITHACA, NEW YORK. 14853.
Proj. No.: NYC-433379 Project Type: STATE
Agency ID: SAES Period: 01 JAN 78 To 31 DEC 80

OBJECTIVES: Determine the rate of removal in the water stream of *Salmonella typhimurium*, *Shigella flexneri*, *Escherichia coli*, and *Vibrio parahaemolyticus* from hard clams. Examine the binding properties of clam mucus for these test bacteria.

APPROACH: Clams will be exposed to the test bacteria for one hour and then removed for u/v irradiation of their outer surfaces to inactivate bacteria on their shells. The clams will then be placed in a model depuration tank which is designed for removal of all bacteria from the water. The rate of disappearance of the test organisms from the clam tissues will then be measured by timed samplings of randomly chosen clams. Mucus will be collected using a suitable irritant. The homogenized mucus will then be mixed with the test bacteria incubated at 20C and timed samples taken and centrifuged. Bacterial counts will be performed on the supernatant and sediment.

PROGRESS: 79/01 TO 80/12. The uptake and clearance of *Salmonella typhimurium* and *Escherichia coli* by actively siphoning clams was studied. The following conclusions are possible from the experiments performed. Enteric bacteria are rapidly concentrated 100X within actively siphoning clams. Accumulated bacteria are then rapidly cleared. Counts of bacteria are reduced 1,000X within 8 hours. A further 10X reduction occurs by 24 hours. Bacteria are cleared in the form of mucus-fecal aggregates which rapidly sediment in the water. Very few free bacteria are released. Clams which are prevented from siphoning do not clear themselves of bacteria within 24 hours. Ionic phenomena are not important in binding of bacteria to mucus-fecal aggregates.

PUBLICATIONS: 79/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

001.073

CRIS0077773

ECOLOGICAL AND MANAGEMENT OF WALLEYE

FORNEY J L; NATURAL RESOURCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.

Proj. No.: NYC-147331 Project Type: STATE Agency ID: SAES Period: 30 MAR 79 To 30 SEP 92

OBJECTIVES: Define the role of interspecific competition and predation in governing walleye recruitment from an analysis of fish community structures.

APPROACH: Reproductive success of walleye as measured by abundance of young and age composition of the population will be compared with size distribution and species composition of fish communities in a wide spectrum of lakes. Information on community structure will be gathered primarily from the catch in gillnets and trawls. More specific information on the nature of interspecific competition and predation will be generated by following the fate of larval and fingerling walleye stocked in lakes with different densities and assemblages of potential predators or competitors. Role of walleye in restructuring fish communities will be assessed from pre- and post-surveys of lakes where walleye populations are established by stocking.

PROGRESS: 80/01 TO 80/12. Beginning with a strong year-class in 1962, the walleye population in Chautauqua Lake, New York expanded from an occasional adult to over 50,000 mature fish in 1979. Analysis of scale samples, tagging records and other data showed that recruitment stabilized while growth and survival of walleye declined during the period of population expansion. Recruitment was initially highly variable with three year classes contributing 91% of the adult stock from 1962-1973, but subsequent cohorts were more uniform in size. Average length of a 5-year old male decreased from 515 mm in 1966-1973 to 436 mm in 1980 while adult survival declined from near 100% to about 70%. As walleye stocks expanded numbers of adult muskellunge decreased in the 1970s to about one-fourth the levels which prevailed in earlier years. The timing of events suggests the increase in walleye may have contributed to the collapse of muskellunge but analysis of historical data did not reveal any evidence of direct interactions. Reduced growth and survival may limit further expansion of walleye stock and favor development of a new equilibrium with muskellunge.

PUBLICATIONS: 80/01 TO 80/12 NO PUBLICATIONS REPORTED THIS PERIOD.

001.074

CRIS0062657

INTRODUCTION OF WALLEYE AND NORLUNGE FINGERLINGS INTO A LAKE DOMINATED BY PREY SPECIES

YOUNGS W D; GREEN D M; NATURAL RESOURCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.

Proj. No.: NYC-147310 Project Type: STATE Agency ID: SAES Period: 01 APR 78 To 31 MAR 78

OBJECTIVES: Determine survival and growth of walleye and norlunge (northern pike X muskellunge) fingerlings stocked in a lake dominated by prey species. Measure abundance of yellow perch and other prey species. Measure effect of walleye and norlunge populations on angling effort, catch and traits. Determine the suitability of stocking these fingerlings in other New York waters with similar predator-prey composition.

APPROACH: Stock fingerling walleye and norlunge for 4 falls. Determine survival by population estimates in successive years. Determine growth by periodic capture of fish. Base prey species abundance on gill net indices compared to indices for 1972-76. Determine fishing effort, catch and angler trait changes by creel census, compared to 1973-76 census results.

PROGRESS: 79/01 TO 79/03. Project discontinued. Probably will be reinstated in 1981. Canadarago Lake has been stocked with walleye and tiger musky (northern pike X muskellunge) fingerlings each fall

since 1977. In 1977 to 3000 walleye, mean size 93mm and 5.8g, were stocked. Mean size of survivors was 250mm and 131g in Fall 1978 and 365mm and 474g in Fall 1979. Survival to Fall 1978 was 13.5% (10.7-19.3%). A preliminary estimate of survival from fall 1978 to Fall 1979 was 70%. Survival of fingerlings raised on an artificial diet in hatchery troughs (101mm and 8.2g at stocking) was similar to pond raised fish. One male stocked in 1977 was mature in Spring 1979. Survival of 7025 fingerlings (raised on artificial diet) stocked in 1978 (78mm, 3.9g) to Fall 1979 was 0-1%. In late July 1979, 7255 pond raised fish (74mm, 2.6g) and in Sept. 1979, 3735 artificial diet fish (86mm, 6.7g) were stocked. Recaptures of both of these groups in the fall was higher than in 1977 and 1978 (0.99/hr. and 0.36/hr., respectively, vs 0.02/hr. in 1978 and 0.38/hr. in 1977). In 1977 12500 tiger musky fingerlings were stocked (179mm, 27g). Mean size of survivors was 422mm and 400g in Fall 1978 and 620mm and 1394g in Fall 1979. Survival to Fall 1978 was 18% (11.1-100%). A preliminary estimate of survival from 1978 to 1979 was 50%. Survival of the 12500 stocked in 1978 (173mm, 26g) was on the order of 5% and they had grown 395mm and 287g.

PUBLICATIONS: 79/01 TO 79/03

BARR, T.E., FUHS, G.W., GREEN, D.M., BETTING, I.J., SMITH, S.B. and ALLEN, S.F. 1980. Limnology of Canadarago Lake. In: Bloomfield, J. A. (ed.). Lakes of New York State. Vol. III. Ecology of the Lakes of East-Central New York State.

001.075

CRIS0072691

POPULATION DYNAMICS OF LARGEMOUTH AND SMALLMOUTH BASS IN 16 NEW YORK LAKES

YOUNGS W D; GREEN D M; NATURAL RESOURCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.

Proj. No.: NYC-147324 Project Type: STATE Agency ID: SAES Period: 01 APR 77 To 31 MAR 82

OBJECTIVES: Determine growth, survival, population size and exploitation of bass in 16 New York lakes. Develop models to assess impact of present and potential fishing mortality and effectiveness of current management techniques on bass populations in the study lakes. Determine differential growth, survival and retention of mandible ring and disk dangler tags on bass in Canadarago Lake.

APPROACH: Study lakes will be electrofished in May. Bass collected will be processed for age and growth data and will be tagged. Trained volunteer anglers will maintain diaries relating fish caught and released as well as tag recaptures. Population statistics will be derived from both sources of data.

PROGRESS: 80/01 TO 80/12. The third and final year of the collection of data by diary cooperators and by standard fishery sampling methods was completed in fall 1980. Data analysis and report preparation is expected to be completed late in 1982. Population estimates have been made for several of the study waters during 2 - 3 successive years. Population size of bass is greater than or equal to 254 mm has been variable in some lakes, with increases of 3 to 14 fold occurring in 1 year. Electro-fishing recaptures of bass tagged and released following capture by angling (artificial lures only) and those tagged and released following capture by electrofishing, were compared. There were 103 smallmouth and 35 largemouth bass tagged after angling capture and 442 smallmouth and 111 largemouth tagged after capture by electrofishing. There was no significant difference in the recapture rate of bass originally captured by the two methods suggesting that anglers released bass do not suffer increased mortality due to being hooked and released. Actual participation by anglers volunteering to maintain diaries has been constant over 3 years (48 - 54%). Response rate (number of volunteers accounted for) at the end of the season increased to 70% compared to 66% in 1977 and 1978.

PUBLICATIONS: 80/01 TO 80/12

GREEN, D.M. and SCHONBOFF, B.J. 1980. Population Dynamics of Largemouth and Smallmouth Bass in New York Waters. New York Federal Aid Project F-35-R-3 (Annual Performance Report). N.Y.S. Dept. Environ. Cons., Albany, N.Y. 46 pp.

001.076 CRIS00E3084
NEUROTRANSMITTERS, NEUROMODULATORS, AND LOCOMOTION

HARRIS-WARRICK R M; NEUROBIOLOGY & BEHAVIOR; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-191410 Project Type: HATCH
Agency ID: CSRS Period: 01 NOV 80 To 30 SEP 83

OBJECTIVES: To study the roles of biogenic amines as long-term modulators of neuronal activity controlling posture and movement in the lobster, *Homarus americanus*, and the sea lamprey, *Petromyzon marinus*.

APPROACH: The biochemical events that occur in the central nervous system to direct or modify ongoing behavior are largely unknown. We have shown that two biogenic amines, octopamine and serotonin, appear to act as long-term modulators of central nervous activity controlling posture in the lobster. Using electrophysiological and biochemical approaches, we will study the detailed effects of these compounds on the activity and synaptic interactions of single identified neurons in the lobster CNS in an attempt to determine the molecular mechanisms of modulation of neural activity. We will seek similar effects of biogenic amines in the lamprey to see if these amines affect motor output in vertebrates (and perhaps man) as well as invertebrates.

001.077 CRIS0080411
VISUAL PIGMENT CHANGES DURING THE LIFE CYCLE OF THE AMERICAN EEL, *ANGUILLA DOSTRATA*

LOEW E R; PHYSIOLOGY; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-195401 Project Type: HATCH
Agency ID: CSRS Period: 16 OCT 79 To 30 SEP 82

OBJECTIVES: Chromophore and opsin "type" will be ascertained for upstream, downstream migrant and resident eels, using the technique of microspectrophotometry (MSP). This allows direct examination of cones. The visual pigment composition for a given animal will be correlated with its age and other parameters such as color and eye diameter/body length. Since the visual pigment in other migrating species appear to "pre-adapt" them for their future environment, it may be possible to predict when and if a particular eel will migrate. These data will be correlated to those obtained for the European eel perhaps shedding some light on the question of speciation in eels.

APPROACH: All analyses will be made using techniques standard to MSP. Exact visual pigment composition will be determined using two techniques. The first is by partial bleaching and the second is to bleach all pigment and regenerate new visual pigment using pure A1 and A2. Animals will be obtained in several ways. The first is to seine them personally during migration. Alternately, they will be obtained from "commercial sources". The last source will be from Prof. E. Brothers (CU). Correlations with European eel data will be made via an already ongoing collaboration with Dr. J. Lythgoe (U. Bristol). Any study involving eyes of a species that undergoes dramatic physical changes during its life cycle demands backup histology to confirm the photoreceptor types present and their distribution within the retina. Little is known of retinal changes during metamorphosis.

001.078 CRIS0076699
AN INVESTIGATION OF THE ADAPTIVE SIGNIFICANCE OF MELANISM IN THE MALE MOSQUITOFISH, *GAMBUSIA AFFINIS*

MARTIN R G; BIOLOGY; AGRIC & TECH UNIVERSITY OF N C, GREENSBORO, NORTH CAROLINA. 27412.
Proj. No.: NC.X-003-5-79-221-1 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 78 To 30 SEP 81

OBJECTIVES: Determine the following aspects of melanism in male mosquitofish: The mechanism of inheritance, competition with normal males for some resource or resources, vulnerability to predation compared with normal males, frequency of mating success compared with normal males.

APPROACH: For the 4 areas of investigation, the following approaches will be used: Mechanism of inheritance -- mating experiments; large scale collections from known sites, competition -- genetic size differences, competition for food, and competition for space experiments, predation -- predator preference in the laboratory, microhabitat investigation in the field, sexual selection -- examination of female urogenital tracts for the presence of sperm.

PROGRESS: 80/03 TO 81/02. This year we completed analyzing the length and weight of melanistic male mosquitofish compared to normal male mosquitofish from a large scale fish collection conducted on a Central Florida lake in the mid 1970's. The results showed conclusively that the average length of melanistic males was greater than that of normal males (23.3 vs 19.4 mm), and their average weight was also greater (202 mg. vs 135 mg.). Also analyzed were the results of a mating preference study, in which it was concluded that female mosquitofish do not demonstrate a mating preference for either melanistic or normal males when given a 50:50 choice regardless of whether or not a female had previous exposure to melanistic males. Finally, analyzed were the results of a breeding program between normal females and melanistic males, and discovered that in seven separate matings, 54 percent of the adult male offspring turned out to be melanistic. The appearance of the pattern of melanism in these males did not occur until the onset of sexual maturity. Also, only 9.67 percent of the F(1) generation adults were females, a rather serious sex ratio imbalance in these matings. In summary, although we still are not close to an answer to whatever the adaptive value of melanism might be in male mosquitofish. Progress has been made in laying the groundwork to be able to arrive at an answer.

PUBLICATIONS: 80/03 TO 81/02

MARTIN, E.G. 1980. Evidence Against Sexual Selection as a Factor in Maintaining Two Male Color Morphs in Populations of Mosquitofish, *Gambusia affinis holbrooki*. Bull. Ecol. Soc. America 61:80. (Abst.)

MARTIN, E.G. and BONNER, M.J. 1980. The Proportion of Melanic Male Offspring Born to Melanic Male X Normal Female Mosquitofish, *Gambusia affinis holbrooki*. Abst. Papers Third Biennial Research Symp., Atlanta, GA. 1980. (Abst.)

001.079 CRIS0073629
ESTUARINE INVERTEBRATE BEHAVIOR; AN INDEX OF SUBACUTE TOXICITY OF AQUATIC HERBICIDES

BARTHALMUS G T; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05397 Project Type: STATE
Agency ID: SAES Period: 15 JUN 77 To 31 DEC 78

OBJECTIVES: Determine the chronic, subacute behavioral effects of 2,4-D herbicide on grass shrimp, *Palaemonetes pugio* Hclthuis; to explore the feasibility of assessing xenobiotic-induced behavioral dysfunctions of aquatic vertebrates and invertebrates by application of behavioral toxicology techniques.

APPROACH: Dosages of 2,4-D which produce no lethality or locomotor dysfunction for 7 days following a 3 day post-collection period will be determined for adults and larvae. Then, the phototactic behavioral reflexes of dark adapted and dosed shrimp will be tested daily in compartmentalized chambers illuminated by a horizontally directed, intensity controlled monochromatic light stimulus with a duration of 5s at 15s intervals for 5 replications. Shrimp in the compartment nearest the light will be designated photo-positive. Swimming speeds of larvae will be determined in Petri dishes by measuring distances traveled per unit time.

PROGRESS: 77/07 TO 78/12. The effect on adult females, three larval stages, and eggs of the grass shrimp, Palaemonetes pugio, exposed to subacute doses of the herbicide Weedar-64 (registered trademark) (Am. Chem., Inc.), containing 49.3% of the dimethylamine salt of 2,4-dichlorophenoxyacetic acid, was tested. Auxiliary ingredients, mainly water, were assumed to be non-toxic. Alteration of phototaxis was chosen as the indicator of an effect on adults and larvae; eggs were examined for percent hatch. Photoactive patterns of larvae and adults receiving 100 ppm Weedar-64 daily were recorded for 12 days. Positive phototaxis was reduced by 2,4-D in all three larval stages tested. Sensitivity varied with developmental stage (stage 1 was most sensitive). Stage 1 larval responses were altered more by 2,4-d exposure than by aging, but for stages 3 and 7, larval ages influenced phototaxis more than doses. Adults were unaffected. The doses tested did not affect the hatching of eggs.

PUBLICATIONS: 77/07 TO 78/12

MOYER, C.A.J. 1978. Effect of the herbicide 2,4-d on the phototactic response of the grass shrimp, Palaemonetes pugio. M. S. Thesis. N. C. State University, Raleigh. 33 p.

001.080

CRIS0075631

POSSIBLE CAUSES OF BLUEGILL LEPCNIS MAECOCIRUS DEFORMITIES

DEMONT D J; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NCC5447 Project Type: STATE
Agency ID: SAES Period: 01 JUN 79 TO 31 MAR 80

OBJECTIVES: Examine temperature shock, genetics, and water quality as possible causes of deformities in bluegill sunfish in Lake Robinson, S. C.

APPROACH: Fish will be spawned in the laboratory and the eggs and larvae will be subjected to temperature shock at five stages in development. Tests will be conducted using parental stock from Lake Robinson and another source to detect genetic effects. Lake Robinson water and water from another source will be used in duplicate tests to crudely assess the effects of water quality.

PROGRESS: 79/06 TO 80/03. Work commenced on this project in July after authorization was received. Bluegills chosen from among those which seemed to be approaching spawning condition were stocked into 8 foot diameter fiberglass ponds for "natural spawning." The fish fed poorly and no spawning activity was observed through mid-September. Attempts to strip and fertilize bluegill eggs in the laboratory were also unsuccessful. Even with the injections of Human Chorionic Gonadotropin used late in the summer, eggs obtained were rarely fully developed. Those few eggs which began development died within 24-30 hours. I concluded in early September that further attempts to induce spawning in 1979 were futile and halted work and further spending on the project. This action was communicated to Carolina Power and Light Company officials in a meeting on the 19th of September, 1979. The project will be revised and extended before March 31, 1980 or will be terminated with remaining monies reverting back to Carolina Power and Light Company as per our contractual agreement.

PUBLICATIONS: 79/06 TO 80/03
NO PUBLICATIONS REPORTED THIS PERIOD.

001.081

CRIS0069601

THE STATUS, ABUNDANCE, AND YIELD OF THE STRIPED BASS IN THE ROANOKE RIVER, NORTH CAROLINA

BASSLER W W; BILL N I; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05352 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 TO 30 JUN 79

OBJECTIVES: Delineate the status, abundance, and the ecological factors essential to the perpetuation of the Striped Bass population in the Roanoke River.

APPROACH: Before the bass migrate upstream a creel census will provide a base for analysis of subsequent censuses taken as the bass move upstream. In the spawning area (Halifax, N. C.) counts of eggs will provide estimates of productivity. Measurement of rate of flow, extent of turbidity, temperature and other factors will indicate factors essential to perpetuation.

PROGRESS: 75/07 TO 79/06. The commercial catch of striped bass in the Roanoke River from 1975-79 was 19,989; 7,156; 10,465; 16,253; and 10,000 fish respectively. Anchor gill nets were the most successful commercial gear used. The striped bass sport catch for 1975-79 was 22,219; 40,799; 32,983; 28,016; and 25,419 fish respectively. The CUE for these years was 3.61, 4.00, 3.27, 2.76, and 3.25 striped bass/boat. Tagging was conducted on striped bass from 1976-79. The exploitation rates were 22.73, 13.47, 21.24, and 13.0% respectively. Trawling in the Albemarle Sound nursery area (1975-79) resulted in catch/haul of 10.80, 10.52, 3.63, 0.59, and 0.55 young-of-year striped bass. Reduced catches in 1978 and 1979 were associated with high river discharge flows during the spawning season. Estimates of striped bass egg production for 1975-79 were 2.19, 1.5, 1.76, 1.69, and 1.61 billion eggs respectively. The annual estimated striped bass spawning population was 3.27, 2.78, 3.48, 3.54, and 3.43 x 10⁵ respectively. In 1978 trawling studies in the lower Roanoke River resulted in the collection of 14,309 fish of which white perch was the dominant species.

PUBLICATIONS: 75/07 TO 79/06
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD

001.082

CRIS0073509

LIMNOLOGY OF FARM PONDS

MILLER J M; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC03556 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 77 TO 30 SEP 80

OBJECTIVES: Determine the important factors controlling quality and quantity of fish production in N.C. farm ponds. Develop a capability to diagnose and recommend treatment for various pond problems - fish disease, fish die-off, nuisance weeds, etc. Collaborate with others as necessary in publishing and revising guidelines for farm pond management as Ag. Extension Bulletins.

APPROACH: During the first year, determine the ranges of farm pond types in North Carolina and their important physico-chemical and biological factors influencing fish production. Begin intensive studies to determine the relationships between the above and fish production and pond "problems." This will include experimental manipulations in small enclosures in some ponds, food chain studies and a survey of fish parasites. Follow-up studies of fish stockings by the State will be performed.

PROGRESS: 77/07 TO 80/09. Ranks of the primary productivities of 3 study ponds in the Raleigh area were: L-26; Yates and A-2. Zooplankton was highest in Yates, while benthos was highest in L-6. Competition, measured as dietary overlap between size classes of fish, was highest in A-2, and least in L-6.

Competition was most severe in mid-summer, suggesting growth depression. Turbidity depressed feeding rates of bluegill sunfish 50% but did not cause a shift in preferred prey size. Perceptual bias was not responsible for the size selection of prey; rather a hypothesis of behavioral preference was supported. Data collected from previous years was assembled as a basis for submitting a proposal to OWRT entitled "Effects of Low-Level Turbidity on Fishes". This proposal was accepted and a grant of \$126,108 was awarded 1 October 1979. A technique using radioactive glycine uptake by fish gill tissue was developed to determine short-term growth rates of fishes in relation to turbidity. A method was developed to separate the effects of biotic and abiotic particles on turbidity. A precipitation technique for manipulating turbidity in ponds was developed. A 50 channel, computer interfaced, scanner was purchased to continuously monitor relative humidity, water and air temperature, oxygen, wind speed and direction and light.

PUBLICATIONS: 77/07 TO 80/09

GARDNER, M.E. 1979. The Effects of Turbidity on Feeding Rates and Prey-Size Selection by the Bluegill Sunfish (*Lepomis macrochirus*): a Test of a Foraging-Strategy Hypothesis. M.S. Thesis. Dept. of Zoology, NCSU.

001.083 **CFIS0078749**
ECOLOGY OF JUVENILE FISHES IN NC ESTUARIES

MILLER J M; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05435 Project Type: STATE
Agency ID: SAES Period: 01 JAN 79 To 30 JUN 81

OBJECTIVES: To estimate the seasonal abundance of juvenile sciaenid fishes in the Pamlico River estuary. To relate their distribution to certain environmental factors such as depth and vegetation. To determine their food habits, local availability of these food items, and rate of consumption.

APPROACH: Sample juvenile fishes and their food approximately biweekly in the Pamlico River estuary in relation to major habitat features. Perform analyses of these data and data from the Department of Natural Resources and Community Development to determine the critical features of nursery areas.

PROGRESS: 79/01 TO 81/06. Juvenile fish populations were sampled in Rose Bay, N.C., for a period of two years. They enter the estuary as post-larvae in December and January and grow there for about 8 months before migrating off shore as adults. During this nursery period they eat mainly zooplankton, clam siphons, polychaete worms, as well as a number of invertebrate organisms. Sampling showed reduced abundance in areas subject to salinity depression and variation due to freshwater runoff through canals. Spot and croaker are more or less ubiquitous in Rose Bay, while other species, e.g., speckled trout, red drum and silver perch are more restricted to submerged grass beds. There was much dietary overlap among species suggesting the possibility of food competition. Growth rates and mortality schedules are being analyzed now to test this hypothesis. Spot and croaker, the two dominant species, are segregated on the habitat axes of salinity and temperature. Spot have a higher optimum temperature than croaker which is reflected in a higher growth rate for croaker in early Spring and a higher growth rate for spot in summer. The high abundance of food and low mortality rates suggest that the major limiting factors to these juvenile fish populations are reduced habitats owing to salinity variability and the lack of abundance of submerged vegetation. Four Master's theses and one Ph.D. dissertation are in progress on the project.

PUBLICATIONS: 79/01 TO 81/06

MILLER, J.M. and DUNN, M.L. 1980. Feeding strategies and patterns of movement in juvenile estuarine fishes. In V.S. Kennedy, Ed. Estuarine Perspectives Academic Press, N.Y. 533 p.

001.084 **CRIS0077002**
USE OF BENTHIC MACROINVERTEBRATES IN N. C. FISHERY MANAGEMENT AND WATER QUALITY ASSESSMENT

MOZLEY S C; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC03632 Project Type: BATCH
Agency ID: CSSES Period: 01 NOV 78 To 31 DEC 81

OBJECTIVES: Determine the control exerted by predatory midge larvae (Chaoborus) over zooplankton in N.C. ponds, and develop a taxonomic key to N.C. Chironomidae larvae with a supporting reference collection.

APPROACH: The distribution, seasonal cycles and feeding habits of Chaoborus in campus ponds will be determined. Experimental variation of Chaoborus and food densities will be used to test for controlling ability. Specimens of Chironomidae submitted by state agencies and industry will be used to revise and newly illustrate older keys which were written for other geographical regions.

PROGRESS: 78/07 TO 81/06. One general objective of this project was to document species composition, timing of the life cycle, seasonal population fluctuations, depth distribution, production and migratory behavior for Chaoborus (Diptera, Chaoboridae) in Yates Pond. Two species were found in Yates Pond, *C. punctipennis* and an undescribed, smaller one. Both probably pass through two or more generations per year. Fall population densities increase steeply with depth, reflecting the refuge from predatory fish offered by anoxic deep waters. Usually, less than 10% of all Chaoborus were floating above bottom during the day, but a consistent 90% moved out of the sediments at night. Chaoborus was most abundant when anoxic water was present in summer and fall, but decreased an order of magnitude in winter and spring. Incomplete studies include production, feeding habits and the ecological role of Chaoborus in structuring zooplankton communities. The other project objective was to produce a taxonomic key to Chironomidae (Diptera) larvae for North Carolina, a diverse group useful as biological indicators of water quality. A key to the subfamily Orthocladinae was devised, covering 65 northern-hemisphere genera. Representatives of 41 genera (7 undescribed) were found in collections from the state's streams and rivers, and another 10 genera are expected to show up in further collections. The key greatly increased the capability of water quality biologists to identify stream fauna.

PUBLICATIONS: 78/07 TO 81/06

MOZLEY, S.C. 1980. Biological Indicators of Water Quality in North Carolina. I. Guide to Generic Identification of Orthocladine Chironomidae (Diptera). Report to the North Carolina Department of Natural Resources and Community

001.085 **CRIS0073132**
THE EFFECTS OF ARTIFICIAL STRUCTURES OF GAME FISH IN A BOREW PIT POND

JOHNSON D L; LARSON E; FISHERIES & WILDLIFE; CHIO AGRIC RES AND DEVL P CENTER, W COSTER, CHIO. 44681.
Proj. No.: OH000609 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 77 To 30 SEP 80

OBJECTIVES: Develop and evaluate a new device called a pop net for sampling various types of artificial cover. Also to chronicle the development of the airwuchs and fish communities associated with both tire and stake structures at various depths. Also to determine the use made by various species and sizes of game fish.

APPROACH: Construct 12 reefs about 25 meters long each made up of 5 separate units each about 1.5 meters high. The reefs will extend into the lake from the north shore. Six of those reefs will be made up of tire structures and the other six of verticle stake beds. Half of the tire reefs will be kept food-free with bi-weekly scrubbing while the remaining reefs will develop attached communities normally. A new net device, SCUEA, and angling will

all be used to evaluate the effect of depth, cover type, and food availability on fish community development and fish behavior.

PROGRESS: 77/01 TO 80/09. The pop net has been developed to sample artificial structure. The floor of the cylindrical, open-ended net is placed on the lake bottom, the 4 m diameter circular wall collapsed, and secured around the floor's perimeter. Structure to be sampled is placed on the net floor. The net released mechanism is triggered remotely. The net wall with floats rises, enclosing the structure and associated fish. Eighteen tests were conducted in clear water to determine pop net efficiency. Escapement rates were 0.5% and 2.1% respectively for bluegills (*Lepomis macrochirus*) 75-130 mm and large-mouth bass (*Micropterus salmoides*) 180-230 mm in total length. No bluegill greater than 160 mm and bass greater than 315 mm escaped. A total of 671 fish were susceptible to capture. Of these, 4 escaped resulting in a net efficiency of 99.4%. Initial examination of data suggests that number of bluegill captured, regardless of size, is inverse to the percentage of small bass associated with structure. Also, number of small bass captured is inverse to the percentage of small bluegill associated with structure. An inverse relationship is also suggested for water temperature and the percentages of small bluegill and all fish associated with structure.

PUBLICATIONS: 77/01 TO 80/09

NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

001.086

CRIS0072485

POTENTIAL HARVEST OF LAKE ERIE WHITE CRAPPIE FROM AN ADJOINING BORROW PIT

TRIFLETT J R; LECKIE F D; FISHERIES & WILDLIFE; OHIO AGRIC RES AND DEVELP CENTER, WCOSTER, OHIO. 44691.
Proj. No.: ORO00258 Project Type: STATE
Agency ID: SAES Period: 01 JAN 77 To 31 MAR 79

OBJECTIVES: Determine the potential for increasing accessibility and harvest of fish populations, particularly white crappie, from large bodies of water through fisheries in small adjoined bodies of water.

APPROACH: The study area will be mapped. Basic limnological parameters will be monitored in the borrow pit and the immediate bay area to detect differences or potential limiting factors. Mark and recapture studies, sonar scans, test netting and electrofishing will provide an estimate of migration into and out of the immediate bay area and the borrow pit. Fishing pressure and total harvest in both areas will be estimated by creel surveys. The populations structure of white crappie will be determined and compared in both areas from fish sampling data. Management recommendations will be developed on the basis of the significance of migrations and possible causes.

PROGRESS: 77/01 TO 79/03. In 552 hours of sampling, a total of 838 adult fish (18 species) moved through a culvert connecting a borrow pit with Sandusky Bay. Of these, 506 (53.8%) were moving from the Bay into the borrow pit. White crappie (6.3%) and black crappie (4.1%) together represented a greater percentage of the total catch than all other species except gizzard shad and brown bullheads. Culvert current direction regulated the direction of fish movements; of 755 movements during discernible flow, 82.9% were counter current. Spawning activity appeared to determine which species, what size, and when movements occurred. In the borrow pit, larger, older fish of both crappie species were prevalent in the spring inshore trap sets, culvert movements, and the fishermen's creel, while smaller crappie (150mm or less) were abundant offshore and dominated the summer fish collections. Black crappie consistently showed up earlier than did white crappie in all sampling methods. This difference in the timing of seasonal activities between the two indicated that black crappie are active earlier in the spring, and suggested black crappie may spawn earlier than white crappie. The estimated net gain of adult white and black crappie moving into the borrow pit potentially

represented 7.6% and 6.1% of each species harvest respectively.

PUBLICATIONS: 77/01 TO 79/03

NO PUBLICATIONS REPORTED THIS PERIOD.

001.087

CRIS0064796

CULTURE OF PACIFIC SALMON

LANNAN J E; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.

Proj. No.: ORE00163

Project Type: STATE

Agency ID: SAES

Period: 01 JUL 73 To 30 DEC 84

OBJECTIVES: Determine the relationship between incubation density and fry quality in shallow gravel incubators.

APPROACH: Chum salmon eggs will be incubated at six densities ranging from 1000 to 10,000 eggs per square foot of gravel, with six replicates of each density. Emergence timing, size at emergence, yolk utilization and proximate tissue analysis will be compared between and within treatments (densities). The fry quality criteria will also be compared to natural fry. Samples from each treatment will be marked and released and the relationship between density and survival subsequently observed.

PROGRESS: 80/01 TO 80/12. Within the tested range of 1000 - 7000 eyed eggs/ft² gravel substrate (1.05 - 7.53 eggs/cm²), the optimum stocking density for chum salmon (*Oncorhynchus keta*) eggs in shallow matrix substrate incubators occurred at 3,000-4,000 eggs/ft². Premature fry, which predominated early emergence, showed greater variability in lipid content than fry at peak emergence. Cumulative premature fry emergence was lowest at 3000 - 4000 eggs/ft² and highest at 5000 - 7000 eggs/ft². Early emerging fry are considered to be of lesser quality than peak emerging fry because the observed increase in variation in lipid content (i.e. primary energy reserve) may lead to increased variation in survival during seaward migration. Neither survival (from egg stocking to emergence) nor the gross body composition (determined by proximate analysis) of emerging fry were affected by egg stocking density. Development indices decreased in a linear fashion throughout emergence but the slope and intercept of the line did not differ among egg stocking densities. The frequency of yolk sac abnormalities was negligible in all treatments. The water content of fry increased from early to late emergence while dry weights remained relatively constant. The implications of this observation are discussed. Application of these results depends on the relative importance of biological vs. economic optimization in a hatchery. 3,000-4,000 eggs/ft² favors high quality fry production, while 7,000 eggs/ft² minimizes the cost of producing each fry.

PUBLICATIONS: 80/01 TO 80/12

KAPUSCINSKI, A. 1980. In Search of the Optimum Stocking Density for Chum Salmon (*Oncorhynchus keta*) Eggs in Shallow Matrix Substrate Incubators. M.S. Thesis. Oregon State Univ. Corvallis, Oregon. 36 pp.

001.088

CRIS0075513

CHRONIC TURBIDITY AND STRESS IN JUVENILE COHO SALMON AND STEELHEAD TROUT

SCHRECK C B; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.

Proj. No.: ORE00401

Project Type: STATE

Agency ID: SAES

Period: 25 APR 78 To 31 DEC 80

OBJECTIVES: Objectives will be met by answering: Is there a generalized, physiological response to stress in juvenile salmonids; are the physiological responses to stress correlated or related to reduced fitness; does stress produce predictable physiological responses?.

APPROACH: Juvenile coho salmon and steelhead trout will be exposed to salination and their resistance to other stresses determined. Clinical chemistries involving primary aspects of the general adaptation syndrome of stress, such as cortisol, will be monitored.

PROGRESS: 80/01 TO 80/12. Juvenile coho salmon and steelhead trout exposed to suspended topsoil, clay or Mt. St. Helens volcanic ash had elevated plasma cortisol, suggesting that exposure to high levels of suspended solids is a moderately stressful condition. Although cortisol returned to pre-stress levels and osmoregulatory performance of the fish was not affected by exposure to sediment, topsoil significantly reduced the fish's tolerance to the pathogen *Vibrio anguillarum*. The absence of light during imposition of stress may mitigate in part the reaction to the stress.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

001.055 CRIS0083604
PERFORMANCE OF SALMONIDS: SMOLTIFICATION, STRESS AND FITNESS

SCHRECK C B; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: OEB00908 Project Type: STATE
Agency ID: SAES Period: 02 FEB 81 TO 30 JUN 86

OBJECTIVES: Increase percent return of anadromous salmonids by providing an understanding of the functional basis of parr-smolt transformation. Monitor clinical indicators of smoltification. Conduct tests of performance as indicators of smolt quality to signify effects of rearing conditions on development.

APPROACH: Analyze clinical criteria of smoltification, particularly those associated with the endocrine system. Specifically, determine effects of loading regimes on smolt performance criteria; determine effects of loading regimes on smolt-indicators; determine correlations of smolt-indicators and performance and determine effects of loading on food consumption and feed conversion efficiency and correlate nutritional status with smolt performance and smolt-indicators.

001.090 CRIS0069301
COLUMBIA RIVER CHINOOK SALMON STUDY

SCHRECK C B; KRISTIANSSON A C; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: OEB00313 Project Type: STATE
Agency ID: SAES Period: 01 OCT 75 TO 30 JUN 78

OBJECTIVES: Determine biological and environmental factors influencing run size of Columbia River spring chinook salmon. Predict the future of anadromous salmonid runs in the upper Columbia River.

APPROACH: A computerized file of physical and biological data will be constructed. Relationships between fixed parameters with correlation analyses will be defined. Correlation and regression techniques will be utilized to isolate those combinations of variables that appear to have the most important influence on run-strength of spring chinook salmon. The analysis will proceed to the development of a model of sufficient sophistication to predict, with an acceptable level of confidence, annual run-strength for spring chinook salmon.

PROGRESS: 79/01 TO 79/12. A statistical analysis of factors influencing the survival rate of both upper Columbia River and Lemhi River spring chinook salmon was performed using correlation and multiple regression techniques. Ocean upwelling and Columbia River flow regimes during outmigration may influence the survival rates of the studied fish. A theoretical model characterizing a Columbia River spring chinook

salmon population was developed to (i) suggest the types of data to be collected in future studies, and (2) suggest the nature of functional relationships influencing selected life history events. An outline for a management model was developed within the framework of the theoretical biological model to illustrate a potentially useful application of the modeling effort.

PUBLICATIONS: 79/01 TO 79/12

BARTON, A.C. 1975. Factors influencing the life history of spring chinook salmon (*Oncorhynchus tshawytscha*) spawning in the Columbia River watershed from 1960 to 1977. Ph.D. Thesis, Oregon State University. 243 pp.

001.091 CRIS0066734
STOCK DYNAMICS AND ASSESSMENT IN MARINE FISHERIES

TYLER A V; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: OAE00254 Project Type: STATE
Agency ID: SAES Period: 01 JUL 74 TO 30 JUN 81

OBJECTIVES: Provide a revised statistical area map for landings of Oregon groundfish that will improve assessment of fish stocks and provide the basis for a standardized inter-state unit of fishing effort.

APPROACH: Compile and chart local distribution of recent Oregon landings of principal groundfish species from commercial log-book data of the Fish Commission of Oregon. Analyze and chart distribution of major assemblages of continental shelf fishes, including principal species landed, potentially exploitable species, and minor species. Analyses will be made with recurrent group, species-association coefficient methods. Based on the distribution of major assemblages of fishes, develop a proposal for revised statistical reporting areas that will be small enough to allow analysis of the status of individual stocks. This map will also provide the basis for a standardized inter-state unit of fishing effort.

PROGRESS: 80/01 TO 80/12. We propose that management concerns for continental shelf fishes must include not only yield maximization goals on target species (modified by social concerns to OY), but also fish assemblage maintenance goals. MSY oriented management has been shown with models to simplify fishery systems toward species with highest productivity rates. However, there is no assurance that simplified, high production portions of formerly species-rich assemblages can persist in ocean systems. Our analyses of research trawling surveys have indicated there are geographic fish-species assemblages. We conceptualize that each assemblage is part of a geographically definable natural production system of interacting organisms (a "community"). The "regular" species of the community having strong trophic linkages among themselves comprise an "assemblage production unit" (APU). The "regular" species are those that are present in every season. As a management technique for the APU, we propose that monitoring the transition states following controlled pulse fishing by the commercial dragger fleet may be a means of exploring and maintaining the viability of the APU's. These pulses could be applied simultaneously to a group of near-replicate APU's. The goal would be to find the limits of repetitive pulse fishing that would allow persistence of APU structure.

PUBLICATIONS: 80/01 TO 80/12

BAYMAN, R.A., TYLER, A.V. and DEMOREY, R.L. 1980. A Comparison Between Cohort Analysis and Catch per Unit Effort Using Dover Sole (*Microstomus pacificus*) and English Sole (*Parophrys vetulus*). Trans. Am. Fish. Soc. 109:35-53.

BAYMAN, R.A. and TYLER, A.V. 1980. Environment and Cohort Strength of Dover Sole (*Microstomus pacificus*) and English Sole (*Parophrys vetulus*). Trans. Am. Fish. Soc. 109:54-70.

GABRIEL, W.L. and TYLER, A.V. 1980. Preliminary Analysis of Pacific Coast Demersal Fish Assemblages. Marine Fisheries Review. March-April: 83-88.

001.092 CRIS0009462
THE BEHAVIOR OF FISH AS RELATED TO ARTIFICIAL COVER

BUTLER R L; BIOLOGY; PENNSYLVANIA STATE UNIVERSITY,
UNIVERSITY PARK, PENNSYLVANIA. 16802.
Proj. No.: PEN01757 Project Type: STATE
Agency ID: SAES Period: 01 JUL 67 To 30 SEP 79

OBJECTIVES: Determine what components of cover are related to its use, the role of cover as a determinant of population size, the effects of cover on agonistic and aggressive behavior, and to test response to cover as a bioassay for chronic toxicity.

APPROACH: Procedures will be carried out in a stream aquarium where water velocities, water temperature, water quality and light can be controlled. Observations will be made with six different types of artificial cover. Duncan's multiple range test will be used to define gradient of use among the covers. Covers found to be most intensively used under the stream aquarium conditions will be introduced in a natural stream without cover. Population changes will be noted through the use of electrofishing gear. Agonistic and aggressive behavior between two or more fish will be quantified by noting the number and type of frontal and lateral displays, attacks and attitudes of submission or appeasement. Statistical comparisons will be made between the utilization of cover under "unpolluted" soft and hard water conditions versus polluted conditions characteristic of mine acid drainage or industrial wastes.

PROGRESS: 78/01 TO 79/09. Utilization of overhead cover among 12 strains of inbred brook trout was significantly different. Cover utilization has a genetic base. Response of wild juvenile smallmouth bass to 11 different types of cover in a stream aquarium was related to the following features of covers: tactual reference, visual reference, area of darkness, and quiet water. The two covers that supplied all four of the features were significantly higher in utilization. Utilization of the best covers under a regime of decreasing pH from 7 to 4 provided no significant difference. Distress movements was significantly higher at lower pH levels. However, under a regime of decreasing dissolved oxygen from 8 ppm to 5 ppm cover utilization decreased significantly with any change of 2 or more ppm. Activity, that is swimming from quadrat to quadrat, increased. Cover utilization increased significantly under artificially controlled increases in Tennessee No. 10 tall clay from <10 nephelometric turbidity units to >100 NTU. Utilization of cover by adult wild brown trout in a semi-natural stream was significantly higher than that of brown trout of long domestication. These differences persisted in two different sections of stream taken at two different seasons and whether resident or non-resident as populations were doubled with superimposition of either hatchery or wild stock in the same section.

PUBLICATIONS: 78/01 TO 79/09

BUTLER, ROBERT L., HAWTHORNE, VERNON 1979. Anchor ice -- its formation and effects on aquatic life. Science in Agri. 26(1): 1pp.

HAWTHORNE, VERNON, BUTLER, ROBERT L. 1979. A Trout Stream in Winter. A 16 mm color and sound documentary. Psychological Cinema Register. 18 minutes.

McLAREN, JAMES B. 1979. Comparative behavior of hatchery-reared and wild brown trout and its relation to intergroup competition in a stream. Ph.D. thesis. Pa. State Univ., 156 pp.

YOUNG, John E. 1979. The behavioral response of smallmouth bass ('Micropterus' 'dolomieu') to increased turbidity. M.S. Thesis. Pa. State Univ.

001.093 CRIS0069189
ZOOGEOGRAPHY AND ECOLOGY OF FISHES IN PENNSYLVANIA

CCCER E L; BIOLOGY; PENNSYLVANIA STATE UNIVERSITY,
UNIVERSITY PARK, PENNSYLVANIA. 16802.
Proj. No.: PEN02276 Project Type: HATCH

Agency ID: CSRS Period: 01 JUL 77 To 30 JUN 81

OBJECTIVES: Measure the impact of environmental disturbance on patterns of distribution of fish species; investigate the phylogeny of selected fish groups in order to assess the validity of species nomenclature.

APPROACH: The severity of environmental degradation due to acid mine drainage, soil erosion, industrial pollution or other disturbances to aquatic habits will be correlated with the presence or absence of species of fishes known to be sensitive to these forms of pollution. Predictions of the level of pollution permissible to maintain diverse fish populations are then possible. Studies will be continued to better understand the diversity of taxa and the geographic distribution of fishes in northeastern United States.

PROGRESS: 80/01 TO 80/12. Work is continuing on a manuscript "Fishes of Pennsylvania" which is in Press. The phylogeny of the sculpins (Teleostei: Cottidae) of eastern North America has been revised by detailed electrophoretic and meristic analysis of many Appalachian species and populations. An acceptable thesis is now being prepared for publication.

PUBLICATIONS: 80/01 TO 80/12

STRAUSS, R. E. 1980. Geographic variation and the intra- and interspecific relationships of eastern North American freshwater sculpins (Teleostei: Cottidae). The Graduate School, Penn State Univ., Ph.D. Thesis, 210 p.

001.094 CRIS0068635
STUDIES OF THE ECONOMICALLY IMPORTANT SPECIES:
MERCENARIA MERCENARIA AND MACROBRACHIUM ROSENBERGII

EVERSOLE A G; ENTOMOLOGY & ECONOMIC ZOOLOGY; CLEMSON
UNIVERSITY, CLEMSON, SOUTH CAROLINA. 29631.
Proj. No.: SC00155 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 JUN 80

OBJECTIVES: Objectives of the Mercenaria phase are: Explore important biological and ecological aspects of rearing clams; investigate the extent and nature of natural clam populations; and provide environmental estuarine base-line data. Objectives of the Macrobrachium phase are: Investigate the effects of mirex on Macrobrachium; and investigate the feasibility of polyculturing Macrobrachium.

APPROACH: Approach of the Mercenaria phase includes: Evaluations of artificial seedling and growing programs; regular sampling and collection analysis of natural populations; and determination of biological, chemical and physical characteristics of clam habitats. Approach of the Macrobrachium phase includes: Monitoring the effects of exposure to mirex; and analyzing niche utilization in polyculture situations.

PROGRESS: 80/01 TO 80/06. Juvenile and postlarval Macrobrachium rosenbergii were exposed to mirex concentrations of 0.1, 10, 50, 150, 500 and 1000 ug/l, plus control, for 96 hours. Whole animal residue analysis indicated postlarvae and juveniles concentrated mirex, and mortality response appeared to follow residue levels. Postlarvae and juveniles exposed to 1000 ug/l accumulated mirex up to 513x and 88x control levels, respectively. Mirex residues in juveniles were greatest in nerve tissue with levels up to 250x control. Residue analysis of test water revealed a 10-fold decline in mirex concentrations over 96 hours. Residues were not detected in the water from control, 0.1, 10, 50, 100 and 150 ug/l treatments, and only 126 and 165 ug/l mirex was found remaining after 96 hours in water from 500 and 1000 ug/l mirex treatments, respectively. Three studies with hard clams, Mercenaria mercenaria, were initiated in 1980. Two studies were designed to determine growth of hard clams cultured in South Carolina, and a third to evaluate reproductive responses to increased density.

PUBLICATIONS: 80/01 TO 80/06

AAS, C.A. and EVERSOLE, A.G. 1980. Effect of mirex on postlarval *Macrobrachium rosenbergii* in different water hardnesses. *Bull. S.C. Acad. Sci.* 42:72.

AAS, C.A. 1980. Effects of mirex on *Macrobrachium rosenbergii* in various water hardnesses. M.S. Thesis. Clemson Univ. South Carolina. 34 p.

001.095

CRIS0070455

ANALYSIS OF PREDATION OF *MERCENARIA MERCENARIA* BY DECAPOD CRUSTACEANS

EVSOLE A G; ENTOMOLOGY & ECONOMIC ZOOLOGY; CLEMSON UNIVERSITY, CLEMSON, SOUTH CAROLINA. 28631.

Proj. No.: SC00205 Project Type: STATE
Agency ID: SAES Period: 01 JUL 76 To 30 SEP 80

OBJECTIVES: Determine the predators (i.e. decapod crustaceans) of seed clams; determine the important factors influencing predation; investigate alternate methods for controlling predation; and evaluate these methods in pilot culturing systems.

APPROACH: Collecting potential predators and evaluate stomach contents; examining rates of predation by principal predators under controlled laboratory conditions when variables such as size of prey and predators are altered, water temperature is varied and different substrate composites are used; and finally, to test prospective methods of reducing predation in field conditions.

PROGRESS: 80/01 TO 80/09. *Mercenaria mercenaria* maintained in protected trays provided estimates of annual mortality rates for clams 3-5 and 1-5.5 years of age. Clams 3-5 years old averaged 51.12 mm SL (range, 31.6-72.2 mm) at planting and 58.53 mm SL (38.0-74.7 mm) two years later. Clams 1-5.5 years old starting at 24.74 mm SL (11.7-35.3 mm) reached 64.45 mm SL (50.1-78.0 mm) after 4.5 years growth. Annual mortality rates without predation were 1.43% and 1.98% for clams age 3-5 and 1-5.5, respectively.

PUBLICATIONS: 80/01 TO 80/09

NO PUBLICATIONS REPORTED THIS PERIOD.

001.096

CRIS0083473

PRELIMINARY STUDIES ON CRAWFISH AND FRESHWATER SHRIMP DISEASES

SIS R F; LEWIS D B; LEE E J; VETERINARY ANATOMY; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.

Proj. No.: TEX06531 Project Type: ANIMAL HEALTH
Agency ID: CSRS Period: 04 MAR 81 To 03 MAR 82

OBJECTIVES: The objectives are to assess the effects of water hardness on shell calcium content, shell morphology and colonization of chitinoclastic bacteria on *Procambarus* sp. and *Macrobrachium rosenbergii* and characterize the hemocytes of *Procambarus* sp. (crawfish) and correlate types with water hardness.

APPROACH: Percent shell calcium content will be determined from atomic absorption analysis. Shell morphology will be described by scanning electron microscopy and electron X-ray microprobe analysis. Colonization of bacteria will be quantified using standard bacteriologic techniques. Hemocytes will be histologically identified and enumeration studies will be done with a Coulter Counter.

001.097

CRIS0064272

POPULATION CHARACTERISTICS OF TEXAS GULF OF MEXICO FISHES

CHITTENDEN M E; WILDLIFE & FISHERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.

Proj. No.: TEX06049-S

Project Type: STATE

Agency ID: SAES

Period: 30 JUN 75 To 29 JUN 80

OBJECTIVES: Determine abundance, species, and size of fishes. Determine seasonality and distribution of fishes and factors affecting their seasonality, distribution and abundance. Delineate communities and life histories of Gulf of Mexico fishes. Assess attainable fish yields and potential effects of coastal development, oil related activities and superport construction.

APPROACH: collect fishes with a trawl, aboard research vessels and obtain hydrographic data such as depth, temperature, salinity and sediments at each station. Other capture techniques such as seines, gill nets, hand-lines, long-lines and angling will be employed in special situations. Stomach contents will be identified and measured for food habits studies. Scales, otoliths or other hard parts will be collected to age specimens for studies of population dynamics.

PROGRESS: 80/01 TO 80/12. Continued studies on life histories and population dynamics of Gulf of Mexico demersal fishes have emphasized sand seatrout (*Cynoscion arenarius*). Sand seatrout mature as they approach age 1. Spawning occurs in a distinct Spring period (March to May) and in a distinct Late Summer period (August to September). Spawning coincides with the periodicity of onshore winds and surface currents which transport eggs and larvae to estuarine and inshore Gulf nurseries. The main Gulf nursery in the northwestern area lies in water shallower than 18 meters. Estuarine nurseries may be most important to Late Summer spawned groups. Both spawned groups leave estuarine nurseries in the fall to overwinter in the Gulf. The largest specimen captured by trawling was 342 mm total length, and 99.5% were less than 280 mm. The typical maximum life span was 1-2 years for trawling years and possibly 2-3 years for other years. The total annual mortality rate was best estimated at 89.79% based on trawling data and appears to be no lower than 80-90% if maximum life span typically is as great as three years. The apparent temporal isolation of the two spawned groups produced each year suggests they may be separate populations or species. Sand seatrout population dynamics stress short life spans, high mortality rates and rapid turnover of biomass. This supports previous suggestions that the abundant species of the white and brown shrimp communities in the Gulf of Mexico have evolved a common pattern of population dynamics.

PUBLICATIONS: 80/01 TO 80/12

SHLOSSMAN, P.A. 1980. Aspects of the Life History of the Sand Seatrout, *Cynoscion arenarius*, in the Gulf of Mexico. M.S. Thesis. Texas A and M Univ., College Station, Texas. 75 pp.

001.098

CRIS0072931

EXPERIMENTAL FISH ECOLOGY

NEILL W B; WILDLIFE & FISHERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.

Proj. No.: TEX06295 Project Type: BATCH
Agency ID: CSRS Period: 17 JUN 77 To 16 JUN 82

OBJECTIVES: Experimentally determine biophysical, physiological, and behavioral responses of fishes to environmental variation; evaluate energetic costs and benefits of such responses; generate and evaluate hypotheses relating such responses and their energetic costs/benefits to ecology of wild cultured fishes; develop from these relations generic models for within-habitat distributions of fishes.

APPROACH: Mathematical and computer simulation models to provide conceptual framework within which environment-fish relationships are hypothesized, tested by behavioral-physiological experiment, then used in turn to improve models; final validation of models in field, using such techniques as telemetry.

PROGRESS: 80/01 TO 80/12. Experimental Fish Ecology project is directed towards understanding how fishes' behavioral and physiological responses to environment are integrated in an ecological context; project successes enhance the capability for predicting ecological responses under both natural and aquacultural conditions. Realistic patterns of fish movement in temperature gradients have been simulated with a generalized mechanistic model that seems potentially valid for species as diverse as carp, Atlantic salmon, and albacore tuna; the model invokes stochastic increases in turning rate whenever physiological comparisons of ambient and body-core temperature imply worsening thermal conditions. The major obstacle to an experimental test of the model's underlying hypothesis has now been overcome: Experiments with bluegill (sunfish) and Tilapia spp. have resulted in a highly accurate model, derived from Newton's law of cooling, for predicting core temperature (+ 0.2 degrees C) of fish under conditions of continuously fluctuating ambient temperature (+ 10 degrees C); thus, the need for stressful telemetry of core temperature in thermoregulating fish has been obviated. An apparatus for evaluating environmental responses of fish in multivariate situations has been constructed and will be put into service during early 1981.

PUBLICATIONS: 80/01 TO 80/12

CHAMBERLAIN, G.W., NEILL, W.H., KCMANOWSKY, P.A. and STRAWN, K. 1980. Vertical Responses of Atlantic Croaker to Gas Supersaturation and Temperature Change. Trans. Amer. Fish. Soc. 109:737-750.

001.095

CRIS0075551

CIGUATERA FISH POISONING IN THE U.S. V.I.: BIOCHEMICAL, PHYSIOLOGICAL, AND MICROBIOLOGICAL STUDIES

MCMILLIAN J F; RAKOCY J E; EUSCH R L; ADMINISTRATION; VIRGIN ISLANDS AGRIC EXPT STAT, KINGSBILL ST CIRCIX, VIRGIN ISLANDS. 00550.

Proj. No.: V100020

Project Type: BATCH

Agency ID: CSSES

Period: 26 MAY 78 To 25 MAY 83

OBJECTIVES: Achieve a better understanding of the biology and chemistry of ciguatoxin. Develop a simple, reliable test for the ciguatoxicity of fish. Determine the biological source(s) of toxin.

APPROACH: The nature of the Virgin Islands ciguatoxin will be determined and compared to that investigated in other areas. Ciguatoxin extracts will be tested whether it inhibits the growth of a variety of rapidly growing bacteria. The gut contents of toxic and non-toxic fish will be examined for the presence of microorganisms that may be associated with ciguatoxin. The usefulness of immunological methods to detect ciguatoxin will be determined. Suspect coral reef microorganisms will be grown on artificial media to determine if a ciguatoxin-like substance is produced. Efforts will be made to determine whether the toxin can be detected by immunological methods and also whether there is an alteration of blood or liver enzymes in ciguatoxin fish.

PROGRESS: 80/01 TO 80/12. Two methods of purification for ciguatoxic extracts obtained from fish flesh previously implicated in human poisonings have been developed. The first method involves two-step thin-layer chromatography, TLC-I and TLC-II, which give, respectively, lethal doses (LD₅₀) of 500 µg/kg and 10 to 100 µg/kg when tested in the mouse bioassay. The second technique employs silicic acid column chromatography (CC) and gives a LD₅₀ of 50 to 200 µg/kg. The second method (CC) is much less time and labor intensive than the first and provides comparable purification. Gambierdiscus toxicus is a dinoflagellate found in the tropical oceans of the world usually on or near coral reefs, often in association with various macroalgae. Extraction and bioassay of G. toxicus from field collections in the Virgin Islands and from unialgal cultures (provided by Southern Illinois University) suggests the presence of at least three toxic fractions; a chloroform soluble fraction (CX), an acetone insoluble fraction (MTX), and an acetone soluble

fraction (Other).

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

001.i00

CRIS0081384

AN EVALUATION OF ENDANGERED MUSSELS IN VIRGINIA

NEVES R J; PARDEE G B; BENFIELD E F; FISHERIES & WILDLIFE; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.

Proj. No.: VA-111111

Project Type: STATE

Agency ID: SAES

Period: 01 JUL 80 To 30 JUN 83

OBJECTIVES: Develop a literature review, species range and relative distribution maps for the nine endangered species; develop habitat characterization for the nine species; determine and life histories of two common mussels; summarize components 1 and 2 and prepare final report.

APPROACH: Survey mussel populations in the Clinch, Powell and Holston River; determine water quality, substrate composition and species associations at sites with endangered mussels; artificially infect various species of fish in the laboratory to determine the required fish hosts; apply appropriate statistical analyses to data and write final report.

PROGRESS: 80/01 TO 80/12. The final report on the first phase of this project was submitted to the Virginia Commission of Game and Inland Fisheries in October, 1980. Based on recently completed mussel surveys in southwestern Virginia, the following 7 endangered species reside in the Clinch, Powell, and Holston Rivers: Fusconaia edgariana, Fusconaia cuneolus, Droxus dromas, Conradilla caelata, Quadrula intermedia, Quadrula sparsa, and Dyscnxia walkeri. Three of these species occur only in the lower Powell River, an area influenced by upstream coal mining operations. Two of the species are relatively widespread, and approximately 59 river kilometers in Virginia are considered of utmost importance for the continued survival of 5 of the 7 species. Mussel surveys at 2 bridge construction locations on the Clinch River recorded 3 endangered species near these sites. Recommendations were made to the U.S. Fish and Wildlife Service and the Virginia Department of Highways and Transportation for mitigating disturbance of the habitat of these endangered species.

PUBLICATIONS: 80/01 TO 80/12

ZALE, A.V. 1980. The Life Histories of Four Freshwater Lampsiline Mussels (Mollusca: Unionidae) in Big Moccasin Creek, Russell County, Virginia. M.S. Thesis. Va. Poly. Inst. and State Univ., Blacksburg. 256 pp.

001.101

CRIS0081472

EVALUATION OF THE ECOLOGICAL REQUIREMENTS OF RESERVOIR FISH SPECIES

NEY J J; FISHERIES & WILDLIFE; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.

Proj. No.: VA-1111113

Project Type: STATE

Agency ID: SAES

Period: 01 JUL 80 To 30 JUN 83

OBJECTIVES: Determine risks and benefits of alewife as pelagic forage in S.E. reservoirs, assess use by gamefish, describe trophic competition with young fish, define predation on larval fish; determine spawning requirements of striped bass in reservoirs, define degree of homing to spawning tributaries, assess reservoir recruitment from tributary streams.

APPROACH: Determine food habits of alewife larval fish, and gamefish/over 2 years as related to food availability. Describe consumption of alewife by gamefish, trophic overlap between alewife and planktivorous life stages of resident fish and use of larval fish by alewife. Compare growth of major species at different life stages before and after alewife introduction. Determine degree of reproductive isolation by electrophoretic analysis between spawning groups of striped bass in each river

over 2 years. Compare gene frequencies of young-of-year fish from Kerr Reservoir to parent spawning stocks. Compare tributaries for hydrologic, water quality and morphoedaphic characteristics to assess differential spawning.

PROGRESS: 80/01 TO 80/12. Project to evaluate alewife as a forage species in Southeastern reservoirs was completed. Summer temperature and lack of littoral area are factors which will limit alewife establishment. Alewife are used by pelagic predators but not littoral predators. Adverse effects of alewife include predation on fish larvae, competition with planktivorous fish for food, and downstream emigration. Alewife introductions should be limited to closed systems in which predators are stocked on a put-grow-take basis. Evaluation of reproductive isolation in the use of spawning tributaries by striped bass was completed. Isozyme analysis showed no consistent genetic differences between streams. New projects include (1) analysis of resource partitioning in juvenile fishes, and (2) channel catfish movement and feeding patterns.

PUBLICATIONS: 80/01 TO 80/12

- KOHLER, C.C. and NEY, J.J. 1980. Piscivory in a Landlocked Alewife (*Alosa pseudoharengus*) Population. Can. J. Fish. Aquat. Sci. 37(8):1314-1317.
- KOHLER, C.C. 1980. Trophic Ecology of a Landlocked Alewife Population and Assessment of Alewife Impact. Ph.D. Thesis. Va. Poly. Inst. and State Univ., Blacksburg. 192 pp.
- NIGRC, A.A. 1980. Reproduction and Early Life History of a Landlocked Population of Alewives in Claytor Lake, Virginia. M.S. Thesis. Va. Poly. Inst. and State Univ., Blacksburg.
- GUSE, C.J. 1980. Assessment of Genetic Variation Between Spawning Aggregates of Striped Bass from Kerr Reservoir, Virginia-North Carolina. M.S. Thesis. Va. Poly. Inst. and State Univ. Blacksburg. 83 pp

001.102 CRIS0081386
FACTORS INFLUENCING TROUT PRODUCTION IN VIRGINIA STREAMS

PARDUE G B; IENFIELD E F; WEBSTER J F; FISHERIES & WILDLIFE; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.
Proj. No.: VA-111114 Project Type: STATE
Agency ID: SAES Period: 01 JUL 80 To 30 JUN 83

OBJECTIVES: Examine links between the food production base and brook trout production, develop the work on brook trout competition with other age classes or trout and with nongame fish to include competition, determine rainbow trout production and gonadal energetics during the year.

APPROACH: Collect monthly quantitative samples of macroinvertebrates to determine trophic structure, biomass, production and feeding rates; collect quarterly depletion samples of fishes to determine trophic structure, biomass, production and food habits, compare food habits of trout with nongame fishes and examine longitudinal zonation of fishes in the stream, conduct quarterly mark-recapture sampling, collect length-weight data and use bomb calorimetry on somatic and reproductive tissues during the year.

PROGRESS: 80/01 to 80/12. Microinvertebrate identification and enumeration from quarterly drift samples is largely completed and is being used to relate to food habits of trout and non-game fishes to determine trophic relationships and feeding overlaps. One hundred sixty taxa of benthic invertebrates have been identified from Guys Run. Measurements of primary and secondary production have been collected and are in the process of analysis. Behavioral observations of spatial distribution and feeding activities have been conducted for brook trout and five non-game species in laboratory experiments. A conceptual model of energy flow dynamics is being developed for Guys Run, a second order native brook trout stream. Collections of rainbow trout for reproductive biology, gonad energetics and annual

production have been completed and are being analyzed using multivariate statistics and Kicker's cohort production formula ($P = GB$).

PUBLICATIONS: 80/01 TO 80/12

- WENDALL, W.T. 1980. The Dispersion of Hatchery-reared Rainbow Trout (*Salmo gairdneri*) Stocked in Big Stony Creek, Giles County, Virginia. M.S. Thesis. Va. Poly. Inst. and State Univ., Blacksburg. 86 pp.
- GARMAN, G.C. 1980. Impacts of Stocked Brown Trout (*Salmo trutta*) on the Native Fish Fauna of Bottom Creek, Virginia. M.S. Thesis. Va. Poly. Inst. and State Univ., Blacksburg. 81 pp.

001.103 CRIS0083531
AQUACULTURE FOR RESOURCE ENHANCEMENT

AMUNDSON C H; KAYES T B; FOOD SCIENCE; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.
Proj. No.: WIS02581 Project Type: STATE
Agency ID: SAES Period: 01 SEP 80 To 31 AUG 81

OBJECTIVES: To determine the quantitative amino acid requirements of rainbow trout and yellow perch; to examine the feasibility of employing anabolic substances; to control sexual differentiation and enhance growth and food conversion efficiency and to apply this information to the propagation and culture of Great lakes fishes.

APPROACH: An amino acid test diet will be developed to promote good growth at 15°C for trout and 22°C for perch. The dietary requirements of these species will be determined under high NH₃ versus low ammonia condition and to determine his, ile, leu, phe, thr, and val requirements and amino acid interrelationships. These studies will be undertaken to determine whether selected biochemical correlates of growth can be used in evaluating the amino acid in protein quality requirements of fishes. With respect to yellow perch only, a study will be undertaken to determine the size or age at which sexual differentiation occurs. Selected androgenic and estrogenic compounds will be used to control sexual differentiation or reverse the sex of immature fish. The dosages and length of treatment required to control sexual differentiation will be studied. A comparison will be made of the growth rate food consumption, food conversion efficiency, protein conversion efficiency, and body composition of treated and untreated fish. Finally, the treated & untreated species will be evaluated for the affect of these substances on production & palatability of edible flesh.

2. Breeding and Genetics

002.001 CRIS0060855
FRESHWATER FOOD ANIMALS

SMITHERMAN R O; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
Proj. No.: ALA00338 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 71 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals cultured for food -- genetics and breeding.

APPROACH: A crossbred population of channel catfish will be established to serve as a control for selective breeding programs. Genetic material from geographically isolated sources will be utilized. Crossbreds among blue, channel and white catfish will also be tested. Crossbreeding between species of tilapia will be utilized to produce all-male broods.

PROGRESS: 80/01 TO 80/12. Realized heritability for body weight in a wild strain of channel catfish was found to be 0.13. However, this still resulted in an 11% increase in growth through one generation of selection. Fingerling growth of two other strains also indicates a positive response to selection. Reproduction performance of individuals selected for growth did not vary from non-selected individuals. The reproductive advantage that three-year-old crossbred channel catfish exhibited over pure-line channel catfish was not maintained as four-year-olds. Although intraspecific mating abilities did not vary, only crossbred individuals hybridized with blue catfish. Variables that appeared important for hybridization were stocking time, hormone injection, genotype, and size. Reciprocal crossbred channel catfish fingerlings did not grow at the same rate. Channel female x blue female fingerlings grew at the same rate as channel catfish fingerlings. Channel female x blue male fingerlings produced from different strains of different parents grew at different rates. Genotype x environment interactions were significant when the environmental variables were stocking density and C(2) levels.

PUBLICATIONS: 80/01 TO 80/12

- MCGINITY, A.S. 1980. Survival, Growth, and Variation in Growth of Channel Catfish Fry Fingerlings. Ph.D. Dissertation, Auburn Univ., AL. 63 p.
- TAVE, D., MCGINITY, A.S., CHAPPELL, J.A. and SMITHEEMAN, R.C. 1980. Evaluation of Hybrid Catfish for Alabama Fee-Fishing Ponds. Highlights of Agric. Res., Auburn Univ. Agric. Exp. Sta. 27(2):3.
- YOUNGLOCD, P.N. 1980. Growth and Feed Conversions of Six Genetic Groups of Adult Channel Catfish Selected as Broodstock. M.S. Thesis. Auburn Univ., AL. 35 pp.

002.002 CRIS063270
ANIMAL BREEDING AND GENETICS OF FISH

GALL, G.A.E.; ANIMAL SCIENCE; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ASC-2881-E Project Type: HATCH
Agency ID: CSES Period: 30 JAN 73 To 30 SEP 84

OBJECTIVES: Establish pedigree stocks of fish for use in estimating genetic parameters and developing efficient methods of genetic improvement of hatchery populations. Apply biochemical electrophoretic techniques to the identification of genetic variability useful in characterizing the taxonomy of wild trout populations.

APPROACH: A crossbred base population has been used to develop lines for the estimation of genetic variances and covariances for growth and reproduction. In addition data from production stocks carried by the California Department of Fish and Game will be utilized for the estimation of genetic parameters. Selection will be practiced in single trait selection lines for increased growth and reproductive performance. Standard electrophoretic and histochemical techniques are used to identify protein and enzyme polymorphisms in wild populations of trout. The latter data are used in recommending management programs for threatened and endangered species.

PROGRESS: 80/01 TO 80/12. Significant non-genetic sources of variation were found to influence growth rate in rainbow trout including spawn date, tank, density, stress, water temperature and rate of sexual maturation. Growth to one year of age was found to be heritable and, under controlled conditions can be expected to respond to selection. Survival characteristics had high error variance but hatchability appeared to exhibit additive genetic variance under proper experimental conditions. Rainbow trout and golden trout crosses produced viable second generation progeny suggesting that interspecific hybrids will be reproductively viable.

PUBLICATIONS: 80/01 TO 80/12

- GOLD, J.E., PIPEKIN, R.E. and GALL, G.A.E. 1979. Notes on a Hybridization Experiment Between Rainbow and Golden Trout. California Fish and Game 65:179-183.
- THORGAARD, G.H. and GALL, G.A.E. 1979. Adult Triploids in a Rainbow Trout Family. Genetics 93:961-973.
- HUSACK, C.A. and GALL, G.A.E. 1980. Ancestry of Artificially Propagated California Rainbow Trout Strains. California Fish and Game 66:17-24

002.003 CRIS0080309
GENETIC ASSESSMENT AND DEVELOPMENT OF CRUSTACEAN
AQUACULTURE STOCKS

HEDGECCOCK, D.; ANIMAL SCIENCE; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ASC-3394-E Project Type: HATCH
Agency ID: CSES Period: 01 NOV 79 To 30 SEP 83

OBJECTIVES: Assess amounts of genetic variation within and between wild-caught stocks of cultured marine crustaceans; develop lobster and shrimp broodstock in which the mating system can be demonstrated with genetic markers; estimate environmental, genetical and interaction components of growth and metabolic variability in laboratory-reared family groups.

APPROACH: The culture of marine crustaceans is currently being initiated with wild-caught gravid females; As a step towards domestication of broodstocks, we will undertake two complementary lines of research; electrophoretic studies of gene-enzyme variability both in native populations and in laboratory-reared family groups, and quantitative experimental studies of growth and metabolism in postlarval juveniles. Studies on the inheritance of electrophoretically detectable protein variants will make possible the selection of genetically tagged broodstock. These, in turn, will guarantee production of pedigreed F(1) juveniles that may be mass-reared to marketable ages. Quantitative studies on these pedigreed family groups will be used to estimate the heritabilities and genetic correlations needed for the construction of an initial selection index.

PROGRESS: 80/01 TO 80/12. A comprehensive review of crustacean genetics literature completed this year highlights the great diversity of genetic systems and thus the need for a multifaceted approach to genetic assessment and development of potential and real aquaculture stocks. Work on the important brine shrimp, *Artemia*, has focused on the genetic and biochemical control of cyst-egg formation. Electrophoretic studies of natural populations of the freshwater prawn *Macrobrachium rosenbergii* revealed very distinct racial groups that are now being assessed for production potential in Hawaii. Reproduction of lobsters is being controlled with photoperiod, and pedigreed pure-bred and hybrid F(1)'s are being grown out by commercial pilot plants. Discovery of chemical growth inhibition among juvenile lobsters has temporarily precluded further measurement of genetic variations in growth and metabolism.

PUBLICATIONS: 80/01 TO 80/12

- HEDGECCOCK, D., SIELMACH, D.J., NELSON, K., LINDENFELSER, M.E. and MALECHA, S.K. 1979. Genetic Divergence and Biogeography of Nature Populations of *Macrobrachium rosenbergii*. Proceedings World Mariculture Society 10:873-879.
- HEDGECCOCK, D. 1979. Biochemical Genetic Variation and Evidence of Speciation in *Chthamalus* Barnacles of the Tropical Eastern Pacific. Marine Biology 54:207-214.
- NELSON, K. and HEDGECCOCK, D. 1979. Enzyme Polymorphism and Adaptive Strategy in the Decapod Crustacea. The American Naturalist 116(2):238-280.
- KALEZIC, M.L. and HEDGECCOCK, D. 1978. Genetic Variation and Differentiation of Three Common European Newts (*Triturus*) in Yugoslavia. British Journal of Herpetology 6:49-57.

BEDGECOCK, D. and NELSON, K. 1980. Gene-enzyme Variator and Adaptive Strategies in the Crustacea. In: Genetics of Marine Animals, a Symposium of the XIV Pacific Science Congress (to be Published in Russian), Pudovkin, A.I.,

002.004* CRIS0075881
ENVIRONMENTAL AND ECOLOGICAL INFLUENCES ON GENETIC VARIABILITY

FCIN T C; ECCLCGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 5616.
Proj. No.: CA-D*-ECL-3669-B Project Type: HATCH
Agency ID: CSRS Period: 20 JUL 76 To 30 SEP 83

OBJECTIVES: This project is intended to identify the ecological and environmental correlates of genetic variability in grassland and marine ecosystems. This will help us to identify the role of genetic variation in mediating population response to environmental and ecological conditions. If the results are similar, analysis of two widely different to ecosystems should produce generalizations applicable both to agricultural and natural ecosystems.

APPROACH: In both systems we shall routinely measure levels of genetic variation in enzymes using gel electrophoresis; the ecological structure of the community; and relative environmental and trophic stability. With these data we can identify what conditions are most closely associated with high genetic variability. This long-term (several years) study is principally located in the northern California coastal grassland and in the tropical Pacific. The project is currently coordinated with personnel at the University of Hawaii, the University of Washington, and the Departments of Genetics and Agronomy and Range Science at U.C. Davis.

PROGRESS: 80/01 To 80/12. This program currently consists of two parts. One is the direct measurement of genetic variability in a family of tropical marine gastropods. Ey and large, little work in research has been undertaken in this past year, although two manuscripts bearing on this work have been completed and submitted within the year. The other part of the program is the ecological assessment of a perennial grass species, *Anthoxanthum odoratum*. The program currently emphasizes the ecological aspects of increase of this species in a coastal grassland at Sea Ranch, Sonoma County, to define the limits of adaptability of a species well-known for its genetic variability. Three students are now working on this program: two abstracts and one paper have been produced in the past year. The principal result to emerge is that *Anthoxanthum* is highly successful along the coast in a variety of environments. There appears to be a strong correlation between *Anthoxanthum* abundance and soil water availability, conditioned on the presence of other perennial species which are potential competitors.

PUBLICATIONS: 80/01 To 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

002.005 CRIS0072302
INTENSIVE CULTURE OF TILAPIA IN GEOTHERMAL WATERS IN THE SAN LUIS VALLEY, COLORADO

FLICKINGER S; FISHERY & WILDLIFE BIOLOGY; COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO. 80523.
Proj. No.: CCL00067 Project Type: STATE
Agency ID: SAES Period: 15 FEB 77 To 30 JUN 80

OBJECTIVES: Develop techniques to spawn tilapia year-round and to have only males for rearing either through early sorting or through hybridization to produce all male offspring.

APPROACH: Brood fish will be held under various photoperiods to determine what length induces spawning and what length inhibits spawning. With controlled spawning to produce large numbers of offspring at the same time, grading to sort faster growing, and hence larger, males will be tried for

accuracy in sorting sexes. Hybrid crosses will also be made to test for unusual sex ratios.

PROGRESS: 80/01 To 80/12. No progress report this period.

PUBLICATIONS: 80/01 To 80/12
MAIOLIE, M.A. 1979. Effects of Various Photoperiods on the Spawning of *Tilapia aurea*. M.S. Thesis, Colorado State University, Fort Collins, 41 pp.

002.006* CRIS0065219
CHARACTERIZATION OF GONAD-STIMULATING SUBSTANCES IN MARINE ANIMALS

CAEDBILBAC P T; VETERINARY SCIENCE; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-VY-01673 Project Type: STATE
Agency ID: SAES Period: 14 MAR 74 To 31 DEC 80

OBJECTIVES: Develop assay for gonad-stimulating substances. Isolate and characterize substances involved in the regulation of spawning and gamete maturation. Identify and characterize neuroendocrine mechanisms involved in spawning and gamete maturation. Determine patterns of similarity among gonad-stimulating substances from different animals.

APPROACH: An assay system for gonadotrophins, similar to the one used for starfish, will be developed. Purification of the gonadotrophins will be accomplished by chromatography. The mechanism of action will be studied using purified substances. Patterns of similarity among isolated gonadotrophins will be investigated by determining amino acid sequences, physical and chemical properties and mode of action.

PROGRESS: 74/03 To 80/12. Warm water marine teleosts which lay pelagic eggs, (snapper, grouper, mackerel, trout, drum, etc.), are a group of fish of major importance to mariculture, sport fishing and commercial fisheries. The pinfish, *Lagodon rhomboides*, was selected from this group as a model for the study of toxins, hormones, etc. which effect gamete maturation and spawning. Photoperiod and several mammalian hormones were found to be highly stimulatory. The development of mature oocytes to ripe eggs could be induced, stripped from the fish, fertilized and normal yolk-sac larvae produced. Culture of ovarian follicles and follicle cells in vitro was investigated to determine the action of hormones and toxins directly on the ovary. A defined medium was developed to further simplify these studies and reduce complex interactions and metabolic conversions. Stem cells in the follicle appear to differentiate to oogenesis following LH stimulation. Estradiol-17- β is the primary stimulator for vitellogenin production, and a primary and secondary response to estrogen was independent of salinity but dependent on water temperature. Toxicity of copper to the fish and the reproductive process was investigated because of the hazard presented by environmental copper poisoning and the importance of copper in disease control. A potassium intoxication follows copper poisoning caused by cell damage and failure of osmoregulation by the gills and kidneys.

PUBLICATIONS: 74/03 To 80/12
YOSHA, S. 1980. Detection and Induction of Estrogen Effects in a Marine Teleost. Ph.D. Thesis University of Florida, Gainesville, FL. 185 pp.
CARDEILHAC, P.T. 1980. Mechanisms of Copper Toxicity to Marine Fish in Aquatic Animal Medicine: A State of the Art. Florida Sea Grant Report 32:101. Jenkins, R.L. and Ealuskay, J.G. (Eds.).
CARDEILHAC, P.T., SIMPSON, C.F., LOVELLCK, E.L., YOSHA, S.F., CALDERWOOD, E.W. and GUDAT, J.C. 1979. Failure of Osmoregulation with Apparent Potassium Intoxication in Marine Teleosts: A Primary Toxic Effect of Copper.
WILEY, M.A. and CARDEILHAC, P.T. 1977. Possible Mammalian Induced Differentiation of Follicle Cells to Cogenic. *The Physiologist* 20(4):102.

CARDEILHAC, P.T. 1976. Induced Maturation and Development of Pinfish Eggs. Aquaculture 8:389-393.

002.007

CRIS0071491

FRESHWATER FICD ANIMALS

BCNDARI K; HILL T K; ANDREWS J W JF;
ENTOMOLOGY-FISHERIES; GEORGIA COASTAL PLAIN EXPT STA,
TIFTON, GEORGIA. 31754.
Proj. No.: GEO00286 Project Type: BATCH
Agency ID: CSRS Period: 01 OCT 76 To 30 SEP 82

OBJECTIVES: Level up and Improve Production and Management Systems for Freshwater Animals Culture for Food, Genetics and Breeding.

APPROACH: Estimation of genetic parameters of commercially important characters. Selection of growth, viability, feed conversion, dressing percentage and fecundity. Selection will be made initially on fish raised in high-density tanks with subsequent evaluation in ponds. Development through individual and family selection of a genetically improved strain of channel catfish.

PROGRESS: 80/01 TO 80/12. One generation of bi-directional selection for body weight and size uniformity has increased body weight and total length at 40 wks of age 22.2% and 9.2% and 3.2% respectively. The rates of decline in the downward line were 18.7% for body weight and 4.1% for total length. Family coefficient of variation for 40-wk body weight in the upward line was also 7% less than in the downward line. Fingerlings produced from 5-year old brood channel catfish weighed 20% less and were 8% shorter in total length than fingerlings produced from 3-year old brood fish. Multipletrait selected fingerlings were also 10.4% heavier in body weight and 3.3% longer in total length than unselected control fingerlings at 40 weeks of age. Genetic selection for growth rate will continue for several generations. One generation of inbreeding study with channel catfish resulted in 7.4% and 5.8% growth depression at 16 and 40 weeks of age, respectively. A study concerning the effects of albinism on growth of channel catfish indicated that normal fingerlings were in a 13% and 20% growth advantage over their full-sib albinos at 16 and 28 weeks of age, respectively. The albinos, however, possessed the ability to compensate in growth at 40 and 70 weeks of age.

PUBLICATIONS: 80/01 TO 80/12

BONDARI, K. 1980. Genetic Experiments in channel Catfish. Aquaculture Magazine 6(4):38-39.
BONDARI, K., SHEPPARD, D.C. and WINEAR, L.H. 1980. The Use of Soldier Fly Larvae in Diets of Channel Catfish. Third Annual Proceedings Catfish Farmers of America Research Workshop 31-32.

002.008

CRIS0063554

PRAWN AQUACULTURE PROGRAM - BIOLOGICAL BASIS OF PRODUCTION

MALECHA S R; LAWS E; ANIMAL SCIENCE; UNIVERSITY OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW00250-S Project Type: STATE
Agency ID: SAES Period: 01 OCT 80 To 30 SEP 82

OBJECTIVES: To aid the development of an improved feed and better feed management; to aid the development of management strategies for crises associated with low oxygen levels in ponds; to test management strategies emphasizing the pattern of growth (observed size-frequency distribution) in pond populations of prawns; to contribute to the controlled domestication of prawns; and to aid the development of alternative stocking and harvesting strategies and management systems.

APPROACH: To determine oxygen budget and nutrient flux to simulated pond ecosystems; to size grade prawn populations and test them against ungraded groups; raise and compare growth of individuals under a variety of confinements; determine tolerances and

growth to low fluctuating dissolved oxygen and temperature; assess the degree of domestication between cultured stocks and wild ancestors; estimate the heritability of size variation using analysis of variance in full and half sib families; and compare larval growth among genetic groups.

002.009=

CRIS0073098

GENETICS OF NATURAL FISH POPULATIONS

MENZEL B W; ANIMAL ECOLOGY; IOWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: IOW02235 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 82

OBJECTIVES: Develop biochemical/genetic approaches to fish taxonomy and to certain problems of fisheries management by electrophoresis of body tissue proteins. Several subprograms are recognized. Survey and compare natural populations of fishes with respect to levels of electrophoretically detectable genetic diversity, determine taxonomic relationships of selected fish species on the basis of biochemical/genetic characters, compare wild and hatchery stocks of sport fishes on a genetic basis in order to evaluate the genetic impact of stocking programs.

APPROACH: Fish populations will be sampled by seines, nets and electrofishing, as appropriate. Blood and tissue samples will be analyzed by starch and acrylamide gel electrophoresis. Biochemical staining procedures will be used to identify specific proteins. Protein patterns will be analyzed and qualitatively and quantitatively, based on allelic frequencies of polymorphic loci.

PROGRESS: 78/01 TO 78/12. Two manuscripts were prepared on an investigation of the genetic impact of stocking upon wild brook trout populations. Wild trout were collected from nine streams in central Wisconsin and domesticated fish were sampled from the Osceola State Trout Hatchery, Wisconsin. Over many years, the study streams had variously received light to heavy stocking of Osceola trout. Blood plasma and whole-eye homogenate samples from the trout were analyzed electrophoretically for genetic variation in the transferrin and lactate dehydrogenase systems. The hatchery stock was genetically distinctive from most wild populations at two genetic loci. There were significant correlations between stream stocking histories and allelic frequencies at the Ldh-E(2) locus, the wild type allele decreasing in frequency as stocking intensity increased. This relationship does not seem to reflect interbreeding between wild and hatchery trout, however. Rather, it may indicate alteration of selective pressures induced by ecological interactions between the two stocks.

PUBLICATIONS: 78/01 TO 78/12

NO PUBLICATIONS REPORTED THIS PERIOD.

002.010

CRIS0069239

BREEDING, PRODUCTION, NUTRITION AND MARKETING OF CHANNEL CATFISH

KELLEY J R JR; DEYCE C; KLAASSEN B E; BIOLOGY; KANSAS STATE UNIVERSITY, MANHATTAN, KANSAS. 66506.
Proj. No.: KAN00962 Project Type: STATE
Agency ID: SAES Period: 01 SEP 75 To 30 JUN 80

OBJECTIVES: Obtain quantitative data on the growth rates of selective strains of channel catfish and the reaction of selected strains to different dietary formulations. Identify interaction of growth rates, diets and pond water quality degradation. Quantify water quality parameters associated with pond degradation and develop methods of maintaining water quality. Develop methods for product storage and flavor quality.

APPROACH: Earthen ponds will be used to replicated experiments to test diets against four strains of channel catfish. Growth rates will be used to compare the effect of diet on strain performance and for between-strain performance using a factorial arrangement of treatments. Full and half sib analysis will be used to compare within-strain performance. Dietary treatments will include evaluation of protein quality and quantity. Effect of diets with different nutrient densities involving nutrients such as vitamins and minerals will be evaluated in relationship to protein levels.

PROGRESS: 80/01 TO 80/06. Ponds treated with cobalt chloride as a trace component of fertilizer were not found to produce more channel catfish than control ponds. Cobalt chloride was added to the diet of channel catfish to determine if vitamin B12 could be spared by the addition of this trace mineral. No significant difference was recorded in growth rates of fish receiving normal amounts of B12 and those fish receiving cobalt in place of B12 in purified diets. Significant differences were found in serum proteins between three of five populations of catfish. Additional differences in these populations were found in serum esterase patterns. It was concluded that the population of channel catfish in the White River, Arkansas and the Blue River, Kansas, were different from each other and from the other three populations examined. A domestic population from Arkansas, a domestic population from Kansas and wild population in the Kansas River, Kansas.

PUBLICATIONS: 80/01 TO 80/06
NO PUBLICATIONS REPORTED THIS PERIOD.

002.011 CRIS0056869
IMPROVEMENT OF CATFISH STOCK THROUGH SELECTIVE BREEDING

AVAULT J W; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, EATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAE01524 Project Type: STATE
Agency ID: SAES Period: 01 JAN 70 To 30 SEP 81

OBJECTIVES: Improve catfish stock, used in fish culture, by selective breeding for fast growth rate, high dressing percentage, and other desirable traits.

APPROACH: Initially, five spawns of channel catfish will be collected for each of four populations from diverse areas of the southeastern United States. Each spawn will be stocked separately in a pond. At maturity male and female sibs will be mated for each of the four populations. All possible crosses and reciprocal crosses between the four populations will be made. Ultimately, it is hoped to develop inbred lines for crossing.

PROGRESS: 80/01 TO 80/12. Fifteen channel catfish families from the Yazoo strain and eight from the LSU strain were tested for genetic variability in mortality rate at a low level of dissolved oxygen (1.1±.01 mg/l). Channel catfish fry of both strains ranging from 2 to 10 days of age were administered low dissolved oxygen shock tests for 10-hour periods following 12-hour acclimation. There was no significant difference (P greater than 0.05) between the LSU and Yazoo strains in mortality. Test fish of each strain averaged 63% mortality during the shock tests. No significant differences (P greater than 0.05) were detected among the age groups of fry (3 and 4; 5 and 6; 7 and 8; and 9 and 10 days old). There were highly significant (P less than 0.01) and significant (p less than 0.05) intra-class correlations among the families. These led to high heritability estimates for the trait of being resistant to low dissolved oxygen. The heritability estimates ranged from 0.9 + 0.3 to 1.7 + 0.1). These inflated heritability estimates were probably due to excess environmental effects common to each family. Based on the high intra-class correlations for low-DO resistance found in this study, one could probably select among 2 to 10-day-old channel catfish fry for the trait of being resistant to low DO. It is not known, however, whether the ability to resist low DO at these ages will hold for the same fish or family of fish at older ages, such as among grow-out fish

for the food market or brood fish.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

002.012 CRIS0071457
FRESHWATER FOOD ANIMALS

AVAULT J W; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, EATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB01878 Project Type: STATE
Agency ID: SAES Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and improve Production and Management Systems for Freshwater Animals Cultured for Food, Genetics and Breeding, Culture Systems.

APPROACH: Catfish. Improved strains of channel catfish will be developed through cross-breeding and progeny testing. Crawfish. Various agricultural by-products will be fed to rawfish in replicated ponds. Production per acre will be compared between treatments. Populations of crawfish will be monitored in ponds to determine management techniques. Various stocking rates and feeds will be tested with crawfish in tanks. Crawfish will be stocked together with various other species to determine best combinations for increasing production. Traditional trapping methods will be compared, and new methods, such as the use of electricity, will be tested.

PROGRESS: 80/01 TO 80/12. Research conducted on catfish management under well-aerated culture and prawn-catfish culture indicated: (1) Catfish were stocked into ponds at rates of 7,500, 15,000, and 22,000 per ha. All ponds received aeration each day from 0200 hrs until 1 hr after sunset. In control unaerated ponds, catfish were stocked at 7,500 per ha. Fish in all ponds were fed a commercial ration containing 36% protein. Production of catfish in kg/ha was: 2717 at a stocking of 7,500; 3,474 at 15,000; and 5,277 at 22,000. In non-aerated ponds production was 1,870 kg/ha. (2) Prawns were stocked into ponds at rates of 25,000/ha, at 50,000/ha, and at 25,000/ha plus channel catfish fry at 75,000/ha. Ponds were also stocked with catfish fry only at 75,000/ha. Prawns and catfish in all ponds were fed Purina catfish chow. Prawn survival, 22%, and production 265 kg/ha were greatest in ponds stocked at 25,000/ha. This production was much lower than that from 1979 study at a stocking density of 25,000/ha. Overall, catfish survival was 33% and production was 695 kg/ha.

PUBLICATIONS: 80/01 TO 80/12
PLEMMONS, B. 1980. Effects of Aeration and High Stocking Density on Channel Catfish Production. M.S. Thesis. LSU. 37 pp.
AVAULT J.W., J.W. 1980. Fishery Products from Aquaculture and Capture Fisheries, pp. 142-155. In: Cole, B.B. and Garrett, W.N. (Editors) Animal Agriculture. San Francisco: W. H. Freeman and Co., 739 pp.
AVAULT J.W., J.W. 1980. Management of Aquatic Species, pp. 658-674. In: Cole, B.B. and Garrett, W.N. (Editors), Animal Agriculture. San Francisco: W. H. Freeman and Co., 739 pp.
PLEMMONS, B. and AVAULT J.W., J.W. 1980. Use of Aeration to Increase Catfish Production (Summary Only). In: Res. Work. Sum. of Papers Catfish Farmers of Amer. Annu. Conv. 1980:12-13.
HUNER, J.V., MILNER, M., BEAN, R.A. and AVAULT J.W., J.W. 1980. Survival and Reproduction of Blue Tilapia, *Tilapia aurea*, in Ponds Stocked with Bowfin, *Amia calva*, to Serve as Predators (Summary Only). In: Res. Work. Sum. of Papers

002.013 CRIS0030722
DEVELOPMENT OF METHODS FOR MASS PRODUCTION AND MANAGEMENT OF BULLFROGS

CULLEY D D JR; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, EATON ROUGE, LOUISIANA. 70803.

Proj. No.: LAB01445 Project Type: STATE
Agency ID: SAES Period: 01 SEP 68 To 31 JAN 84

OBJECTIVES: Determine the effects on tadpoles of diet and water quality. Development of pelleted diets for bullfrogs. Determine methods of disease control in tadpoles and bullfrogs. Effect of environmental factors and hormone injections on controlled reproduction. Influence of selective breeding on improved growth, acceptance of artificial foods and other useful characteristics.

APPROACH: Modify protein, fats, carbohydrates, vitamins and minerals in tadpole diets and determine the effect on food conversion, growth, abnormalities, etc.; modify water pH and determine effects on growth, mortality and disease occurrence. Determine the effect of temperature, photoperiod and hormone injections on reproductive development. Determine the relationship between diet and mortality due to gut pathogens. Attempt to develop a method to immunize bullfrogs.

PROGRESS: 80/01 TO 80/12. Studies involving the effect of pH of the culture water on disease occurrence in the larvae showed that mortality related to disease increased at pH values above 7.0. The optimum pH appears to be between 6.5 to 6.9. The presence or absence of calcium in the water could not be related to disease at various pH levels. Abnormalities increased when calcium was low (less than 2mg/l in water and less than 0.5% in diet). Addition of calcium to the water did not reduce abnormalities, but addition to the food (and not water) up to 5% did reduce abnormalities. Selection of bullfrogs for accepting non-living food (F(3) generation) showed no improvement in the number of animals responding over previous generations. This phase of the study was terminated. Selection studies for rapid growth produced an F(3) generation. Growth rates are currently being monitored. Reproduction studies showed that wild-caught females could be brought into ovulatable condition in the laboratory within eight weeks when placed on a heavy feeding program, 20-25 degrees C and 12 hr light. Repeated ovulations were achieved within 8 to 12 weeks. Transition metals play significant roles in controlling the production of toxins by pathogenic bacterial in the presence of certain amino acids. The addition of Zinc stimulated production and iron inhibited production.

PUBLICATIONS: 80/01 TO 80/12
MEYERS, S.F., CULLEY JR., D.D., MARSHALL, D.G. and MARSHALL, G.A. 1980. Evaluation of Binders in Larval Bullfrog Diets. J. Aquaric. 1:20-28.

002.014 CEIS0071642
FRESHWATER FOOD ANIMALS

REAGAN R E; ROBINETTE B E; WILSON E P; WILDLIFE & FISHERIES SCI; MISSISSIPPI STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI. 39762.
Proj. No.: MIS-0815 Project Type: BATCH
Agency ID: CEES Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and improve production and management system for freshwater animals cultured for food. Nutrition, genetics and breeding. Evaluate the economics of production processing and marketing of freshwater food animals. Develop and improve products and processing methods that will enhance marketability and insure quality of cultured freshwater food animals.

APPROACH: Project is multidisciplinary with Departments of Biochemistry, Horticulture, Agricultural Economics, and Wildlife and Fisheries. Least cost rations will be tested in aquaria and one-tenth acre ponds. Genetics parameters, heritability, and genetic correlations estimated for several traits with concurrent selection program. Amino acid requirements on quantitative basis and digestibility of common feed stuffs determined for catfish. Processing methods compared for dress out yield, with standard nutritional values of catfish flesh determined.

PROGRESS: 80/01 TO 80/12. Apparent and true amino acid availability values have been determined for the following feed ingredients commonly used in catfish feeds: corn, wheat middlings, rice bran, rice mill feed, soybean meal, peanut meal, cottonseed meal, meat and bone meal, and menhaden fish meal. Fingerling channel catfish appear to be more sensitive to the antinutritional factors present in soybean meal than poultry. Studies are currently being conducted to determine the adverse effects of trypsin inhibitors and flavones in soybean meal on catfish. Duckweed (Family Lemnaceae) was incorporated at 15 and 20% into isocaloric diets formulated to meet or exceed nutritional requirements of channel catfish. Diets containing duckweed performed as well as the control. Cottonseed meal was incorporated into isocaloric diets at 5, 10, 15, 20, and 25% of the basal diet. Growth suppression of channel catfish was noted at the 20 and 25% cottonseed meal levels. The procedure for canning tuna-style channel catfish was refined, further data on heat-processing developed, and work was initiated on a consumer acceptance study. Selection of catfish for weight gain, gain in dress out percentage, and decreased percent fat with 25% for high selection and 25% low selection was completed. Fish will be mated at 2 years of age to decrease age at maturity. A Micro-computer program designed to provide information for Management decision-making has been developed. This system computes daily feeding rates by pond and projects feeding days to harvest.

PUBLICATIONS: 80/01 TO 80/12
WILSON, R.P., ROBINSON, E.E. and POE, W.E. 1980. Amino Acid Supplementation of Practical Type Diets for Channel Catfish. Presented 9th Annual Fish Feed and Nutrition Workshop. Univ. of Washington, Seattle.
WILSON, R.P., POE, W.E. and ROBINSON, E.E. 1980. Apparent and True Amino Acid Availabilities of Common Feed Ingredients for Catfish Feeds. Presented 9th Annual Fish Feed and Nutrition Workshop. Univ. of Washington, Seattle.
WILSON, R.P., ROBINSON, E.E. and POE, W.E. 1980. Antinutritional Factors in Catfish Feeds. Presented 9th Annual Fish Feed and Nutrition Workshop. Univ. of Washington, Seattle.
WALDROP, J.E. and SMITH, E.D. 1980. An Economic Analysis of Producing Pond-Raised Catfish for Food in Mississippi: A January 1980 Update. Dept. of Ag. Economics Research Report No. 103, July.

002.015 CEIS0028024
DISEASE-RESISTANT OYSTERS

HASKIN H H; CYSTEE CULTURE; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ32504 Project Type: STATE
Agency ID: SAES Period: 01 AUG 64 To 30 JUN 82

OBJECTIVES: Verify the relative high resistance of Delaware Bay oyster stocks to MSX, increase the supply of such oysters, study and modify current procedures for artificial rearing of oysters, experimentally transmit MSX in the laboratory and increase the yield of market oysters by the control of predators.

APPROACH: Field experiments will be established to accomplish most of the objectives. Disease free oysters will be imported and planted where necessary, various chemicals will be tested for the control of shell-fouling and oyster drills. Laboratory procedures will be established to study artificial rearing of oyster and to experimentally transmit MSX under controlled conditions so that the nature of this disease will be more fully known.

PROGRESS: 80/01 TO 80/12. Earlier reports have emphasized that the epizootic oyster disease, commonly called MSX, which first appeared in Delaware Bay in 1957, has been continuously present in the Bay since then. Its prevalence and intensity have fluctuated in cyclic fashion with 3 periods of low prevalence in 1962, 1971 and 1978. Intervening periods of high prevalence have not been consistently correlated with any environmental factor or set of factors. Survival of the Delaware Bay oyster industry

has been based on the availability, at reasonable cost, of a moderately disease-resistant seed from the upper Bay natural beds. Our studies have shown, that, on long-term average, an oyster planter may expect to lose approximately 38% of his oysters to disease in the first year after planting. In good years, like 1978, this loss will drop to 15 - 20%. In bad years, like 1972 and 1980, the disease loss alone approaches 50%. This disease loss in 1980, coupled with poor growth and condition in the surviving oysters, resulted in a disastrous year for the planters. Our work in this project enabled us to evaluate the 1980 losses and place them in long-term perspective. Our more rigidly selected, laboratory-reared stocks of resistant oysters held up well under the 1980 disease pressure with mortality rates in these experimental stocks at 1/5 to 1/2 those of the native resistant seed stock.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

002.016 CRIS0071700
CRYOGENIC PRESERVATION OF SPERM FROM WARMWATER FISHES

KERRY J H; ZOOLOGY; N CAROLINA STATE UNIVERSITY,
RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05373 Project Type: STATE
Agency ID: SAES Period: 01 OCT 76 To 31 DEC 78

OBJECTIVES: Investigations of methods of cryopreserving sperm from warmwater fishes in a viable state.

APPROACH: The primary emphasis of this project will be to screen those extender and diluents which have been used with success for coldwater species to determine if any would also be of value for use with selected warmwater species. Species to be used will include the striped bass and one or more members of the family Centrarchidae.

PROGRESS: 76/10 TO 78/12. Cryopreservation techniques using sperm from striped bass were investigated using a Linde controlled-rate freezing apparatus. Fourteen different media extended with three different concentrations (5%, 7.5% and 10%) of dimethyl sulfoxide (DMSO), glycerol, ethylene glycol, and propylene glycol were tested. Motility of cryopreserved spermatozoa following thawing was extremely difficult to determine. However, fertilization rates up to 56% were attained when cryopreserved sperm were mixed with freshly-spawned eggs. DMSO was found to be the only adequate extender. No fertilization was obtained using any of the other three extenders. The best media were those which contained lecithin. The difficulty in maintaining consistency in fertilization ability from one set of frozen samples to the next probably resulted from the inability to accurately control the freezing rate through the freezing point. Additional work with better equipment is required to further refine the techniques.

PUBLICATIONS: 76/10 TO 78/12

NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

002.017 CRIS0080273
CRYOGENIC PRESERVATION OF SPERM FROM STRIPED BASS

KERRY J H; BLUSH M T; ZOOLOGY; N CAROLINA STATE
UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05461 Project Type: STATE
Agency ID: SAES Period: 01 OCT 79 To 31 DEC 83

OBJECTIVES: Improve freezing techniques for striped bass sperm to achieve more consistent results; develop methods for freezing large volumes of semen for use under hatchery production conditions.

APPROACH: Striped bass sperm will be cryopreserved using previously developed extenders and dimethyl sulfoxide as the cryoprotectant. Sperm will be frozen at different, carefully controlled rates and different types of containers (french straws, NUNC vials, and blood bags) and stored in liquid nitrogen.

Samples will be thawed and fertilization tests will be used to determine conditions under which fertilization capacity of the cells is maximized.

PROGRESS: 80/01 TO 80/12. Striped bass semen was cryopreserved at various carefully controlled freezing rates (from -1 to -30 degrees C/min) using four previously developed extenders. Dimethylsulfoxide (5% of media) was used as a cryoprotectant. Results of fertilization experiments indicated that the freezing rate needs to be at least -5 degrees C/min for acceptable results, but more rapid rates (up to -30 degrees/min did not appear to provide additional improvement. Egg quality was frequently a problem, however, and may have helped to mask freezing rate effects. Work this year demonstrated that mass production of striped bass fry using cryopreserved sperm is feasible, but is not yet as efficient as using fresh sperm. Over 2,000,000 fry were produced using the frozen sperm. Two separate pond experiments (utilizing six 1.0-acre ponds and six 0.5-acre ponds) indicated no significant differences in survival or growth between fish produced using fresh sperm and fish produced with cryopreserved sperm.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

002.018 CRIS0078543
AN EVALUATION OF STRIPED BASS X WHITE BASS HYBRIDS
AND STRIPED BASS X WHITE PERCH HYBRIDS

KERRY J H; BLUSH M T; KELLER R R; ZOOLOGY; N CAROLINA
STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05430 Project Type: STATE
Agency ID: SAES Period: 01 JAN 79 To 31 DEC 81

OBJECTIVES: To evaluate the potential of striped bass x white bass and striped bass x white perch hybrids for use in aquaculture and to disseminate acquired knowledge to interested individuals.

APPROACH: Hybrids will be cultured in 0.1 hectare ponds using both fresh and brackish (ca. 10 0/100) water sources. Two ponds will be used for cage culture experiments to evaluate hybrid response to limited space and crowding. The experiments will provide data concerning comparative survival, growth and adaptability of the two hybrids to pond and cage culture in both fresh and brackish water. Additionally, food preferences of the larval hybrids will be determined.

PROGRESS: 80/01 TO 80/12. Approximately 1.3 million larval striped bass x white bass and 0.6 million striped bass x white perch larvae were produced using artificial fertilization procedures, demonstrating for the second year that the hybrids can be readily produced using existing techniques. Most were placed into intensive culture troughs at the project site. The remainder were stocked in ponds at the Dennis Wildlife Center and the Orangeburg National Fish Hatchery in South Carolina for grow-out to fingerlings. Because culture ponds were not completed at the project site, fish were cultured under intensive conditions in the laboratory and in a series of 24-foot diameter (11,000 gallon capacity) plastic-lined pools. An important advance was development of a method to train larvae to accept dry diet at an earlier age. By presenting large concentrations of small particles of the dry food, and by keeping it in constant motion through vigorous aeration of the water, we were able to convert the larvae to dry diet at about 15 mm. Previously larvae did not convert until they were 40 mm long. Fingerling striped bass x white bass hybrids obtained from the Orangeburg NFB in January were grown in plastic-lined pools and in cages until September 1980. Mean weight when stocked was 8.1 g (range = 3.0 - 33.0 g). At harvest the fish weighed an average of 266 g (range = 32 - 522 g).

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

002.019
FISH GENETICS

CRIS0026750

SCHRECK C E; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CCEVALLIS, OREGON. 97331.
Proj. No.: ORE00846 Project Type: STATE
Agency ID: SAES Period: 20 JUL 66 To 01 JUL 80

OBJECTIVES: Conduct original research in fish genetics and ecology. Apply findings of research toward clarification of existing problems of race identification, hatchery improvement, evolution of fishes, and genetic tolerance to heavy metal poisoning for fishes. Incorporate graduate instruction and research into each of the above objectives.

APPROACH: Population genetics, DNA homology studies, cytogenetic and Mendelian genetics studies, toxicity studies, and graduate level instruction in fish genetics and fish culture.

PROGRESS: 80/01 TO 80/12. Objectives include facilitating salmon and trout culture by determining phenotypic control of development, particularly stages during smoltification. Experiments on effects of transportation of coho and chinook indicated that post-release performance could be affected. Wild cut-throat tend to dominate hatchery coho salmon. Detection of imprinting odorants may vary during smoltification. Hormone therapy can be used to induce spawning in coho salmon in both fresh and saltwater.

PUBLICATIONS: 80/01 TO 80/12

- DELAHUNTY, G., SCHRECK, C.E., SPECKER, J., CICESE, J., VODICNIK, M.J. and DEVLAMING, V. 1979. The Effects of Light Reception on Circulating Estrogen Levels in Female Goldfish, *Carassius auratus*: Importance of Retinal Pathways
- DELAHUNTY, G., SCHRECK, C.E. and DEVLAMING, V.L. 1980. Effects of Photoperiod on Plasma Corticoid Levels in the Goldfish, *Carassius auratus*: Role of the Pineal. *Comp. Biochem. Physiol.* 65A: 355-358.
- EJIKÉ, C. and SCHRECK, C.E. 1980. Stress and Social Hierarchy Rank in Coho Salmon. *Trans. Am. Fish. Soc.* 109:423-426.
- BEDDING, J.M. and SCHRECK, C.E. 1979. Adaptive Significance of Certain Enzyme Polymorphisms in Steelhead Trout (*Salmo gairdneri*). *J. Fish. Res. Board Can.* 36(5):544-551.
- SPECKER, J.L. and SCHRECK, C.E. 1980. Stress Responses to Transportation and Fitness for Marine Survival in Coho Salmon (*Oncorhynchus kisutch*) Smolts. *Can. J. Fish. Aquatic Sci.* 37(5):765-769.

002.020 CRIS0067332
GENETIC STUDIES OF ABERNATHY CREEK CHINOOK SALMON

SCHRECK C E; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CCEVALLIS, OREGON. 97331.
Proj. No.: ORE00277 Project Type: STATE
Agency ID: SAES Period: 01 JAN 74 To 30 JUN 78

OBJECTIVES: Determine the relative survival and antibody titers between biochemical genotypes; determine the genotype frequencies in juveniles produced and released at Abernathy Creek, and subsequently, to determine the genotype frequencies in the adults returning to Abernathy Creek.

APPROACH: Protein systems previously examined for genetically based variability in chinook salmon will be used in addition to any other variable systems found. The genetic basis of variables will be validated by comparing parental and offspring genotypes for the 1973 brood. Tissue samples from the 1973 brood parents adequate for these analyses have been obtained and samples from their offspring will be obtained prior to release early in 1974. Samples for the required analyses will be obtained from "production" fish prior to release in 1974, 1975, and 1976. Tissue samples from adults returning to Abernathy Creek in 1974, 1975, and 1976, and from smolts released in 1974 and 1975 will be examined also. Electrophoretic studies will be conducted to determine isozyme variation. Microtiters for several

diseases.

PROGRESS: 78/01 TO 78/12. Fall chinook salmon selected for yield (return to fishery plus hatchery) did not produce offspring with a higher survival in the hatchery up to the time of release.

PUBLICATIONS: 78/01 TO 78/12
NO PUBLICATIONS REPORTED THIS PERIOD.

002.021 CRIS0069128
BIOCHEMICAL GENETICS AND CYTOGENETICS OF TROUT

WRIGHT J E; BIOLOGY; PENNSYLVANIA STATE UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA. 16802.
Proj. No.: PEN02213 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 76 To 30 JUN 80

OBJECTIVES: Determine soluble protein types, their genetic bases, linkage and cytogenetic relations, and pleiotropic effects; banding patterns of chromosomes to be determined; use of these traits in differentiating strains of trout.

APPROACH: Tissue samples of trout strains from Pennsylvania Fish Commission and Federal hatcheries will be subjected to electrophoresis and histochemical staining to detect protein types. Genetic, statistical, and cytogenetic analyses, including chromosome banding patterns, will be performed on trout which differ for these traits.

PROGRESS: 76/07 TO 80/06. Electrophoretic examination of approximately 25 enzymes involving 40 gene loci in the tetraploid derivative trouts provided the basis for joint segregation analyses of pairwise combinations of loci. From over 400 such combinations in testcross matings involving 21 loci, nine linkage groupings were found in brook trout and/or lake trout x brook trout hybrids. Six are classical linkage groups since both males and females showed non-random assortment of loci. Three cases involving duplicated loci for LDH, MDH and AAT show pseudolinkage; that is, random assortment in females but excess non-parental gametes from males. The 2n chromosome number in brook trout strains studied was 84, consisting of 68 acrocentrics and 16 metacentrics. All females show the expected 42 bivalent pairing at meiotic pachytene, but males show variable numbers of bivalent (homologous) and tetravalent (homoeologous) pairs at metaphase I. Tetravalents consist of two metacentrics and two acrocentrics - the apparent evolutionary result of centric fusions of non-homologous acrocentrics to form metacentrics whose one arm pairs sometimes with homoeologous acrocentrics in the male environment. Male pseudolinkage of duplicated loci may be explained by homoeologous (tetravalent) pairing in which marker alleles on metacentrics and those on acrocentrics are transmitted to separate (non-parental) gametes. Crossing over in the tetravalents would account for another observed result in which unexpected progeny types occur in low frequency.

PUBLICATIONS: 76/07 TO 80/06

- MAY B., STONER KING M., WRIGHT J.E. 1980. Joint segregation of biochemical loci in Salmonidae: II. Linkage associations from a hybridized 'Salvelinus' genome. *Genetics*. 95:707-726
- WRIGHT J. E., MAY B., STONER KING M., LEE G. M. 1980. Pseudolinkage of the duplicated loci for supernatant aspartate aminotransferase in brook trout. *J. Heredity*. 71:223-228

002.022 CRIS0076879
BIOCHEMICAL GENETICS AND CYTOGENETICS OF TROUT

WRIGHT J E; BIOLOGY; PENNSYLVANIA STATE UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA. 16802.
Proj. No.: PEN02477 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 80 To 30 JUN 84

OBJECTIVES: Determine the genetic bases of electrophoretically variable isozymes in brook, brown, rainbow and lake trout and hybrids; study chromosomes of normal and sex-reversed fish; and

relate these studies to evolution of trout genomes.

APFECACH: Electrophoresis and histochemical staining of tissue extracts of trout from state and federal hatcheries will identify trout to be mated to maximize the number of gene loci to be studied for joint segregation analyses. Cytogenetic analyses, including chromosome banding patterns, will be performed on normal and sex-reversed parents and progeny.

PROGRESS: 80/07 TO 80/12, The 2n chromosome number was found to be 60 (44 metacentrics, 16 acrocentrics) in most of our rainbow trout strains, 58 (46 metacentrics, 12 acrocentrics) in others, and 58, 59 (45 metacentrics, 14 acrocentrics), or 60 in one strain. This variation in number represents homozygosity (2n = 58) or heterozygosity (2n = 59) for a Robertsonian (centric fusion) translocation of two acrocentrics. In all strains, a sub-acrocentric sex chromosome pair is discernible, the male being the heterogametic sex. Meiotic studies reveal bivalent pairing in females but highly pairing patterns within individual males. In the 2n = 58 or 60 males, metacentrics pair in bivalent, tetravalent, or hexavalent rings or as rod tetravalents having two metacentrics and two acrocentrics; remaining acrocentrics pair as rod bivalents. In 2n = 58 males (heterozygotes for Robertsonian fusion) the metacentric pairs with two acrocentrics to form a trivalent rod. In 2n = 60 males octavalent rings are present also. All male meiotic figures contain a unique subacrocentric rod bivalent, apparently the sex chromosomes. The multivalent and bivalent pairing patterns apparently represent random, mixed homoecologous or homologous pairing in males of this tetraploid derivative species. Evolution of the tetraploid karyotype towards a diploid one was through the fusion of non-homologous acrocentrics, coupled with retention of homology among duplicated chromosome arms in males.

PUBLICATIONS: 80/07 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

002.023 CRIS0076533
FRESHWATER FOOD ANIMALS

MCGINTY A S; ANIMAL INDUSTRY; UNIVERSITY OF PUERTO RICO, RIO PIEDEAS, PUERTO RICO. 00928.
Proj. No.: PK00322 Project Type: HATCH
Agency ID: CSRS Period: 14 SEP 78 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals cultured for food: Nutrition, genetics and breeding and culture systems.

APPROACH: Experiments will be designed to determine practical feeds for Tilapia spp. under tropical conditions. Digestibility coefficients for these diets will be determined for each species. Development and evaluations of suitable breeding and sexing techniques for mass production of Tilapia species and monosex hybrids. Determine optimum stocking densities and growth of Tilapia spp. in cage cultures and ponds utilizing supplementary feeding and/or pond fertilization. Flavor and texture of the fish (fresh and processed) will be determined by organoleptic tests.

PROGRESS: 80/01 TO 80/12. Six 1 m 3 floating cages were suspended in three 0.1 ha ponds and stocked with either 150, 300, 450, or 650 Tilapia nilotica fingerlings (75 to 125 mm/long) per cage. At least one of these densities was either fed a 30% protein sinking pellet at a rate of 4% total body weight daily, six days per week, or not fed. This preliminary study was conducted for 77 days at which time the fish from each cage were weighed and measured. Fish that were not fed merely maintained their initial stocking weight, regardless of density. Fish fed 4% daily gained 0.77, 0.70, 0.58, and 0.53 g/day in cages stocked with 150, 300, 450, and 600 fish/cage, respectively. This indicated T. nilotica fed a complete ration grew at a slower rate in cages when stocked at higher densities. The above preliminary study indicates the need to determine the

optimum stocking density of T. nilotica in cages. The effects of pond size may also be important and needs to be studied in conjunction with density. An experiment will be conducted during 1981 to determine these effects. Cages will be suspended in ponds of either 0.70 ha or 0.16 ha and stocked with either 250, 500, 750, or 1000 fingerlings/cage. All fishes will be fed an equal percentage of the total body weight per cage.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

002.024 CRIS0071721
BREEDING EXPERIMENTS WITH SALMONIDS

SMITH L T; ANIMAL SCIENCE; UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: RI00822 Project Type: HATCH
Agency ID: CSRS Period: 15 NOV 76 To 14 NOV 81

OBJECTIVES: Two major problems in profitable rearing of cultured salmon are; reduced growth rate at the onset of sexual maturation and subsequent death of a proportion of the stock during spawning. Fish sterility might alleviate both problems. Induced triploidy in plaice and plaice x flounder hybrids are partially or completely sterile, but the condition has not been described for salmon. In addition, systematic selection should increase the process of domestication and improve growth, feed conversion, and carcass quality in salmon under intensive fish culture systems.

APPROACH: Eggs stripped from ripe female trout will be exposed to various levels of colchicine and related compounds to induce polyploidy which will be determined by chromosome analysis of the embryo cells. Growth, viability, and the development of sexual activity in polyploidy fish will be evaluated. Salmonid species and hybrids will be obtained and evaluated on their performance in water re-use systems.

PROGRESS: 80/01 TO 80/12. The production of polyploidy by induced spawning and cold shocking was completed. Mosaic polyploids were produced and their growth and development followed. They appear to grow at a faster rate and no sterility was noted. Work was begun in sex alteration with the feeding of .004 mg methyltestosterone for 900 degree days to fry coming on feed. Results were variable with some sterility resulting. Alteration of the sex ratio was in favor of males but not significantly so. The Atlantic salmon kelts were reconditioned but mortality to disease was extreme. Post mortem's indicated fish were developing eggs for fall spawning. Only one fish survived to spawn. Thirteen survived at the DEM facility, however, only one spawned. Canadian kelts were obtained in December 1980 for reconditioning.

PUBLICATIONS: 80/01 TO 80/12
LEMOINE, H.L. and SMITH, L.T. 1980. Polyploidy Induced in Brook Trout by Cold Shock. Transactions of the American Fisheries Society 109:626-631.

002.025 CRIS0071695
FRESHWATER FOOD ANIMALS

WILSON J L; FORESTRY & WILDLIFE; UNIVERSITY OF TENNESSEE, KNOXVILLE, TENNESSEE. 37916.
Proj. No.: TEN00491 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for Freshwater animals cultured for food.

APPROACH: Standard methods will be employed to determine the effects of steroids and selected marking techniques (branding, tagging, mutilation) on survival and growth of catfish. Polycultural methods using food fishes such as catfish, sunfish hybrids, etc., will be compared to monocultural practices as relating to growth and total production.

PROGRESS: 80/01 TO 80/12. Experimentation evaluating the feasibility of polyculturing channel catfish and tilapia in a high-density, flow-through system was completed. Growth and condition of catfish were significantly reduced in all polyculture treatments as compared to monoculture treatment. Correlation of species densities (3:1, 6:1, 12:1 tilapia/catfish) and growth of catfish resulted in a significant negative relationship. Tilapia growth and condition were unaffected except at the highest stocking density. Water quality parameters were similar between the treatments, except for dissolved oxygen levels which at times were lower in the polyculture treatments. A tetracycline-resistant strain of *Edwardsiella tarda* was isolated from infected fish; this is the first report of this strain in channel catfish. Preliminary work was restricted to examine the feasibility of using freshwater mussels as a food source. Replicate samples using the washboard variety of mussel are being examined for composition, microbial profile, and quality of surrounding water.

PUBLICATIONS: 80/01 TO 80/12

HILTON, E. and WILSON, J.L. 1980. Tetracycline-resistant *Edwardsiella tarda* in Channel Catfish. *Prog. Fish Culturist* 42(3):159.
HILTON, E. 1980. Effects of Tilapia Densities on Growth of Channel Catfish in Flow-through Polyculture. M.S. Thesis, 29 pp. The University of Tennessee, Knoxville.

002.026 CRIS0075320
METAPHASE CHROMOSOME BANDING OF FRESHWATER FISHES

GOLD J R; EICKHAM J; PLANT SCIENCE; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06187 Project Type: BATCH
Agency ID: CSRS Period: 28 APR 78 To 27 APR 83

OBJECTIVES: Development of techniques and procedures which give consistent chromosome banding of rainbow trout, largemouth bass and channel catfish. Application of chromosome banding to fish resource management and teleostean research.

APPROACH: Analysis of metaphase chromosome banding patterns of populations of these freshwater fish species (rainbow trout, *Salmo gairdneri*; largemouth bass, *Micropterus salmoides*; and channel catfish, *Ictalurus punctatus* will be undertaken using basic and established methods in order to resolve individual, unique chromosomes of each species. The resolution of individual chromosomes will be used in both applied and basic research.

PROGRESS: 80/01 TO 80/12. We have recently obtained at least partially banded karyotypes for four species belonging to three cyprinid fish genera. Our findings show that longitudinal patterns such as G-, Q-, and R-bands appear conserved in these fishes, at least to the level generally observed in many vertebrates. Constitutive heterochromatin (C-) banding patterns, however, appear heterogeneous both within and among species. This type of chromosomal variation may thus be of considerable importance in documenting genetic differentiation among populations of fish species, and in understanding the role of this type of chromatin structure in the genetics and development of fishes. Much of our work in the coming year will focus on this type of variation. Another important recent finding was the discovery of an apparent gene amplification event in the common minnow, *Notropis lutrensis*. Briefly, using silver impregnation techniques, we were able to demonstrate nearly a three-fold increase in chromosomal material on the short arm of the sex chromosome in this species. This was an important observation for two reasons. First, much of the amplified material contained the chromosomal genes for ribosomal RNA. These are vital genes relative to cell growth and function, and it may now be possible to experimentally alter growth rates in fish by manipulating ribosomal DNA content. The second reason was that the remainder of the amplified material was acromatically and homogeneously stained.

PUBLICATIONS: 80/01 TO 80/12
GOLD, J.R., KAREL, W.J. and STRAND, M.R. 1980. Chromosome Formulae of North American Fishes. *The Progressive Fish-Culturist* 42:10-23.
GOLD, J.R. 1980. Chromosomal Change and Rectangular Evolution in North American Cyprinid Fishes. *Genetical Research* 35:157-164.

002.027 CRIS0061207
FRESHWATER FOOD ANIMALS

STICKNEY R R; STRAWN K; COBB E E; WILDLIFE & FISHERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX02831 Project Type: BATCH
Agency ID: CSRS Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals cultured for food, including: Nutrition, genetics and breeding, water quality, diseases, and culture systems. Develop and improve products and processing methods that will enhance marketability and insure quality of cultured freshwater food animals.

APPROACH: Various methods will be utilized to meet the objectives of the overall S-38 project in the several cooperating institutions. The thrust of the Texas Agricultural Experiment Station will be on channel catfish, Tilapia and freshwater shrimp, with emphasis being placed on objectives I above, especially nutrition, water quality and culture systems.

PROGRESS: 80/01 TO 80/12. Lipid energy requirements of channel catfish fry were evaluated with semipurified diets over the period from onset of feeding until the fish reached several grams in weight. The data obtained will be utilized to aid in the preparation of fry feeds specifically developed for channel catfish. It is anticipated that the protein: energy ratio will be adjusted as food particle size is increased during the initial year of life. Semipurified diets with varying lipid sources and percentages revealed no significant differences in channel catfish fingerling growth over the lipid range from 6 to 14% at a mean temperature of 22 degrees C, though fish fed 10% lipid were slightly larger in mean size at the end of the 20 week experiment. Fatty acid composition revealed that there were no significantly different patterns among diets with the same lipid source, but there were differences among lipid sources with respect to final fatty acid composition. Polyculture studies with freshwater shrimp and tilapia revealed some depressed growth when the two were stocked together, but in general, feeding on the basis of estimated fish biomass will yield a secondary shrimp crop, without the need to provide shrimp feed. Overwintering of large numbers of tilapia is being conducted to determine if the technique is feasible for use in central Texas and to provide fish for a study of second year growth potential of this fish. Plastic and fiberglass covered ponds as well as indoor overwintering facilities are being compared.

PUBLICATIONS: 80/01 TO 80/12
BENDERSON-AEZAPALC, A., STICKNEY, R.R. and LEWIS, D.H. 1980. Immune Hypersensitivity in Intensively Cultured Tilapia Species. *Trans. Am. Fish. Soc.* 109:244-247.
YINGST III, W.L. and STICKNEY, R.R. 1980. Growth and Survival of Caged Channel Catfish (*Ictalurus punctatus*) fingerlings on Diets Containing Various Lipids. *Prog. Fish-Cult.* 42:24-26.
BURNS, E.P. and STICKNEY, R.R. 1980. Growth of Tilapia aurea in Ponds Receiving Poultry Wastes. *Aquaculture* 20:117-121.
CUENCO, M.L. and STICKNEY, R.R. 1980. Reliability of an Electrode and a Water Analysis Kit for Determination of Ammonia in Aquaculture Systems. *Trans. Am. Fish. Soc.* 109:571-576
MCGEACHIN, R.E. 1980. Production of Tilapia aurea in Simulated Lagoons Receiving Laying Hen Wastes. Ph.D. Dissertation, Texas A&M University, 71 pp.

002.028 CRIS0062972
DEVELOP OF AQUACULTURE SYSTEMS FOR COOL WATER FISH SPECIES

CALBERT B E; FOOD SCIENCE; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.
Proj. No.: WIS01953 Project Type: STATE
Agency ID: SAES Period: 01 SEP 72 To 30 AUG 81

OBJECTIVES: Maintain a facility for fish growing operations and research as a service unit. Improve the reproductive efficiency of cool water species of fish to be used in aquaculture. Improve the acceptability and nutritive value of formulated feeds used in aquaculture. Improve methods of yellow perch fingerling production.

APPROACH: The aquaculture research facility at 6080 McKee Road, Madison, WI and the outside ponds on the UW Experimental Farms will be maintained and operated to provide research facilities and fish to be used in aquaculture research. Selective breeding of yellow perch and other cool water species will be used to improve the strains of fish and adapt them to aquaculture operations. Studies on the preservation of fish sperm, ova, and fertilized eggs by cryobiological methods will be made. Various types of protein sources will be investigated for incorporation into formulated diets used in fish growing operations. The care, management and productivity of outside ponds for fingerling production will be investigated.

PROGRESS: 79/01 TO 78/12. Project emphasis over the past 4 years has been on developing methods of commercially culturing yellow perch indoors in closed water-recycling systems. Research has shown that this type of culture is technically feasible, through the application of sanitary engineering principles but is too capital intensive for commercial development. Project emphasis has been shifted to pond, raceway and cage culture, both for commercial applications and wild fisheries enhancement. The project has also worked extensively on diet development, control of reproduction, cryopreservation of sperm, and fingerling production of coolwater species of fish. Dietary recommendations regarding coolwater fish production have been made available through the National Coolwater Fish Diet Steering Committee. Methods for controlling reproduction in coolwater fish have been developed and applied to improve the predictability of spawning. Sperm from yellow perch, northern pike and walleye have been frozen, stored and later used to fertilize eggs. Such research will aid in improving the efficiency and profitability of fish rearing operations, whether they be for commercial purposes or fishery enhancement.

PUBLICATIONS: 79/01 TO 78/12
NO PUBLICATIONS REPORTED THIS PERIOD.

3. Diseases, Parasites, Pests, Weeds

003.001 CRIS0045406
TRANSMISSION OF CULTURED CATFISH VIRUS: DETECTION BY IMMUNOLOGICAL METHODS

PLUMB J A; KLESIOUS P B; AGRICULTURAL EXPR. STATION; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
Proj. No.: 7002-20440-001-A Project Type: COOPERATIVE AGREEMENT
Agency ID: AFS Period: 05 JUN 79 To 31 MAY 82

OBJECTIVES: Determine vertical transmission of channel catfish virus disease by adult catfish to susceptible young fish by immunological methods.

APPROACH: Current immunological procedures will be evaluated as techniques for detecting virus in artificially-infected broodstock and naturally-infected fingerlings. Isolation of virus will be attempted by tissue culture techniques from broodstock and fingerlings. Reproductive products and

excretory products of broodstock will be collected and assayed for virus. Egg massed, fry and fingerlings will be assayed for virus by serological and tissue culture techniques.

PROGRESS: 80/01 TO 80/12. The indirect and direct immunofluorescent antibody techniques are being evaluated for detection of channel catfish virus in tissue culture cells. The direct immunofluorescent antibody technique has worked to detect virus in infected catfish. The variables of the immunofluorescent antibody techniques are being studied for making the techniques diagnostic.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.002 CRIS0082089
TRANSMISSION AND IMMUNOLOGY OF CHANNEL CATFISH VIRUS DISEASE OF CULTURED CATFISH

PLUMB J A; KLESIOUS P B; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
Proj. No.: ALA-27-0007 Project Type: GRANT
Agency ID: CSRS Period: 01 JUL 80 To 01 JUL 83

OBJECTIVES: Demonstration of a carrier state or latency of channel catfish virus in channel catfish (CCV). Determine the mode of vertical CCV transmission through a breeding study. Determine the influence of environmental factors on the epizootiology of CCV disease.

APPROACH: The carrier state will be demonstrated by infecting susceptible fish and applying virological and immunological techniques; the site of virus replication will be determined. Latency will be studied by attempts to restimulate CCV shedding through various stress and other types of techniques. Vertical transmission will be demonstrated by utilizing survivors of known CCV epizootics on broodstock and hatching and holding progeny to demonstrate virus transmission. Effects of environmental stress on CCV outbreaks will be demonstrated by exposing sub-lethally infected fish to various environmental conditions including crowding, low O₂, high temperature, etc.

PROGRESS: 80/07 TO 80/12. Efforts to perfect the application of FA procedures for detection for CCV are continuing using goat anti-CCV serum in both the direct and indirect method. Results are inconsistent in CCV infected cell cultures and fish. Preliminary experimental infections in sub-adult channel catfish resulted in isolation of CCV from gonads, kidney and spleen at 72 hr PI but not from liver or brain. At 144 hr. PI, CCV was isolated only from gonade. Indirect FA procedures failed to demonstrate virus antigen in any tissues. Experiments are underway to study the vertical transmission of CCV.

PUBLICATIONS: 80/07 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.003 CRIS0060554
FRESHWATER FOOD ANIMALS

PLUMB J A; ROGERS W A; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
Proj. No.: ALA00340 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 71 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals or cultured for food - Diseases.

APPROACH: Channel and hybrid catfish will be challenged by several routes of infection with channel catfish virus in aquaria. Experimentally and naturally infected adult and juvenile channel catfish will be tested by neutralization and fluorescent antibody techniques for CCV transmission and carrier. By artificially altering the environment, fish will be stressed and tested for susceptibility to disease.

Immunology of "Icb" to fish will be studied in channel catfish and potentials of vaccination evaluated.

PROGRESS: 80/01 TO 80/12. Adult channel catfish from a population with a history of CCV infected offspring had antibody-titers from 0.00 to 1.14 against 100 TCID₅₀ of CCV per 0.1 ml in mid-April. Females were injected with Eetamethazone (immunosuppressant) at 0.25 and 0.125 mg/kg and 3 wks. later spawned. CCV antibody titers did not change. CCV was not isolated from internal organs of the test fish immediately after spawning, but indirect FA application to frozen sections of ovarian tissues revealed what appeared to be ioci of CCV antigen. Also primary cell cultures from ovarian tissues showed positive fluorescent foci of CCV antigen. Transmission electron microscopy of gonadal tissue revealed no CCV particles. Fry resulting from spawning could not be maintained long enough for adequate CCV assay. An enzyme immunoassay (EIA) has been developed to detect two species of Edwardsiella in fish. Specific antibodies were developed in rabbits and the indirect test run using peroxidase conjugated goat-anti-rabbit antisera. Several substrate compounds were used with best result obtained from 3,3 diaminobenzidine. Preliminary tests in the laboratory show that the EIA compares favorably with the fluorescent antibody technique. Further testing in the lab and field will be conducted.

PUBLICATIONS: 80/01 TO 80/12

ECWSEK, P.E. and PLUME, J.A. 1980. Channel Catfish Virus: Comparative Replication and Sensitivity of Cell Lines from Channel Catfish Ovary and the Brown Bullhead. J. Wildl. Dis. 16(3):451-454.

ECWSEK, P.E. and PLUME, J.A. 1980. Growth Rates of a New Cell Line from Channel Catfish Ovary and Channel Catfish Virus Replication at Different Temperatures. Can. J. Fish. and Aquat. Sci. 37(5):871-873.

WALLENS, G.E. and PLUME, J.A. 1980. Environmental Stress and Bacterial Infection in Channel Catfish. J. Fish. Biol. 17:177-185.

003.004 CRIS0056021
COOPERATIVE FISH PARASITE AND DISEASE STUDY

ROGERS W A; FLUMB J A; FISHERIES & ALLIED
AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA.
36830.

Proj. No.: ALA-27-0002 Project Type: STATE
Agency ID: SAES Period: 01 JUL 69 To 30 JUN 79

OBJECTIVES: Determine the disease producing organisms responsible for epizootics in fish populations in each of the seven cooperating states. Conduct research on identification, life history, epizootiology, pathogenicity and control of organisms associated with fish kills.

APPROACH: Sites of fish kills will be visited by project personnel to collect dead and dying fish. Fish collected by State biologists will be shipped to Auburn. Collected fish will be examined using standard parasitological and microbiological techniques. Isolated pathogens will be utilized to produce diseases in laboratory fish for research.

PROGRESS: 80/01 TO 80/12. A total of 303 fish cases was received for disease diagnosis at the Southeastern Cooperative Fish Disease project laboratory during 1980. Of these, 13 (4.3%) were viruses, 86 (28.4%) were bacterial, 58 (19.1%) were parasitic, and 146 (48.2%) were miscellaneous. Aeromonas sp was the most prominent pathogenic organism. Drug sensitivity was conducted on all bacterial isolates. Golden shiners (Notemogonus crysoleucas) infected with golden shiner virus yielded virus from kidney, liver and spleen at 23 degrees C and 28 degrees C. Virus titers were higher at 28 degrees C than 23 degrees C. Largemouth bass, bighead carp, Tilapia sp. and golden shiners could not be experimentally infected with Edwardsiella sp., the causative agent of enteric septicemia of catfish. An enzyme immunoassay was developed for detecting Edwardsiella tarda and E. sp. of catfish compared favorably with the fluorescent antibody test in

laboratory experiments. Phagocytes were separated from whole channel catfish blood by isopycnic centrifugation on PVF coated colloidal silica and were used in a luminol-dependent phagocytic chemiluminescent assay to determine the effect of temperature on the cellular immune response in channel catfish.

PUBLICATIONS: 80/01 TO 80/12

MITCHELL, A.J. and PLUME, J.A. 1980. Toxicity and Efficacy of Furance on Channel Catfish Infected Experimentally with Aeromonas hydrophila. J. Fish. Dis. 3:93-99.

ECWSEK, P. R. and PLUME, J.A. 1980. Fish Cell Lines: Establishment of a Line from Ovaries of Channel Catfish. In Vitro. 16:365-268.

SCHWEDLER, T.E. and PLUME, J.A. 1980. Fish Viruses: Serologic Comparison of the Golden Shiner and Infectious Pancreatic Necrosis Viruses. J. Wildl. Dis. 16:587-599.

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003.005 CRIS008266J
MANAGEMENT STRATEGIES FOR RICE PESTS

TUGWELL N P; LEE F N; SMITH R J; RICE-PASTURE RES &
EXT CENTER; RICE-PASTURE RES & EXT CENTER, STUTTGART,
ARKANSAS. 72160.

Proj. No.: AR.S104E Project Type: STATE
Agency ID: SAES Period: 01 JUL 80 To 30 JUN 83

OBJECTIVES: Develop improved practices and systems for control of rice sheath blight, blast, red rice, grass-broadleaf - aquatic weed complexes and the grape colaspis.

APPROACH: Disease - Rice sheath blight and blast nurseries will be expanded and evaluated for disease resistance. Optimum rates, times and methods of application of fungicides for disease control will be determined in inoculated plots. Estimates will be made of damage thresholds under different inoculum and fertility levels and cultural practices. Spatial distribution of inoculum in rice will be determined by intensive surveys. Weeds - Replicated experiments will be conducted at several locations to compare efficacy of treatments for control of red rice in rice and crops rotated with rice and for control of grass-broadleaf - aquatic weed complexes in rice. Control programs for rice will emphasize herbicides other than those of the phenoxy group. Insects - Extensive surveys will be made across rice/soybean growing areas. Intensive surveys will be made within highly infested field where insecticides will be screened in replicated plots for grape colaspis control.

003.006 CRIS0003201
WEED CONTROL IN RICE PRODUCTION

SMITH R J; AGENOMY; UNIVERSITY OF ARKANSAS,
FAYETTEVILLE, ARKANSAS. 72701.

Proj. No.: ARK00419 Project Type: STATE
Agency ID: SAES Period: 01 MAR 70 To 28 FEB 75

OBJECTIVES: Develop more effective chemical, cultural, mechanical, biological, and combination methods of controlling weeds in rice, and in crops grown in rotation with rice.

APPROACH: Evaluate and compare new herbicides and mixtures with standard ones. Determine the effects of weeds and herbicides on yield and quality of rice. Study the interactions of various control methods with the physiology, ecology, morphology, and anatomy of rice, and of annual and perennial weeds. Characterize the effects of selected herbicides on succeeding crops, fish, and other aquatic animal life. Determine the fate of herbicides, applied to rice, in the rice crop, soil, and water, and in other crops grown in rotation with rice.

PROGRESS: 80/01 TO 80/12. Herbicide programs for rice controlled weed complexes better than standard propanil, molinate or phenoxy's. Herbicides that combined effectively with propanil for weed control and safety to rice included thiobencarb, butachlor, oxadiazon, pendimethalin, and acifluorfen. Many of these new treatments substitute applications of propanil or molinate and single applications of 2,4, 1, -D silvex or 2,4-D. Tank mixtures of propanil + MCPA or propanil + acifluorfen controlled weeds growing on leaves and were effective substitutes for propanil + 2,4,5-T. Cropping-herbicide systems controlled red rice; important in this system was control of red rice in rotated crops. Effective treatments in soybeans were ppi alachlor, metolachlor, and tank mixtures of these with pendimethalin; ppi profluralin, UBI-S734, KE-28269 and MCN 037; ppe directed paraquat alone, and tank mixed with 2,4-DB; ppe directed BAS 9052; and ppe overdrop mefluidide + bentazon. Effective in grain sorghum were ppi metolachlor, alachlor, propazine, propazine + metolachlor and alachlor. CGA species controlled northern jointvetch in rice and soybeans; CGJ controlled winged waterprimrose in rice; both effectively combined in a weed-pest management system. All season competition of dayflower reduced rice yields 15-20%, but competition for up to 80 days had no effect. Midseason applications of glyphosate controlled most weed species growing in rice field flooding and draining canals.

PUBLICATIONS: 80/01 TO 80/12

SMITH JR., E.J. 1980. Rice. pp. 118-124. In: Suggested Guidelines for Weed Control (SEDA Agric. Handbook 565, 330 pp.

SMITH JR., E.J. 1980. Progress Report on Weed Control in Rice. Abstracts 19th Annual Meeting Arkansas Agricultural Pesticide Association. pp. 11-12 (Abstract).

SMITH JR., E.J. and SULLIVAN, J.D. 1980. Reduction of Red Rice Grain in Rice Fields by Winter Feeding of Ducks. Arkansas Farm Research. 29(4):1-3.

TEMPLETON, G.E., SMITH JR., E.J., and KUMPARENS, W. 1980. Commercialization of Fungi and Bacteria for Biological Control. Biocontrol News and Information. 1(4):291-294.

003.007 CRIS0044542
CONTROL OF AQUATIC WEEDS BASED ON ALLELOPATHIC CHARACTERISTICS IN SPIKERUSH (ELEOCHARIS SPP.)

ASETON F M; FRANK P A; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: 5090-20281-003-A(1) Project Type: COOPERATIVE AGREEMENT.
Agency ID: ARS Period: 07 JUN 78 To 30 SEP 79

OBJECTIVES: Develop procedures for qualitative and quantitative bioassay of allelopathic compounds in spikerush, *Eleocharis coloradoensis*. Extract, isolate, and identify allelopathic compound(s) present in spikerush.

APPROACH: Growing stands of spikerush will be harvested and natural components extracted and partitioned with organic solvents. The extracts will be partitioned further and isolated using various chromatographic techniques. The allelopathic fraction(s) will be segregated from other fractions by appropriate bioassay, followed by chemical characterization and the development of chemical structure.

PROGRESS: 78/06 TO 79/09. Spikerush (*Eleocharis coloradoensis*) was subjected to several methods of extraction and chromatography. Pure compounds isolated were triclin, luteolin, "gamma-sitosterol," ferulic acid, and dihydroactinidiolide (I). Compound I was synthesized by two routes: Reduction of Beta-ionone (II) to trans-Beta-ionol, phytolysis to cis-Beta-ionol, and Jones oxidation; photolytic ring closure of II to a pyran followed by Jones oxidation. The above compounds were tested for allelopathic activity or inhibition of root elongation of watercress (*Nasturtium officinale*) seedlings and/or of germination of radish seeds. Ferulic acid and dihydroactinidiolide were very active, luteolin

slightly, and triclin and "gamma-sitosterol" inactive. Analogs of dihydroactinidiolide are being synthesized and tested for allelopathic activity (K. L. Stevens). A cultured cell bioassay to rapidly screen allelopathic compounds was developed using rose, tomato, and sugarcane cells. Synthetic allelopathic compounds were detectable below 5 ppm. Using this assay on crude and purified extracts of spikerush from K. Stevens, a strongly inhibitory compound(s) in fractions of aqueous-ethanol extracts was detected. Bioassays using whole or excised plant parts of sage pondweed on these extracts have been negative. To increase the specificity of the cultured cell bioassay, we are attempting to obtain a cell culture of sage pondweed.

PUBLICATIONS: 78/06 TO 79/09
NO PUBLICATIONS REPORTED THIS PERIOD.

003.008 CRIS0045580
A SURVEY FOR PATHOGEN FOR AQUATIC WEEDS IN CALIFORNIA FOR USE IN BIOLOGICAL CONTROL

DUNIWAY J M; ANDERSON L W; AGRICULTURAL EXPER. STATION; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.

Proj. No.: 5090-20282-006-A Project Type: COOPERATIVE AGREEMENT.
Agency ID: ARS Period: 23 AUG 79 To 30 JUN 82

OBJECTIVES: Conduct a survey to discover pathogens that have potential for development as biological control agents for several important submersed aquatic weeds.

APPROACH: Collect, identify, and culture pathogenic-type organisms found on elodea, milfoil, hydrilla, pondweeds, coontail, and algae in the Davis area and other selected localities. Determine the characteristics of infection, transmission, virulence. Study promising phytopathogens for purposes of augmentation, release, and other manipulations.

PROGRESS: 80/01 TO 80/12. Aquatic weeds were sampled at a number of sites in Central and Northern California, usually at 2-4-week intervals during the past growing season and at less frequent intervals during the dormant season. The survey emphasized submersed weeds and algae, but nonsubmersed weeds were also sampled where disease symptoms were apparent. Submersed weeds did not appear to be killed or otherwise generally affected by diseases in the field, but occasionally they had small necrotic or discolored local lesions. Many fungi and a few bacteria were observed and/or isolated from such lesions, and after artificial inoculations in a greenhouse, a few fungi reproduced lesions somewhat like those observed in the field, especially in Eurasian watermilfoil. However, the inoculations have not yet shown that local lesions have a negative impact on weed growth and many of the attempted inoculations failed. Efforts are underway to improve the weed culture and inoculation methods. Some stands of emersed weeds had more apparent symptoms of disease, and several fungi known to be plant pathogens were isolated from apparently diseased specimens of cattail, bullrush and parrot's feather.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.009 CRIS0078667
SURVEY OF DISEASES OF CULTURED FRESHWATER FISHES OF CALIFORNIA

BOWSER P B; ANIMAL SCIENCE; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.

Proj. No.: CA-D*-ASC-3732-AE Project Type: ANIMAL HEALTH
Agency ID: CSRS Period: 19 MAR 79 To 30 SEP 83

OBJECTIVES: Identify infectious diseases which limit production efficiency of freshwater aquaculture in California; identify those diseases of freshwater fishes which limit the production of aquaculture and

determine the extent of these diseases throughout the state; catalog diseases found and describe conditions associated with the epizootics. Management techniques and procedures will be developed by which the aquaculturist can limit or eliminate losses due to disease.

APPROACH: Data will be collected through necropsy of specimens from disease outbreaks at aquaculture facilities. Using the standard procedures of fish pathology, specimens will be examined for parasitic and bacterial infections. Any bacteria isolated will be tested for antibiotic sensitivity. Trout and young channel catfish will also be routinely screened for viral diseases. An effort will be directed toward the development of rapid fluorescent antibody techniques for the diagnosis of bacterial and viral diseases.

PROGRESS: 80/01 TO 80/12. Continuing progress has been made in identifying diseases of freshwater aquaculture species. These diseases represent limiting factors for economic production. Symptoms of these diseases are recorded along with information describing conditions associated with the epizootics. Through this information, management techniques and procedures can be developed to help eliminate losses due to diseases. This survey has also made available diagnostic services to the California aquaculturist. Diseases have been diagnosed for sturgeon, bass, channel catfish, rainbow trout, Koi, freshwater shrimp, goldfish and tropical aquarium fish. The most common disease problem is bacterial, usually caused by *Pseudomonas* sp., *Aeromonas* sp., and *Vibrio* sp. *Flexibacter columnaris* is often seen causing gill necrosis. The parasitic protozoans *Ichthyophthirius*, *Costia* and *Trichodina* were the most often observed. A report of this survey was presented to the annual California Fish Farmers and California Aquaculture Association meeting.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.010
AQUACULTURE PATHOLOGY

CRIS0080249

BOWSER P R; ANIMAL SCIENCE; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ASC-3895-E Project Type: BATCH
Agency ID: CSRS Period: 01 NOV 79 To 30 SEP 83

OBJECTIVES: Investigate the causes of diseases of those marine invertebrate which are being studied under the Aquaculture Program at the Bodega Marine Lab; expand disease diagnostic capabilities of the disease project.

APPROACH: Information on the disease and water quality problems faced by the state's aquaculture industry will be solicited. Established techniques of microbiology, pathology, and bioassay will be used to investigate two diseases of particular interest to the Bodega Marine Lab, namely shell disease syndrome and epibiotic fouling. The initial phase of these studies will involve the isolation of the etiological agents and investigation of the pathogenesis of the disease syndromes. Through in-house training and attendance at workshops and scientific meetings, the expertise of the disease project personnel will be enhanced.

PROGRESS: 80/01 TO 80/12. Continuing progress has been made in establishing a statewide disease diagnostic center for both freshwater and marine aquaculture species. The laboratory has developed the capability for the diagnosis of parasitic protozoans, fungal and bacterial pathogens. Other techniques such as histological transmission and scanning electron microscopy can also be utilized. During 1980, 38 cases from California aquaculturists were diagnosed and corrective treatments recommended. Research and diagnostic work is counting on marine invertebrates being cultured in the Aquaculture Program at the Bodega Marine Laboratory. During 1980, 102 cases were submitted for disease diagnosis from other research groups at the Bodega Marine Laboratory. At the present time, a survey and diagnostic procedures for marine bacterial disease are being conducted. The

water quality lab monitors experimental aquaculture systems for ammonia, nitrite, nitrate and phosphate and has maintained its standards as a state certified water quality laboratory.

PUBLICATIONS: 80/01 TO 80/12

CRANDALL, T.A. and BOWSER, P.K. 1980. The Biology of a Parasite Found in the Mosquitofish *Gambusia affinis*. Proceedings and Papers of the Forty-eight Annual Conference of the California Mosquito and Vector Control Association, Inc.

003.011
BIOLOGICAL CONTROL OF AQUATIC WEEDS WITH COMPETITIVE SPECIES OF SPIKERUSH (ELAEOCHARIS SPP.)

CRIS0045521

ASHTON F M; ANDERSON I W; ROTARY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: 5090-20281-004-A(1)

Project Type:
COOPERATIVE AGREE.

Agency ID: ARS Period: 27 JUL 79 To 30 JUN 84

OBJECTIVES: Conduct a pilot test project to establish use of spikerush (*Elaeocharis* spp.) as a practical approach to control of submersed aquatic weeds in irrigation channels, farm ponds, lakes, and reservoirs.

APPROACH: Select sites for planting spikerush in irrigation channels, ponds, and reservoirs. Survey site to collect data on water quality, soil characteristics, weed species, and weed distribution. Plant spikerush at appropriate times of year as determined by the nature of individual sites. Plot size and number to be determined by availability of seed, length or size of body of water, and opportunity for replication to tests. Determine relationships between water quality, soil characteristics, and other parameters to success of establishment, growth, and spread of spikerush. Determine persistence of spikerush, its ability to encroach into previously established stands of weeds, ability to resist reinvasion of sites by undesirable aquatic species. It is intended that this work will be followed by Phases II through V.

PROGRESS: 80/01 TO 80/12. Field, germination, ecological studies. Traces of spikerush have been found in P800318, in which southern naiad, waterstargrass, leafy pondweed, curlyleaf pondweed and elodea are also present to varying degrees. The growth of spikerush in P791205 is very extensive both upstream, as well as downstream from the planted plots, indicating either an extremely rapid spread from the seed planted, or a natural invasion of the area. An additional ecological study (E800709) has been initiated in a group of small reservoirs in which both spikerush and American pondweed naturally occur. Allelopathy. The effect of spikerush soil leachate on the growth of tomatillo cells was studied. Chromatographic methods will soon be employed to further concentrate the active fraction(s). Dihydroactinidiolide has not been found in the leachate material. Tissue Culture. Research on the development of callus and cell cultures of spikerush and sago pondweed is continuing. Several types of growth media and various hormone levels were used to speed the growth of the callus, as well as produce free cells for suspension culture.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.012
THE USE OF SELECTED AQUATIC ORGANISMS FOR PURPOSES OF AQUACULTURE (FOOD PRODUCTION)

CRIS0066814

KNIGHT A W; LAND, AIR & WATER RESOURCES; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.

Proj. No.: CA-D*-LAW-3350-H Project Type: BATCH
Agency ID: CSRS Period: 05 NOV 74 To 30 SEP 80

OBJECTIVES: Determine the tolerances, growth dynamics, food preference, egg hatchability of selected pest organisms. Utilize existing pest organisms such as tadpole shrimp and cladophora algae

for beneficial purposes such as low cost protein source.

APPROACH: Initially information will be obtained relating to the environmental needs of the organisms under consideration. Later we will manage environmental factors in order to maximize the production of the potential protein material for purposes of either a domestic animal food (i.e., chicken or catfish food) or a protein supplement for humans.

PROGRESS: 80/01 TO 80/12. Preparation of manuscripts resulting from our work with the Malaysian prawn (*Macrobrachium rosenbergii*) continues. These manuscripts focus on physiological aspects of our research and will be submitted to scientific journals in the near future. Research to better understand the laboratory culture of the grass shrimp (*Crangon*) is progressing well. This shrimp is a key food item for striped bass and sturgeon. Those culturing the sturgeon in the laboratory have indicated a need for food that is also under culture and therefore readily available to feed fish. Our research to determine the environmental needs of the shrimp has increased our capabilities to successfully culture this shrimp in the laboratory. Recently we have included the Asiatic clam (*Corbicula*) in our culture operations. This clam exhibits potential as a filter feeder to remove undesirable particulate matter from aquaculture systems. In addition, the clam has demonstrated an ability to accumulate toxic materials such as heavy metals and organic materials. Clams, it is felt, will serve as excellent monitoring organisms in aquaculture systems. We are experimenting with methods of placing the clams in aquatic systems and their retrieval for tissue burden determination.

PUBLICATIONS: 80/01 TO 80/12

STEPHENSON, M.J. and KNIGHT, A.W. 1980. Growth, Respiration and Caloric Content of Larvae of the Prawn *Macrobrachium rosenbergii*. *Comparative Biochemistry and Physiology* 66A(3):385-391.
NAGAMINE, C., KNIGHT, A.W., NAGAMINE, C., KNIGHT, A.W., MAGGENTI, A. AND FAXMAN, G. 1980. Effects of Androgenic Gland Ablation on Male Primary and Secondary Sexual Characteristics in the Malaysian Prawn, *Macrobrachium rosenbergii* with First Evident of Induced

003.013

CEIS0070558

DISEASES OF AQUATIC ANIMALS

RAGGI I G; MEDICINE; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-V*-MED-3470 Project Type: STATE
Agency ID: SAES Period: 01 JUL 76 To 30 JUN 81

OBJECTIVES: Develop a reliable diagnostic method of "Whirling Disease" of Salmonids. Determine the role of diseases in California aquaculture.

APPROACH: Concentration and partial purification of *Myxosoma cerebralis* spores from ground tissue of suspected trout. Specific density of spores as criterion of identification. Bacteriological, virological, and pathological identification of pathogens of California catfish, abalone, oysters, crab and lobster. Experimental reproduction of diseases.

PROGRESS: 78/01 TO 78/12. There is no progress report for the period as the Principal Investigator officially retired to "Emeritus" status during this period.

PUBLICATIONS: 78/01 TO 78/12

NO PUBLICATIONS REPORTED THIS PERIOD.

003.014

CEIS0066708

NEMATODE PARASITES OF FRESHWATER FISH: BIOLOGY AND EFFECTS

MAGGENTI A R; NEMATOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.

Proj. No.: CA-D*-NEM-3121-H Project Type: HATCH
Agency ID: CSRS Period: 16 OCT 74 To 30 SEP 85

OBJECTIVES: Determine the distribution, species, disease incidence and intensity of nematodes parasitic in freshwater, both game and nongame, cold and warmwater fish of the State. Investigate nematode life history and reservoir hosts. Determine the parasitic role in affecting fish growth and mortality. Investigate means of parasite control and management.

APPROACH: Collection and identification and dissection. Effects on growth and mortality will be determined by standard procedures utilized by fishery biologists. Control measures to be investigated are anthelmintics and non-chemical pest management such as manipulation of stream-bank vegetation or fish population rotation by species or resistance.

PROGRESS: 80/01 TO 80/12. Studies continue on the descriptions of two new species of spirurid nematode parasites of rainbow trout from California. Underway is a revision clarifying the genetic validity of *Hulbodonitis*, a nematode commonly occurring in salmonids throughout the world. The revision will contain notes on host specificity. Findings indicate this nematode can also attack fresh water bass species.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

003.015

CEIS0015828

CONTROL OF WEEDS AND CERTAIN OTHER AQUATIC PESTS IN THE PACIFIC SOUTHWEST

ANDERSON L W; YEO & R; USCA-ARS AQUATIC WEED CONTROL RES, DAVIS, CALIFORNIA. 95616.

Proj. No.: S206-20280-001 Project Type: INHOUSE
Agency ID: ARS Period: 26 FEB 70 To 15 NOV 81

OBJECTIVES: Investigate individual and integrated approaches to control aquatic weeds, including herbicides, herbivorous fish and other aquatic fauna, insects, competitive plants, pathogens and other organisms. Investigate physiology, ecology, and biochemistry of aquatic plants in order to understand why and how the weed problems occur, and how effective control programs can be devised.

APPROACH: Find and test in laboratory, greenhouse, and field, biological agents that consume, destroy, or inhibit species of problem aquatic weeds. Discover new herbicides and growth regulators, and devise improved methods of using known phytotoxic chemicals for control of aquatic vegetation. Combine chemical and biological control methods to produce effective and acceptable integrated control programs. Study nutrition, growth, reproduction, and response of aquatic weeds to environmental factors, and utilize this information in programs designed to eliminate weed infestations and to prevent their recurrence.

PROGRESS: 80/01 TO 80/12. Several canals and Sheldon Reservoir in El Centro, Ca., were sampled to determine Hydrilla biomass and tuber density. Fresh biomass varied from 0 to 7.4 kg/m² and tuber density varied from 0 to 423/m² in canals. Biomass varied from 0.64 kg/m² to 2.03 kg/m² and tuber density from 12/m² to 65/m² in Sheldon Reservoir. When water was held in Sheldon Reservoir, concentrations of greater than 1 ppm copper resulted in good control of Hydrilla. Draw-down application of fluridone (without soil incorporation) at 1 or 2 lb/acre did not control Hydrilla. Application of endothal (Aquathol -K R) to a small pond in El Centro resulted in ca. 75% control of Hydrilla. Although continuous contact bioassays of PB 4062 at .25 to 1.0 ppm controlled both algal species, *Cladophora* appeared to be slightly more resistant than *Rhizoclonium*. In limited contact tests, *Rhizoclonium* was controlled one week after exposure to 1.0 ppm concentration of PB4062 for 2 h. while exposure to a 2.0 ppm of PB4062 for 2 h. was necessary for good *Cladophora* control. A dense

infestation of *M. brasilienses* in a drainage canal was controlled by a foliar application of fenac at 15 lb/acre in 200 gal/A spray volume. The degree of control in the canal site was not expected and additional studies on foliar application of fenac will follow. A detailed study of the morphology of *Hydrilla* was made using a scanning electron microscope and normal and polarized light microscopy, and macrophotography.

PUBLICATIONS: 80/01 TO 80/12

- ANDERSON, I. and RAINES, R.W. 1980. Response of *Hydrilla verticillata*, *Elodea canadensis*, and *Myriophyllum spicatum* to combinations of Komeen and Endothall in Moving Water. Abstract, WSWS Research Progress Report, p. 335.
- DECHRELTZ, N. and PINE, R.T. 1980. Evaluation of Komeen for Aquatic Weed Control in Ponds. Abstract, WSWS Research Progress Report, p. 335.
- DECHRELTZ, N. and PINE, R.T. 1980. Control of Submersed Aquatic Weeds in Irrigation Canals with Fluridone. WSWS Research Progress Report, p. 340.

003.016

CRIS0045418

USE OF SPIKERUSH (*ELEOCHARIS* SPP.) FOR BIOLOGICAL CONTROL OF AQUATIC WEEDS

ANDERSON L W; YEO R F; USDA-ARS AQUATIC WEED CONTROL RES, DAVIS, CALIFORNIA. 95616.
Proj. No.: 5106-20280-005 Project Type: INBCUSE
Agency ID: AFS Period: 05 JUL 79 To 05 JUL 84

OBJECTIVES: Conduct a pilot test project to establish use of spikerush (*Eleocharis* spp.) as a practical approach to control submersed aquatic weeds in irrigation channels, farm ponds, lakes and reservoirs.

APPROACH: Establish an extensive nursery for production of spikerush seed. Culture, harvest, clean and make postharvest treatment of seed prior to use for plantings. Select appropriate sites for planting spikerush in irrigation canals, quality, soil and weed species and their distribution. Plant and use herbicides for preplanting or postplanting control of weeds in spikerush plots. Determine relationships of water quality, soil characteristics, and other parameters to success of establishment, growth, and spread of spikerush. Determine persistence of spikerush under varied conditions, and ability of spikerush to encroach into established stands of weeds, and ability to resist reinvasion of sites by undesirable aquatic species. Determine comparative costs of aquatic weed control with spikerush vs other approaches, such as herbicides and mechanical means.

PROGRESS: 80/01 TO 80/12. Dormancy of dwarf spikerush seed was reduced to 6 months by exchanging the storage water every month on seed stored wet at 4 degrees C. In field studies, aquascreen placed over sown dwarf spikerush tubers did not aid in establishing a stand in a canal. It may have helped in a lake study. Aquascreen controlled all vegetation except several shoots of sago pondweed that grew through the apertures; however, these shoots remained stunted and did not obstruct the waterflow. When diuron was applied at 20 and 40 lb/A to dwarf spikerush, and sown tubers and seed, followed by several different leaching rates, it caused some injury to the plants. Normal plants were growing vigorously by the 12th week. After growing submersed with dwarf spikerush plants for two seasons, the growth of American, sago, and horned pondweeds, American and Nuttall's *elodea*, and *Hydrilla* was reduced, but the growth of Eurasian watermilfoil was not. The presence of dwarf spikerush appeared to have stunted the petioles of the floating leaves of American pondweed.

PUBLICATIONS: 80/01 TO 80/12

- FRANK, P.A. and DECHRELTZ, N. 1980. Allelopathy in Dwarf Spikerush (*Eleocharis coloradoensis*). Weed Science, 28:489-505.
- YEO, E.R. 1980. Life History and Ecology of Dwarf Spikerush. Weed Sci. 28:263-272.
- YEO, E.R. 1980. Spikerush May Help Control Waterweeds. Calif. Agric. 34:12-13.

- YEO, E.R., THURSTON, J.R. and FALK, R.B. 1980. Seed Dormancy in Dwarf Spikerush. WSSA Feb. 7-9. Abstracts, p. 20.
- YEO, E.R. and THURSTON, J.R. 1980. Response of Dwarf Spikerush to Several Herbicides. WSWS Research Progress Report.

003.017

CRIS0042356

PHYTOTOXINS FROM AQUATIC AND TERRESTRIAL PLANTS, BACTERIA, AND FUNGI

STEVENS & I; USDA-ARS WESTERN LEG RES CNTR, ALBANY, CALIFORNIA. 94710.
Proj. No.: 5102-20280-001 Project Type: INBCUSE
Agency ID: ARS Period: 11 APR 75 To 11 APR 82

OBJECTIVES: Isolate, identify, and synthesize natural phytotoxins from plants, bacteria, and fungi, and evaluate their potential as aquatic and terrestrial herbicides.

APPROACH: A study will be conducted of plants which have been reported to produce and release phytotoxins detrimental (allelopathic) to adjacent plants. These include: Spikerush (an aquatic sedge), couch grass, leafy spurge, giant foxtail, sunflower and, even, some economic plants such as oats, rye, and barley. Plants will be collected, extracted with a variety of solvents and individual, toxic components separated and identified. Bioassay methods will be used (in cooperation with the Aquatic Weed Research Laboratory, SEA, Davis, California) to identify potential herbicides. Promising phytotoxins, as well as analogs of these natural materials, will be synthesized and their effects on the growth of higher plants evaluated.

PROGRESS: 80/01 TO 80/12. Russian knapweed (*Centaurea repens*) has been extracted and several sesquiterpene lactones identified, viz., cynaropicrin, aguarin, jaserin and acroptilin. Two new compounds, repdiolide and epoxyrepdiolide, were also characterized. Similar sesquiterpene lactones have been isolated from yellow star thistle. These compounds are probably cytotoxic; however, they are non-mutagenic. Preliminary investigation of dormant and non-dormant spikerush seed has been initiated to determine the reasons for dormancy. The allelopathic leafy spurge (*Euphorbia esula*) has been extracted. No alkaloids have been detected.

PUBLICATIONS: 80/01 TO 80/12

- STEVENS, K.L. and MERRILL, G.B. 1980. Growth Inhibitors From Spikerush. J. Agric. Food Chem. 28:644-646.

003.018

CRIS0064485

DIETARY FACTORS IN WHITE FISH MEAL RESPONSIBLE FOR CATARACT FORMATION IN TROUT

AZARI F; BIOCHEMISTRY; COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO. 80523.
Proj. No.: CCL00032 Project Type: STATE
Agency ID: SAES Period: 01 JUL 73 To 30 JUN 80

OBJECTIVES: Investigate some of the nutritional factors in white fish meal responsible for growth retardation and high incidence of cataract in trout. Modify the white fish meal by addition of necessary factors or deletion of injurious substances so that it could be effectively used as a supplement to trout feed.

APPROACH: Feeding experiments: Long-range feeding of trout on a complete white fish feed will be performed in order to determine the incidence and time factor involved in the formation of cataract. The effect of lipid-free and heavy-metal-free diets will also be studied. Organic solvents will be used to extract lipid components, and specific chelating agents will be employed to remove heavy elements. The compositional analysis of white fish meal will be aimed at determining the amino acid content of proteins, free and bound carbohydrates and heavy trace elements. Automated amino acid analysis, gas chromatography and atomic absorption procedures will

be used, respectively to accomplish these. Compositional analysis of lens proteins from normal and cataractous fish will be done after solubilization and separation of lens proteins by conventional procedures, followed by acid hydrolysis or proteins to liberate amino acids. The levels of cysteine, cystine and tryptophan will be particularly of interest.

PROGRESS: 79/01 TO 79/12. Inclusion of white fish meal at a 20% level into the trout diet was found to cause cataract (67% at 140 days) and higher incidence of mortality (48%) as compared to herring-meal diet. No significant difference in the amino acid composition was found between herring and white fish meals. Fortification of the white-fish diet with tryptophan, histidine, tyrosine, phenylalanine, cystine, lysine or combination of all showed no significant decrease in the incidence of cataract. Fortification of diet with vitamins, A, D, E, E(12) or niacin did not alleviate the problem. Mineral analysis of the white fish and herring meals revealed significantly lower content of Fe, Zn, Se and Mn and a higher content of Ca and P for the white-fish, as compared to herring meal. Incorporation of commercially available mineral mix (protein-mineral chelates) into the white fish diet at 5-10% levels abolished the incidence of cataract and reduced the mortality by 90%. The ratio of calcium to available phosphate was found to be approximately 1.5 times higher for white-fish diet as compared to herring. Inclusion of additional phosphate into the white-fish diet to produce a Ca/P ratio close that of herring diet, reduced the incidence of cataract to 1%. The Na-K ATPase activity of cataractous lens was decreased by about 50%, as compared to normal lens. Fortification of white-fish diet with the mineral mix caused an increase of Na-KATPase activity to 84% of the normal diet.

PUBLICATIONS: 79/01 TO 79/12

NO PUBLICATIONS REPORTED THIS PERIOD.

003.019 CRIS0044198
UPTAKE AND MOVEMENT OF HERBICIDES AND NUTRIENTS IN
AQUATIC WEED SPECIES

ANDERSON L W; USDA-ARS AQUATIC WEED CONT LAB, DENVER,
COLORADO. 80225.
Proj. No.: 5604-20280-003 Project Type: INHCUSE
Agency ID: AFS Period: 01 DEC 77 To 30 SEP 80

OBJECTIVES: Determine the specific modes of uptake of existing and potential aquatic herbicides and examine the environmental conditions which may affect uptake rates. Elucidate the translocation characteristics of aquatic herbicides to assess their potential in controlling reproductive organs of aquatic weeds.

APPROACH: Use in vitro systems of epithelial leaf tissue of *Potamogeton nodosus* to measure herbicide uptake rates and conditions affecting uptake (temperature, light, water quality). Develop bioassay systems for measuring the effects of flow rate on nutrient uptake in the filamentous alga *Cladophora*, and determine how flow rate affects algal effectiveness. Both approaches will involve use of radioactively labelled herbicide and/or nutrients. Use root/shoot partitioning apparatus to determine nutrient or herbicide uptake route.

PROGRESS: 77/01 TO 80/09. A multi-chambered, temperature-controlled recirculating incubation system was developed to study the effect of flow rate on nutrient uptake in the filamentous alga *Cladophora* sp. Results indicate that relative rates of photosynthesis (measured by ¹⁴C-bicarbonate uptake) increase with increasing flow rates. CuSO₄(4), diquat or Komeen were more effective in reducing ¹⁴C-bicarbonate fixation under flowing conditions than static conditions. Studies on *Fluridone* show the following: (a) light is required for efficacy, (b) optimal exposure is 6-8 days post-sprouting in American and sago pondweed, (c) little or not translocation occurs in American pondweed, (d) some translocation (root to shoot) occurs in *Hydrilla verticillata*, (e) slow movement occurs through isolated stem epidermis or whole leaf sections, (f)

no difference in uptake (for 1, 2 or 14 days) is seen in light or dark exposures. Studies with isolated stem epidermis of American pondweed show that CuSO₄(4) enhances movement of diquat, 2, 4-D, dichlofenil, fenac and sllvex. Movement of atrazine and simazine is more rapid through sections of submersed leaves than through floating leaves of American pondweed. Root/shoot isolations show that glyphosate is translocated both acropetally and basipetally in *Hydrilla*, but the latter is more extensive. A new and improved method of isolating roots and shoots in intact plants was developed using silicon oental impression compound.

PUBLICATIONS: 77/01 TO 80/09

ANDERSON, L.W.J. and PRINGLE, J.C. 1980.
¹⁴C-fluridone penetration of whole leaf sections of *Hydrilla verticillata*. West. Soc. Weed Sci. Progr. Rep. p. 333.
ANDERSON, L.W.J. and PRINGLE, J.C. 1980.
¹⁴C-fluridone movement from root to foliar portions of partitioned hydrilla plants. West. Soc. Weed Sci. Res. Progr. Rpt. p.333.
PRINGLE, J.C. and ANDERSON, L.W.J. 1980. Movements of herbicides through isolated American pondweed (*Potamogeton nodosus*) epidermal tissues. Weed Science, 28(4):419-424, July 1980.

003.020

CRIS0044199

HORMONAL REGULATION OF GROWTH, DEVELOPMENT AND
VEGETATIVE PROPAGATION OF SUBMERSED AQUATIC WEEDS

ANDERSON L W; USDA-ARS AQUATIC WEED CONT LAB, DENVER,
COLORADO. 80225.
Proj. No.: 5604-20280-004 Project Type: INHCUSE
Agency ID: AFS Period: 01 DEC 77 To 30 SEP 80

OBJECTIVES: Determine the role of natural plant growth regulators in controlling development and germination of vegetative propagules of American Pondweed (*Potamogeton nodosus*). Determine the effects of temperature and light on development in relation to growth regulator function.

APPROACH: Characterize the effect(s) of potentially active plant growth regulators (auxins, gibberellins, abscisic acid, cytokinins) on germination of winterbuds (tubers) of American pondweed. Attempt to isolate, identify and characterize natural growth and developmental regulatory compounds from American pondweed using standard solvent partitioning, liquid chromatography, TLC, GC and bioassay techniques. Use radioactively labelled plant growth regulators as standards and to obtain information on the movement and fate of the compound(s) within the plant, or plant organs. Plants grown in greenhouse, environmentally controlled growth chambers and field-collected plants will be utilized in the studies.

PROGRESS: 77/01 TO 80/09. Abscisic acid (ABA) inhibits germination of vegetative winterbuds of American pondweed (*Potamogeton nodosus*) and sago pondweed (*P. pectinatus*) at concentrations above 10⁻⁵M. A bioassay for ABA effects was developed. ABA at 5x10⁻⁷M to 5x10⁻⁶M induced formation of floating-type leaves within 5-7 days. These responses were counteracted by GA(3), EA, zeatin or kinetin. Preliminary results from high pressure liquid chromatography indicate higher levels of AEA in the root and rhizome portion of *P. nodosus* than in leaf plus shoot. Results of high pressure liquid chromatography plus G.C. analysis indicate that water-stressed, sprouting *P. nodosus* winterbuds contain higher levels of ABA than unstressed plants. *P. nodosus* showed seasonal fluctuations in level of AEA, particularly in rhizomes. Water-stressed *P. nodosus* and *P. pectinatus* plants were susceptible to foliar application of dalapon, glyphosate, simazine, or dicamba. Cordycepin, which inhibits RNA synthesis, blocked AEA-induced formation of floating-type leaves while allowing growth of normal submersed leaves. Actinomycin-D, which blocks DNA-dependent RNA synthesis, had little effect on induction of floating leaves by ABA. Cycloheximide, which inhibits protein synthesis, blocked the ABA-effect, and caused a general reduction in leaf development. AEA may operate by modulating synthesis of specific RNAs.

PUBLICATIONS: 77/01 TO 80/09

ANDERSON, I.W.J., 1980. Uptake and mode of action of abscisic acid: control of leaf morphogenesis in *Potamogeton nodosus*, an aquatic angiosperm. Abstract, Sixty-first An. Meeting, Pacific Div. A.A.A.S., Davis, CA.

003.021

CRIS0044200

EVALUATION OF EFFICACY, CROP RESPONSES AND CROP AND WATER RETENTION OF POTENTIAL AQUATIC HERBICIDES

ANDERSON L W; USDA-A&S AQUATIC WEED CONT LAF, DENVER, COLORADO. 80225.

Proj. No.: 5604-20280-005 Project Type: INBCUSE
Agency ID: A&S Period: 02 DEC 77 To 30 SEP 80

OBJECTIVES: Identify effective, new aquatic herbicides and algicides. Determine the phototoxicity of irrigation water containing aquatic herbicides on crops and the extent of herbicide residue retention in the exposed crops. Determine the level of herbicide residue in water resulting from the application of herbicide to irrigation canals, or impoundments.

APPROACH: Use a greenhouse, static water screening bioassay for observing the phytotoxic effects of new chemical compounds on American pondweed sago pondweed and Elodea. Use a unialgal culture bioassay to evaluate new chemicals for algicidal properties. Make applications of candidate aquatic herbicides (which show sufficient efficacy and environmental safety) to irrigation canals or canal banks and subsequently sample exposed water and analyze for herbicide residues. Develop bioassay for evaluating controlled-release aquatic herbicides. Grow representative crops in small, replicated plots and irrigate with water containing appropriate levels of aquatic herbicide and subsequently determine the herbicide residue levels in the harvested crops.

PROGRESS: 77/02 TO 80/09. Rates of 2.25 to 7.43 kg/ha simazine applied to ditchbanks of flowing canals produced a maximum of 60 ug/l. First water flow samples from dry-canal treatments at similar rates produced a maximum of 250 ug/l with rapid subsequent dissipation. In six crops (corn, pinto beans, alfalfa, sugarbeets, tomatoes, cucumbers) irrigated with water containing 0.01 or 0.1 mg/l simazine, only trace amounts (0.5 to 2.9 ppb) were found. Similar studies showed little or no arsenic accumulation in crops exposed to 1.0-2.0 ppm MSMA. Small pond tests showed that granular fluridone controls elodea, pondweeds, and stunts cattails within three months when applied at 2-5 lbs/acre. Its levels of dicamba were determined in 6 crops that had been irrigated with .05 or 0.5 ppm dicamba by furrow or sprinkler. Residues were less than .01 ppm with the .05 ppm. Velpar was tested 1.0 ppm in a small (0.08 ha) pond. Fluridone is effective in stopping growth of American and sago pondweed when vegetative tubers were exposed to 1 ppm in the light.

PUBLICATIONS: 77/02 TO 80/09

ANDERSON, I.W.J. and EAINES, F.W. 1980. Response of *Hydrilla verticillata*, *Elodea canadensis*, and *Myriophyllum spicatum* to combinations of Komeen and Endothall in moving water. West. Soc. Weed Sci. Prog. p.334-335.

ANDERSON, I.W.J. 1980. Dicamba residues in crops irrigated with water containing low levels of Benvel 4SR herbicide. West. Soc. Weed Sci. Progr. Rept. p. 346.

003.022

CRIS0078642

MECHANICAL CONTROL OF AQUATIC WEEDS

BAGNALL L C; AGRIC ENGINEERING; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.

Proj. No.: FLA-AG-01926 Project Type: HATCH
Agency ID: CSES Period: 05 FEB 79 To 30 SEP 83

OBJECTIVES: Develop design criteria and operational procedures for mechanical control of aquatic weeds, primarily waterhyacinth and hydrilla by: Determination of physical and mechanical properties

of the plants, development of harvester components, development of a harvester-reducer-handling system, and development of a harvester-transport.

APPROACH: Plant tissues will be tested in standard testing equipment. Bulk samples will be tested in a large laboratory press. In situ properties will be tested with a specialized floating fixture. Cutters, elevating mechanisms, choppers balers, and transfer systems will be designed, built, tested and modified for the special requirements of aquatic plants. A 2.4 m wide system will be designed, incorporating the best compacting harvester transport components found in the preceding section. Target rate is 100 Mg/hr. A non-elevating compacting harvester transport will be designed, built and tested as a low-cost, low-energy alternative.

PROGRESS: 80/09 TO 80/12. A Bockney aquatic weed cutter was modified and tested in citrus grove irrigation ditches, and found to be unsatisfactory for that use. A 0.6 m wide drag conveyor harvester was designed, built, and tested, and found to operate satisfactorily in hydrilla near standing area 1 density, but ineffective in densities appreciably lower or higher; it is effective in small water hyacinth. A new hydrilla cutter for ditches is being designed and a new hydrilla conveyor-harvester has been designed and is being built. Three new harvester-reducers have been designed and are being built. One is a drag conveyor harvester with crimping rolls, another is a lateral-feeding belt conveyor with a shear-bar chopper, and the third is a lateral-feeding screw press-conveyor.

PUBLICATIONS: 80/09 TO 80/12

BAGNALL, L.O. 1980. Bulk Mechanical Properties of Hydrilla. Journal of Aquatic Plant Management 18:23-26.

003.023

CRIS0046512

BIOLOGICAL AGENTS FOR CONTROL OF HYDRILLA, A SUBMERSED AQUATIC WEED

BALCIUNAS J K; CENTER T D; AGRIC RES & EDUCATION CENTER; UNIVERSITY OF FLORIDA, FT LAUDERDALE, FLORIDA. 33314.

Proj. No.: 7010-20280-007-A Project Type: COOPERATIVE AGREE.
Agency ID: ARS Period: 30 SEP 80 To 30 SEP 83

OBJECTIVES: Discover, identify and assess effectiveness and host specificity of potential natural agents for control of Hydrilla, a submerged aquatic weed.

APPROACH: Conduct field surveys in India and other Southeast Asian countries where Hydrilla is a native aquatic plant, find biological agents, primarily insects, associated with the plant. Make field and laboratory assessments of their effectiveness and host specificity as potential control agents. Identify each agent taxonomically and determine requirements for its culture. Provide information on and specimens of candidate organisms.

003.024

CRIS0069606

THE PHYSIOLOGY AND CONTROL OF VEGETATIVE REPRODUCTION IN HYDRILLA (*HYDRILLA VERTICILLATA* BOYLE)

HALLER W T; AGRONOMY; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.

Proj. No.: FLA-AY-01784 Project Type: STATE
Agency ID: SAES Period: 01 APR 74 To 30 DEC 83

OBJECTIVES: Determine importance of tuber and turion regrowth after chemical control. Determine photoperiod response and flowering to tuber and turion formation. Study propagule germination and evaluate growth regulators to promote germination. Study carbohydrate storage and synthesis with respect to propagule formation and photosynthesis. Study ecology and physiology of hydrilla.

APPROACH: Laboratory, pool, and field studies will screen growth regulator and monitor natural growth, germination of hydrilla propagules. Promising regulators will be injected in hydrosol, in water, or otherwise applied to field plots. Water level manipulation by draining lakes and ponds permits basic studies on hydrilla reproduction and reinfestation.

PROGRESS: 80/01 TO 80/12. Hydrilla reproduces primarily underground tubers, and following chemical control practices re-infestation occurs by their germination and growth. Tubers form at the end of rhizomes during short day conditions (light period less than 12.5 hours) and are hormonally controlled by ABA. Lake drawdown and timed chemical treatments (Fall) prevent formation of new tubers during the following winter months. Annual control practices significantly reduce the presence of tubers, allows growth of native flora, and helps maintain the treated area open to use. The herbicides Fenac, Orchlorobenzil, and Fluridone all reduce tuber germination at concentrations of 10 ppm. Fenac applied to drawdown areas (24 kg/ha) during the winter almost totally eliminated hydrilla growth the following summer. Physiological studies indicate hydrilla and certain other submerged aquatic plants have unique photosynthetic properties. During winter, under short day conditions and cool temperatures, photosynthetic properties are characteristic of C(3) plants, and during summer under heavy growth and CO(2) limiting conditions the plants revert to a C(4) type mechanism. Substrate studies clearly indicate that hydrilla grows most favorably in submerged soils high in organic matter. Nutrient culture studies indicate that hydrilla grow well at comparatively low levels of Phosphorus, but requires high levels of Calcium, Potassium and Magnesium. The total production of hydrilla under ideal conditions is estimated at 5 M.T. Org. weight/hectare.

PUBLICATIONS: 80/01 TO 80/12
NC PUBLICATIONS REPORTED THIS PERIOD.

003.025 CRIS0079913
THE ECOLOGICAL IMPACT OF INTEGRATED CHEMICAL AND BIOLOGICAL AQUATIC WEED CONTROL

HALLER W T; AGRONOMY; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-AY-01987 Project Type: STATE
Agency ID: SAES Period: 01 AUG 79 To 31 DEC 82

OBJECTIVES: Determine the impact of chemical/biological control on the fishery environment, and ascertain the most desirable balance of vegetation versus open water that will maintain desirable water quality, fish growth and reproduction; evaluate the feasibility of combining chemical and biological weed control in a natural lake and determine costs benefit ratios.

APPROACH: Two lakes and 24 ponds will be utilized to test the above objectives, water quality, fish population, benthos, zooplankton, and phytoplankton will be analyzed in each habitat.

PROGRESS: 80/01 TO 80/12. Collection of background information was conducted on aquatic macrophytes, phytoplankton, benthos, algae and fish populations from Orange Lake (4,921 ha), Lake Pearl (23.5 ha), and in 24 0.2 ha ponds before initiation of treatment. The 24 ponds were separated into chemical, grass carp, fertilization, and control. Grass carp were stocked at a rate of 4, 8 and 16/pond and chemical treatments were applied to evaluate effectiveness for 30, 60 and 100% vegetation control. Treatment ponds supported plankton populations consisting primarily of the green algae genera *Cosmarium*, *Scenedesmus* and *Tetraedron*. The cladoceran genera *Macrothrix* and *Alona* and the rotifer *Keratella* numerically dominated all samples. Lake Pearl was chemically treated three times during the spring and summer to reduce biomass and stocked with grass carp to study integrated control. Radio transmitters were implanted in ten grass carp and nine largemouth bass. Although individual bass moved as an immediate response to herbicide application, percent occurrence

of sightings remained evenly distributed in respect to herbicide treatment. Eighty-one percent of the grass carp were found in the treatment area prior to treatment, decreasing to 56% post-treatment. Dominant genera were the flagellated *Ceratium* and *Chlamydomonas* and the nonflagellated chlorophytes *Ankistrodesmus*, *Staurastrum* and *Cosmarium*. Infestation of hydrilla in Orange Lake has increased from 66 ha in 1978 to 1,240 ha in 1980.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.026 CRIS0082486
ECONOMICS AND CONTROL OF CHIRONOMID MIDGES (BLIND MOSQUITOES)

HALL D W; ENTOMOLOGY & NEMATOLOGY; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-EY-02016 Project Type: STATE
Agency ID: SAES Period: 15 AUG 80 To 31 DEC 85

OBJECTIVES: Work out method for distinguishing young larvae of closely related pest species. Determine and describe pathogens of native midges and find ways to augment their impact on the pest species.

APPROACH: The hemoglobin from different species of midges will be crystallized and compared as a possible means of distinguishing young midge larvae. Field populations of midges will be screened for pathogens by macro and microscopic methods. The pathogens will then be studied and propagated in the laboratory to assess control potential.

003.027 CRIS0082837
TAXONOMY AND MORPHOLOGY OF NEMATODES

SMART G C JR; TARJAN A C; ENTOMOLOGY & NEMATOLOGY; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-EY-02024 Project Type: STATE
Agency ID: SAES Period: 21 SEP 80 To 30 DEC 85

OBJECTIVES: Collect and identify any plant, soil and aquatic nematodes that are of significance to the agricultural economy of Florida. Study and describe the anatomy and morphology of such nematodes in order to facilitate identification by concerned research workers and regulatory personnel. Determine the existence of biotypes and economically important nematode species which may influence current Integrated Pest Management and Low Energy Technology practices being employed. Prepare taxonomic treatises, systematic keys, compendia and morphological descriptions for publication in national and international scientific journals.

APPROACH: Acquire, preserve, mount on slides and study morphologically. New taxa will be described and published. Accumulated data may lead to taxonomic revisions and compendia preparation.

003.028* CRIS0068632
BASELINE STUDIES FOR EVALUATING THE RESPONSE OF AN ECOSYSTEM TO THE INTRODUCTION OF WHITE AMUR

EWEL K C; FOR RES & CONSERV; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-FY-01765 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 DEC 80

OBJECTIVES: Determine the forcing functions, main energy flows, and variations in the important components in an aquatic ecosystem; construct and emulate a model which will incorporate these variables and which will include the possible effects of the introduction of white amur to the ecosystem; monitor the changes that actually do take place in an ecosystem when the fish is introduced, revising the model until it is a reasonable generalization of the

ecosystem.

APPROACH: Baseline ecological data will be collected by state agencies on a lake into which the white amur will be introduced in the second year of the study. Models incorporating these data will predict the effects of the fish, and these models will be verified by continued data collection.

PROGRESS: 80/01 TO 80/12. A model of Lake Conway, FL, was simulated with and without white amur present. If rates used in the model are accurate, the grazing food chain in this lake is slightly more important than the detritus food chain, and 10% of the gross primary productivity is grazed. One-quarter of the annual phosphorus input to the epilimnion comes from leaching and decay of submersed macrophytes. Simulated ranges of state variables were close to values measured in most cases. The model was stable during a simulation representing ten years. After two years, simulated addition of white amur (7000 fish, each weighing 458g) decreased submersed macrophyte biomass to 6% of its normal peak biomass. Water quality improved, gross primary productivity and community respiration decreased, and the relative importance of the grazing food chain increased. Biomass of benthic invertebrates and secondary predator fish increased. Addition of half as many fish five years after the first introduction brought about the same degree of macrophyte control, but recovery was more rapid.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.029 CRIS0082301
EVALUATION OF FUSARIUM ROSEUM 'CULMORUM' AS A
BIOLOGICAL CONTROL FOR HYDRILLA VERTICILLATA

CHANDATTAN I; FREEMAN T E; PLANT PATHOLOGY;
UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-PT-02033 Project Type: STATE
Agency ID: SAES Period: 01 SEP 80 To 31 DEC 82

OBJECTIVES: The prospects for biological control of the submersed aquatic weed, hydrilla (*Hydrilla verticillata*, Hydrocharitaceae), with an isolate of a recently discovered, exotic fungal pathogen, *Fusarium roseum* 'Culmorum', will be evaluated. The pathogen, isolated from a diseased aquatic plant from the Netherlands, will be tested under laboratory and field conditions to determine its host range, safety and efficacy as a biological control for hydrilla.

APPROACH: Following quarantine clearance for field use, the ability of the fungus to kill hydrilla under natural conditions will be tested in small and large bodies of water. Several formulations of the fungal inoculum and techniques of application will be developed. Media and methods for mass production of the biocontrol agent will be screened. The effect of the fungicides effective in controlling this *Culmorum* will be identified.

PROGRESS: 80/01 TO 80/12. An isolate of *Fusarium roseum* 'Culmorum' which is capable of killing the submersed, noxious aquatic weed hydrilla (*Hydrilla verticillata*) has been found. Macroconidial suspensions of the fungus when added to water containing hydrilla induced chlorosis of shoots and rotting of the entire plant. On the basis of the results of host range testing on nontarget plant hosts and the lack of toxicity to a fish species, the fungus is considered to be a safe and promising biological control for hydrilla. Moreover, a fungicide capable of controlling this fungus has been identified. A large-scale pilot test has been initiated to evaluate the efficacy of this histopathology and physiology of diseased hydrilla are underway.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.030 CRIS0080007
ENVIRONMENTAL IMPACT AND WEED MANAGEMENT STRATEGIES
UTILIZING GRASS CARP (CTENOPHARYNGODON IDELLA)

SHIREMAN J V; SCHOOL OF FOREST RESOURCES; UNIVERSITY
OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-FY-01986 Project Type: STATE
Agency ID: SAES Period: 24 JUL 79 To 31 OCT 81

OBJECTIVES: Impact assessment of grass carp on the Lake Wales ecosystem. Determine management strategies for vegetation control utilizing grass carp. Develop methods for selective removal of grass carp from Lake Wales.

APPROACH: Standard field and laboratory methods will be utilized. See attached proposal.

003.031 CRIS0074878
IMMUNOLOGIC FACTORS IN CANDIDIASIS IN DOLPHINS

WERNER L L; HALLIWELL R E W; VETERINARY MEDICINE;
UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Agency ID: CSVM-CO-0000 Period: 01 JUL 76 To 30 JUN 81

OBJECTIVES: Establish reference laboratory with Dolphin specific reagents for investigation of immunologic aspects of disease problems. Characterization of the immune system in normal dolphins. Investigation of humoral and cellular immunity in *Candida* infected dolphins treated with Levamisole.

APPROACH: Purification and quantitation of dolphin immunoglobulins. Raising dolphin specific anti Ig antibodies in rabbits. Identification of serum anti *Candida* factor by agglutination reaction. Lymphocyte transformation responses to mitogen and *Candida* antigen.

PROGRESS: 78/01 TO 79/12. Fundamental studies of the dolphin immune system were performed to implement evaluation of immune competence in relationship to chronic infection with the opportunistic fungi, *Candida albicans*. Normal values for washed peripheral blood lymphocyte responses to mitogen stimulation (lymphocyte transformation) were obtained for healthy dolphins, both from the wild and in captivity. Three dolphins suffering from chronic *Candida albicans* infection showed normal lymphocyte transformation responses compared to healthy controls when fetal calf serum was used to enrich the lymphocyte culture media. When sera from *Candida* infected dolphins were used in the culture media, lymphocyte transformation responses for both normal and infected dolphins were severely depressed compared to normal responses obtained when serum from healthy dolphins was used. Serum from one dolphin rendered free of *Candida* infection with systemic antifungal therapy was later utilized to enrich culture media for lymphocyte transformation studies on the healthy controls. Suppression of lymphocyte responses was no longer present. These findings suggest that a serum suppressive factor for lymphocytes was present in the three dolphins with chronic *Candida albicans* infection, but that intrinsic lymphocyte function was intact when free from autologous serum. Immune deficiency might, therefore, be acquired with chronic *Candida* infection in association with suppressive serum factor(s).

PUBLICATIONS: 78/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.032 CRIS0061258
CONTROL OF AQUATIC PLANT GROWTH

SUTTON D L; STEWARD K K; CENTER T D; UNIVERSITY OF
FLORIDA, FT LAUDERDALE, FLORIDA. 33310.
Proj. No.: FLA-PL-01599 Project Type: STATE
Agency ID: SAES Period: 10 FEB 72 To 31 DEC 76

OBJECTIVES: Determine the physiological and nutritional requirements for growth of aquatic plants. Evaluate biological and chemical methods for the control of excessive growth of aquatic plants.

APPROACH: The major portion of this research will be conducted under controlled conditions. Field studies will be limited to small enclosed areas.

PROGRESS: 80/01 TO 80/12. A survey of the insects associated with *Hydrilla verticillata* and *Myriophyllum spicatum* infestations in the U.S.A has just been completed. The insects most numerous on these submerged weeds were the midge larvae (Diptera: Chironomidae), damselfly nymphs (Cdonata-Zygoptera) and the caddisfly larvae (Trichoptera). Several moths (Lepidoptera) species, especially *Acentria nivea*, *Parapoynx diminutalis* and *Synclita oblitteralis*, caused extensive damage to these plants at some locations. Studies in outdoor, circular pools have shown that one shoot tip of hydrilla produced as much dry weight during a 16-week period as 16 tips planted under the same conditions. Dry weight of plants 16 weeks after planting was a high as 1,561 times that of the shoot tips planted. Hydrilla reproduced vegetatively under controlled conditions and under field conditions by development of axillary buds from sub-apical fragments. Fragments with a single node were capable of regrowth under both controlled and field conditions. Forty percent of fragments with one or two nodes were capable of regrowth. Regrowth occurred from 68% or more fragments with three to five nodes. A research demonstration encompassing 283 ha in a 2,428-ha citrus grove was initiated to manage hydrilla and other aquatic weeds in an integrated control program using biological, herbicidal, and mechanical methods.

PUBLICATIONS: 80/01 TO 80/12

SUTTON, D.L., LITTELL, F.C. and LANGELAND, E.A.

1980. Intraspecific Competition of *Hydrilla verticillata*. Weed Sci. 28:425-428.

LANGELAND, E.A. and SUTTON, D.L. 1980. Regrowth of *Hydrilla* from Axillary Buds. J. Aquat. Plant Manage. 18:27-29.

GLANDON, R.P., PAYNE, F.C., MCNAEB, C.D. and BATTERSON, T.R. 1980. A Comparison of Rain-Related Phosphorus and Nitrogen Loading from Urban, Wetland, and Agricultural Sources. Water Res. (In Press).

VANDIVER J.F., V.V. and SUTTON, D.L. 1980. Management of *Hydrilla* in a Citrus Grove. Aquatics (In press).

VANDIVER J.F., V.V. 1980. *Hygrophila*. Aquatics (In press).

003.035 CFIS0045353
BIOLOGICAL CONTROL OF WEEDS WITH EMPHASIS ON AQUATIC HABITATS

CENTER T D; USDA-ARS AQUATIC WEEDS RES LAB, FT LAUDERDALE, FLORIDA. 33314.

Proj. No.: 7615-20280-005 Project Type: INHOUSE
Agency ID: ARS Period: 29 MAY 79 To 29 MAY 83

OBJECTIVES: Determine basic information necessary for implementing biological control agents in weed management programs with particular emphasis on aquatic systems.

APPROACH: Compile lists of organisms of potential use for biological control from foreign and domestic sources. Arrange for host specificity testing of these organisms, importation into quarantine, clearance and final release when appropriate. Assess those organisms released as to efficacy and vagility. Develop data basic to the understanding of the organism-host plant interactions so as to determine the best means of integrating these into weed management schemes. Conduct experimentation to determine the compatibility of biological control with existing chemical and mechanical control technology. Determine factors which limit success of biological control.

PROGRESS: 80/01 TO 80/12. *Sameodes albiguttalis*, a South American pyralid released for the biological control of waterhyacinth, has dispersed throughout Florida. Of 330 sites examined it was found at 170 (52%). Population survival has been documented following a severe frost at one site where the temperature dropped to -13 degrees C. Studies of waterhyacinth leaf production show that rates vary with season, habitat, and shoot size but are highly predictable. Biocontrol agents affect survivorship of leaves in different ways. *S. albiguttalis* appears to increase the mortality of young leaves. Studies are continuing to develop fiduciary tables for waterhyacinth leaf populations at several sites. Surveys of the insects associated with *Hydrilla verticillata* and *Myriophyllum spicatum* in the U.S.A. have been completed. The most numerous insects included midge larvae, damselfly nymphs, and caddisfly larvae. Several moth species, especially *Acentria nivea*, *Parapoynx diminutalis*, and *Synclita oblitteralis*, cause severe damage at some locations. Some caddisfly larvae (*Fabria* sp.) may also feed upon *M. spicatum*.

PUBLICATIONS: 80/01 TO 80/12

CENTER, T.D. and SPENCE, N.F. 1981. Phenology and Growth of Waterhyacinth in a Eutrophic North-Central Florida Lake. Aquat. Bot. 19(1):1-32.

BALCIUNAS, J.K. 1980. New Dragonfly (Cdonata) Records for Tuscarawas County, Including a Species New to Ohio. Ohio J. Sci. 80(2):58.

003.034 CFIS0042568
BIOLOGICAL CONTROL OF AQUATIC WEEDS IN THE SOUTHEAST

PERKINS B D; USDA-ARS AQUATIC WEEDS RES LAB, FT LAUDERDALE, FLORIDA. 33314.

Proj. No.: 7615-20280-003 Project Type: INHOUSE
Agency ID: ARS Period: 27 JUN 75 To 30 MAY 79

OBJECTIVES: Determine best means of implementing biological control using insects, mites, and other organisms against aquatic weeds.

APPROACH: Release and monitor populations of imported host-specific insects or mites to combat specific aquatic weeds. Combinations of insects with mites, other insects, fish, herbicides, and fungus, will be evaluated as to the potential to manipulate them to enhance the degree of control. The potential for using native insects will be determined by evaluating their effect on the weed. Environmental components, such as nutrients, natural enemies, age of host plants, and site conditions, which may affect the biological control agents will be evaluated, and the potential to manipulate them to enhance the degree of control will be studied.

PROGRESS: 75/06 TO 79/05. Two weevils, *Neochetina eichborniae* and *N. bruchi*, and a pyralid moth, *Sameodes albiguttalis*, have been introduced in the SE U.S. for the biocontrol of waterhyacinth. *N. eichborniae* has effectively dispersed throughout Florida but *N. bruchi* has not. The effects of the weevils have been subtle, resulting in minor changes in plant characteristics (such as a reduction in maximum size). This is apparently due to preferential oviposition in older leaves with little resultant damage to the more functional younger leaves. While substantial control has not been achieved, the presence of the weevils retards plant growth and thereby facilitates control by other means. Various combinations of control measures using insects, mites, herbivorous fish, pathogens and chemicals are more effective than any one method used alone. *Sameodes albiguttalis* is now established at several sites in South Florida. Because the larvae preferentially feed on young plant tissues the potential of this insect for effective control of waterhyacinth is high. Its introduction is too recent, however, to adequately assess its effect. A second pyralid moth, *Parapoynx diminutalis*, was first found in the U.S. feeding on *Hydrilla verticillata* in 1975, apparently as the result of an accidental introduction. It was first recorded in Fort Lauderdale and its range has continued to expand. Host specificity studies were conducted and it was

found to feed upon a wide variety of aquatic plants as well as rice.

Proj. No.: 7602-20260-002 Project Type: INHCUSE
Agency ID: ARS Period: 09 JAN 76 To 09 JAN 79

PUBLICATIONS: 75/06 TC 79/05

CHARUDATTAN, K., B. D. PERKINS AND R. C. LITTELL.
1978. Effects of fungi and bacteria on the decline of arthropod-damaged waterhyacinth in Florida. Weed Sci. 26(2):101-107.
PERKINS, B. D. 1977. Preliminary results of integrating chemical and biological controls to combat waterhyacinth. U. S. Army Engineers Waterways Exp. Sta. Misc. Paper A-77-3.

OBJECTIVES: Identify candidate insects to control aquatic weeds and evaluate their suppressive capabilities, with special emphasis on waterhyacinth, hydrilla, and Eurasian watermilfoil.

APPROACH: Import insects into quarantine facility after obtaining proper clearances for quarantine studies and/or release in the United States. Verify taxonomic identification, eliminate extraneous biological material, and establish colony for host specificity studies and supply insects for laboratory and field research. Prepare proper documentation for necessary clearances before field release of imported insects. Conduct field evaluations of insect effectiveness for control of aquatic weeds.

003.035 CRIS0044312
PHYSIOLOGY AND MANAGEMENT OF AQUATIC WEEDS INTERFERING WITH THE USE OF WATER RESOURCES

STEWART E E; BRUNBE M C; VAN T E; USDA-ARS AQUATIC WEEDS RES IAE, FT LAUDERDALE, FLORIDA. 33314.
Proj. No.: 7615-20280-004 Project Type: INHCUSE
Agency ID: AFS Period: 26 JAN 78 To 26 JAN 82

PROGRESS: 76/01 TO 79/01. A pyralid moth, Sameodes albiguttalis, was obtained from Argentina after testing showed that it had potential as a biological control agent for waterhyacinth. Additional testing was conducted in quarantine; a report was prepared requesting permission for introduction; large numbers were reared; and it was finally released in September 1977 at three locations in Florida. Establishment occurred at one location. The colony has been transferred to another laboratory which will continue making releases. A five year field study of the weevil, Neochetina eichhorniae, which was introduced from Argentina for control of waterhyacinth was terminated. Due to the intervention of man and to two severe winters, the effect of the dramatic beetle increase on the plant population is unclear, although it appears that the beetles might help keep the plant population at a steady state by reducing vegetative reproduction. Two insects feeding on Eurasian watermilfoil in the U.S. were colonized in quarantine and detailed biological studies were made with one of them, a weevil, Litodactylus leucogaster. Host specificity tests indicated that L. leucogaster may have potential for reducing seed production but that the moth, Acentropus niveus, is apparently not specific to milfoil. Contrast research conducted for use indicated that the European moth, Parapoynx stratiotata, is not sufficiently specific for introduction into the U.S. for control of Eurasian watermilfoil.

OBJECTIVES: Investigate manipulation of selected growth factors of problem weed species which produce unfavorable habitats. Develop integrated techniques for management of aquatic weeds. Improve technology for chemical control of aquatic weeds.

APPROACH: Establish requirements of selected aquatic weeds for nutrients, light, temperatures, water quality, soil type, and pH. Determine dependence of problem species on water and soil substrate for supply of these factors. Identify weak links in the life cycles of problem weeds that may make them amenable to management. Evaluate ecological modifications which lend themselves to integration with chemical, biological, or mechanical weed control. Evaluate new chemicals, new uses of registered chemicals, and combinations of chemicals to increase effectiveness of chemical control. Develop improved chemical application techniques. Develop faster methods for reliable herbicide bioassay.

PROGRESS: 79/12 TC 80/12. The principle activity in the area of herbicide evaluation research was in design, assembly, and evaluation of a prototype flowing water system for evaluating Controlled Release Herbicide Formulation (CRHF). In this cooperative program with the Army Corps of Engineers, a CRHF of 2,4-D was evaluated in static and flowing water bioassays. Analytical procedures for monitoring 2,4-D residues in water by BPLC and GC were developed and/or modified and refined. Rate of 2,4-D release from CRHF was greater than anticipated by a factor of 3. Phytotoxic 2,4-D concentration was maintained in flowing water for 8 weeks. Plant growth was significantly lower in containers which received CRHF treatments. In an investigation of the influence of hydrosol composition on the growth of hydrilla, hydrilla biomass production after 70 weeks growth was greatest in a manure supplemented soil and least in plain sand. Biomass was as follows: 274, 150, 50, and 4 grams per sq. meter in supplemented soil, soil alone, calcareous marl, or sand, respectively. Biomass was highly correlated with tissue levels of phosphorous and nitrogen and more weakly correlated with potassium tissue levels. There was a strong negative correlation between biomass and calcium concentration in tissue.

PUBLICATIONS: 76/01 TO 79/01

GRAEU, W. E. AND N. E. SPENCE. 1978. A management procedure for the introduction of biological agents for control of weeds. pp.13-34. in Freeman, I. E. Proc. IV INT. SYMP. BIOL. CONTR. WEEDS. AUG 30-SEP 2, 1976.

003.037 CRIS0045077
IMPORTATION AND EVALUATION OF INSECTS FOR BIOLOGICAL CONTROL OF WEEDS AND INSECT PESTS

BUCKINGHAM G E; USDA-ARS BIOLOGICAL PEST CONTR, GAINESVILLE, FLORIDA. 32604.
Proj. No.: 7602-20260-004 Project Type: INHOUSE
Agency ID: ARS Period: 14 FEB 79 To 14 FEB 82

OBJECTIVES: Obtain and evaluate insects for their potential as bio-control agents of important insect pests and weeds, with special emphasis on the aquatic weeds: Eurasian watermilfoil, hydrilla, and waterhyacinth.

APPROACH: Collect or arrange collections of live natural enemies and weed control candidates and prepare documentation necessary for the introduction of exotic species into quarantine and later for their release from quarantine. Establish colonies and study the biologies in the laboratory. Test the weed control candidates against a wide range of plants to determine and host specificity. Conduct or aid the field releases of those candidates for which clearance is obtained.

PUBLICATIONS: 79/12 TC 80/12

STEWART, E.E. 1980. Retardation of Hydrilla (Hydrilla verticillata) Regrowth Through Chemical Control of Vegetative Reproduction. Weed Sci. 28(3):245-251.

PROGRESS: 80/01 TO 80/12. Fall armyworm, Spodoptera frugiperda, larvae collected in Bolivia by a cooperator were reared in quarantine to recover a parasitic ichneumonid wasp, Eiphosca vitticole. Nineteen adult parasites were transferred immediately

003.036 CRIS0042919
IDENTIFICATION OF INSECTS FOR BIOLOGICAL CONTROL OF AQUATIC WEEDS

BUCKINGHAM G E; USDA-ARS BIOLOGICAL PEST CONTR, GAINESVILLE, FLORIDA. 32604.

to a researcher for interbreeding with his previously established laboratory colony. Additional adults were used to establish a quarantine colony and to test whether the parasite larvae would be encapsulated by Bolivian fall armyworm larvae as they had been by Florida fall armyworm larvae during an earlier quarantine colonization in 1979. Many were encapsulated by the Bolivian larvae. The quarantine colony was later transferred to the researcher. Eurasian watermilfoil, *Myriophyllum spicatum*, was surveyed four times during the summer at Crystal River, Florida, for the weevil, *Litodactylus leucogaster*, which had been released during 1979. No adults of *L. leucogaster*, which is native to the northern U.S., were recovered although 1435 adults of the native Florida weevil, *Perenthis vestitus*, were collected during the survey. Eight hundred forty flowers, buds, and stems were examined for immatures of *L. leucogaster* without success. It is still too early to report failure of establishment especially considering the large amount of milfoil to be searched.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.039
FRESHWATER FOOD ANIMALS

CFIS0071451

BILL T K; BROWN B E; CHESNESS J L;
ENTOMOLOGY-FISHERIES; GEORGIA COASTAL FLAIN EXPT STA,
TIFTON, GEORGIA. 31794.
Proj. No.: GE000283
Agency ID: CSRS

Project Type: HATCH
Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and Improve Production and Management Systems for Freshwater Animals Cultured for Food. Nutrition. Water Quality. Diseases. Culture Systems. Evaluate the Economics of Production, Processing and Marketing of Freshwater Food Animals.

APPROACH: Practical diets for channel catfish and rainbow trout will be tested in raceways. Water quality in raceways will be monitored and removal of wastes investigated. Diseases and parasites problems associated with intensive cultures will be identified and treated. The double-crop concept of using CC in summer and RT in winter in raceways will be continued. Polyculture for increased production through wastes utilization will be evaluated. Complete costs and returns analyses will be developed for different levels of production and management.

PROGRESS: 76/09 TO 78/12. Research has been completed with a flowing water system for double-crop fish production in a closed system of raceways. Each raceway segment, ca. 30 m long by 4.5 m wide, was stocked with 3,000 rainbow trout (November - March) and 2,500 channel catfish (April - October) per segment and produced over 3/4 T. and 1 T. of trout and catfish, respectively, each year. Water temperatures for 20 or more days under 4°C reduced trout production significantly. Multiple harvesting of catfish resulted in higher net production of fish per raceway segment. Feed conversion for multiple harvested/stocked fish was 1.3:1; whereas, once harvested fish had a conversion of 1.5:1. Feed conversion ratios were higher for catfish fed a sinking feed than for those fed a floating feed. To facilitate management of waste products in raceways, tilapia were stocked with catfish at 50 and 100 half-pound tilapia. Although they increased in weight from 1/2 pound to 1.1 pounds per fish, the tilapia did not reproduce.

PUBLICATIONS: 76/09 TO 78/12
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

003.038
BIOLOGICAL CONTROL OF AQUATIC WEEDS WITH INSECTS

CFIS0046116

BUCKINGHAM G E; USDA-ARS BIOLOGICAL PEST CONTROL,
GAINESVILLE, FLORIDA. 32604.
Proj. No.: 7602-20280-001
Agency ID: A1S

Project Type: INHOUSE
Period: 11 APR 80 To 11 APR 84

OBJECTIVES: To provide new insect agents for use in the biological control of aquatic weeds, especially Eurasian watermilfoil, hydrilla, and waterhyacinth, and to increase the effectiveness of those agents already present.

APPROACH: Collect or arrange collections of live insects, both exotic and native, which feed on the target aquatic weeds and assemble data necessary to obtain clearance to import them into quarantine or release them in the field. The biology and host specificity will be studied for each new candidate. Field releases will be aided or conducted, if necessary, when clearance is obtained. Studies will be conducted with those agents already present, in order to increase the understanding of their behavior, effect upon the plant, and interspecific competition.

PROGRESS: 80/04 TO 80/12. Laboratory and field observations failed to confirm the literature reports that *Neochetina elchhorniae* weevils were attracted to waterhyacinth plants on which the central petiole had been removed. Large numbers of weevils were found hiding on these plants during the day but it appeared that they were responding to an increase in hiding sites or to increased exposure of succulent new tissue for food. Olfactometer studies reported in the literature were repeated but the reported attraction to chopped plants appeared to be due to an attraction to higher humidity rather than to a plant chemical. Individuals from dense weevil populations were strongly attracted to light while those from sparse populations were only moderately attractive. Migratory activity might be influenced by weevil density since migrating weevils are attracted to lights. Laboratory biology and host specificity studies were conducted with a native aquatic moth, *Parapoinx seminealis*. This species has been reported only upon floating heart, *Nymphoides aquaticum*. Complete development has been obtained thus far only upon floating heart, but after 3 months larvae are still alive and feeding upon two other plant species. The potential feeding range is thus broader than the actual feeding range found in the field.

PUBLICATIONS: 80/04 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.040
A STUDY OF THE MICROBIOLOGICAL FLORA OF ORNAMENTAL FISHES

CFIS0075438

GRATZKE J B; VETERINARY MEDICINE; UNIVERSITY OF
GEORGIA, ATHENS, GEORGIA. 30602.
Agency ID: CSVM-1029

Period: 01 JUL 75 To 30 JUN 80

OBJECTIVES: Survey imported tropical ornamental fish and transport water for parasites, bacteria, and viruses potentially harmful to humans, domestic livestock and fish.

APPROACH: Selected samples of fish imported from Southeast Asia are examined microscopically for parasites. Bacterial and virus identification and isolation are done using standard bacteriological and virological techniques.

PROGRESS: 79/07 TO 80/06. Studies on the use of an ozone generator suggest that the oxidizing effect is significantly reduced as the amount of organics rises in the water. Whereas ozone has a marked antibacterial, antiprotozoal effect *in vitro*, expected results in an actual fish culture system were not forthcoming. Studies using UV light to stem the extension of an infestation of *Ichthyophthirius multifiliis* infection through a central system suggest that UV light will effect tomites if the exposure is intense enough.

PUBLICATIONS: 79/07 TO 80/06
NO PUBLICATIONS REPORTED THIS PERIOD.

003.041 CRIS0075439
DETERMINATION OF EFFICACY OF CERTAIN ANTI-PARASITIC
DRUGS FOR FISHES

GRATZEK J E; VETERINARY MEDICINE; UNIVERSITY OF
GEORGIA, ATHENS, GEORGIA. 30602.
Agency ID: CSVN-X030 Period: 01 JUN 77 To 30 JUN 80

OBJECTIVES: Determine if new classes of drugs are
both efficacious for treatment of monogenetic
trematodes, parasitic protozoans of fish while being
non-toxic to the fish.

APPROACH: Selected fish with known loads of parasites
are subjected to exposure to graded doses of drugs.
Fish are examined at successive intervals
post-treatment to evaluated activity and toxicity of
drugs.

PROGRESS: 79/07 TO 80/06. It was shown that
monogenetic trematodes (*Gyrodactylus elegans*) on
common goldfish (*Carassius auratus*) have developed an
apparent resistance to the recommended dosages of
organophosphates (.25 ppm).

PUBLICATIONS: 79/07 TO 80/06
GCVEN, B.A., GILBERT, J.P. and GRATZEK, J.E. 1980.
Apparent Drug Resistance to the Organophosphate
Dimethyl (2,2,2, - Trichloro-1-hydroxyethyl)
Phosphonate by Monogenetic Trematodes. J.
Wildlife Diseases. 16,343-347.

003.042 CRIS0075472
SEROLOGIC AND VIRULENCE STUDIES OF AEROMONAS
HYDROPHILA

SHOITS E H; DAWE D L; GRATZEK J B; VETERINARY
MEDICINE; UNIVERSITY OF GEORGIA, ATHENS, GEORGIA.
30602.
Agency ID: CSVN-0129 Period: 01 JAN 77 To 31 DEC 81

OBJECTIVES: Determine the existence of serologic
groups within the genus species *Aeromonas hydrophila*.
Determine the relationship of these serologic groups
to virulence for fish and other aquatic life. Develop
diagnostic technique(s) capable of selecting virulent
strains of *Aeromonas hydrophila* from clinical
situations.

APPROACH: Development of a group of selective
antisera against *Aeromonas hydrophila* isolates
through selective sorption of antisera with
appropriate antigens. Having developed the above,
group isolates according to reactivity in the
prepared antisera and examine their virulence through
infectivity studies concomitant with the infectivity
studies carry out an evaluation of the developed
antisera as a diagnostic aid in the detection of
virulent strains of *Aeromonas hydrophila*.

PROGRESS: 79/07 TO 80/06. Extreme heterogeneity
existed among strains of *Aeromonas hydrophila* used.
Cross absorption of antisera resulted in presence of
specific antigenic characters 17% of time. No
correlation seen between characters and virulence in
channel catfish, (*Ictalurus punctatus*). Recovery of
marker strains from fish were reduced from 100% to
38% at 96 h.p.i. in peritoneal cavity and from 25% to
0% at 96 h.p.i. from blood suggesting in vivo
serologic alteration or mortality due to indigenous
flora.

PUBLICATIONS: 79/07 TO 80/06
NO PUBLICATIONS REPORTED THIS PERIOD.

003.043 CRIS0078919
FRESHWATER FISH ANIMALS

GRATZEK J B; DAWE D L; SHOITS E H; VETERINARY
MICROBIOLOGY; UNIVERSITY OF GEORGIA, ATHENS, GEORGIA.
30602.
Agency ID: CSVN-0031 Period: 01 MAR 79 To 30 SEP 81

OBJECTIVES: Develop and improve production and
management systems for freshwater animals cultured
for food. D. Diseases.

APPROACH: Strains of *A. hydrophila* from catfish,
goldfish and trout will be studied using standard
biochemical tests as well as immunological tests.
Efficacy of treatment for monogenetic trematodes will
be determined by dose-response studies using lots of
known infested fish with treatment histories. Drugs
utilized will be trichlorfon and flubendazole.
Development of a vaccine for ichthyophthirius will be
attempted by utilizing the principle of heterologous
vaccination as previously used with virus vaccines.

PROGRESS: 80/01 TO 80/12. A vaccine for
Ichthyophthirius multifiliis has been developed using
antigens from *Tetrahymena pyriformis*. *T. pyriformis*
is easily propagated and antigenic material is easily
recovered.

PUBLICATIONS: 80/01 TO 80/12
GCVEN, E.A., DAWE, D.L. and J.E. Gratzek.
Protection of channel catfish, *Ictalurus
punctatus* Rafinesque, against *Ichthyophthirius
multifiliis* Fouquet by immunization. J. Fish.
Biol. 1980. 17,311-316.

003.044 CRIS0064981
DISEASES OF AQUACULTURE SPECIES

NAKAMURA E M; MIYAHARA A Y; ANIMAL SCIENCE;
UNIVERSITY OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW00239 Project Type: STATE
Agency ID: SAES Period: 01 SEP 73 To 30 SEP 81

OBJECTIVES: Identify and characterize diseases of
aquacultural organisms, seek optimum methods for
control and treatment of these diseases and catalog
this information for use by aquaculturists and
biologists.

APPROACH: Diseases of aquacultural organisms,
particularly of the freshwater prawn, will be studied
as they occur under natural or experimental
conditions. Pathologic and microbiologic techniques
will be used. Environmental parameters such as
temperature, salinity, pH, will be studied and
correlated with the occurrence of disease. Optimal
methods for diagnosis, treatment and control will be
sought. This information will be disseminated by
publication in journals or extension circulars.

PROGRESS: 80/01 TO 80/12. Significant decreases in
daily weight gains were recorded in prawns,
Macrobrachium rosenbergii, subjected to both adverse
temperature and ammonia in the water. Increasing
temperatures up to 34 degrees C caused decreased
weight gains in fed prawns and increased weight
losses in unfed prawns. Significant decreases in
weight gains were seen within 7 days in prawns in 40
and 20 ppm of ammonia as compared to prawns held in
water containing 10, 5, and 0 ppm of ammonia.
Clotting of prawn hemolymph and precipitation of
hemolymph proteins precluded automated clinical
laboratory tests. Increased hemolymph glucose was
detected in heat stressed prawns.

PUBLICATIONS: 80/01 TO 80/12
CROWELL, S.K. and NAKAMURA, E.M. 1980. Effects of
Thermal Stress in *Macrobrachium rosenbergii*.
Proc. West. Sec. Amer. Soc. Anim. Sci. 31:31-32.

003.045 CRIS0083231
ENVIRONMENTAL GILL DISEASE IN RAINBOW TROUT

KLCNTZ G W; FISHERY RESOURCES; UNIVERSITY OF IDAHO,
MOSCOW, IDAHO. 83843.
Proj. No.: IDA00799 Project Type: ANIMAL
HEALTH
Agency ID: CSRS Period: 15 JAN 81 To 30 SEP 81

OBJECTIVES: To document the pathogenesis of
environmental gill disease (EGD) in juvenile rainbow
trout from the standpoints of: quantitative
environmental factors; sequential histopathological

changes, to propose efficacious methods of preventing and/or treating environmental gill disease in juvenile rainbow trout.

APPROACH: Groups of 500-600 juvenile rainbow trout (with appropriate untreated controls) will be exposed to varying levels of dissolved oxygen, ammonia-N, water temperature, and suspended solids for extended periods. Samples will be taken weekly for examination of gill tissues. Growth rates will be monitored. A second series of experiments will measure the relative efficacies of chemicals to prevent or reduce the severity of EGD in juvenile rainbow trout. Appropriate untreated controls will be used.

003.046 CFIS0069632
THE EFFICACY OF SELECTED ANTIHISTAMICS IN THE PREVENTION AND CONTROL OF BACTERIAL KIDNEY DISEASE

KLCNTZ G W; FCREST WILDLIFE & RANGE EXP ST; UNIVERSITY OF IDAHO, MCSCCW, IDAHO. 83843.
Proj. No.: IIA-CFU-0037 Project Type: STATE
Agency ID: CCI Period: 01 JUL 74 To 30 JUN 76

OBJECTIVES: Test several parenterally administered antibacterials for their ability to control bacterial kidney disease in adult salmonids; field test an antibacterial efficacious in controlling bacterial kidney disease.

APPROACH: Adult spring chinook salmon will be injected subcutaneously with one of several potential systemic antibacterials capable of controlling bacterial kidney disease; at spawning time or before all fish will be examined for gross and microscopic lesions of bacterial kidney disease; the progeny of the injected fish will be monitored for congenital anomalies and incidence of bacterial kidney disease; subsequent field trials using the most efficacious antibacterial will be conducted to determine cost:benefit ratio in detail.

PROGRESS: 80/01 to 80/12. This is a continuing study to reduce the prespawning mortality due to the bacterial kidney disease in adult spring chinook salmon. During 1980 the prespawning mortality due to bacterial kidney disease was 9.48% - a significant reduction from previous years. The study is also designed to reduce the mortality due to bacterial kidney disease in juvenile spring chinook salmon. The annual mortality has been reduced from more than 20% to virtually 0.0%. The adult fish are injected with 5 mg/lb erythromycin phosphate at the time they enter the trapping facility. The juvenile occurrences of bacterial kidney disease are prevented by water hardening the eggs at the time of fertilization in 2 mg/l erythromycin phosphate.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.047 CFIS0069916
SELECTIVE CHEMICALS FOR THE CONTROL OF THE THREESPINE STICKLEBACK

MACPHEE C; FCREST WILDLIFE & RANGE EXP ST; UNIVERSITY OF IDAHO, MCSCCW, IDAHO. 83843.
Proj. No.: IDA-CFU-0038 Project Type: STATE
Agency ID: OCI Period: 01 AUG 74 To 30 DEC 80

OBJECTIVES: Increase the production of salmon in Alaska waters by selective chemical control of stickleback.

APPROACH: Screened by fish assays about 2000 potential piscicides to detect those which might be selectively lethal to the threespine stickleback.

PROGRESS: 80/01 TO 80/12. Control of stickleback in streams and other locales is achieved by selective addition of chemicals that form free azide radicals in water, specifically sodium azide and potassium azide. Subsequent deactivation, when desired, is achieved by addition of calcium compounds. High

selectivity to stickleback can be achieved with minimal risk to desirable game fish in the salmon and trout groups. (Federal regulations require that azides be cleared for use in natural waters.)

PUBLICATIONS: 80/01 TO 80/12
MACPHEE, C. and CHENG, F.F. 1980. Fish Culture by Stickleback Population Eradication. United States Patent 4,221,702, 5 pp. Sept. 9.

003.048 CFIS0059946
BIOLOGY AND CONTROL OF AQUATIC VEGETATION

LEMBI C A; BOTANY & PLANT PATHOLOGY; PURDUE UNIVERSITY, LAFAYETTE, INDIANA. 47907.
Proj. No.: IND055036 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 71 To 30 SEP 81

OBJECTIVES: Evaluate effects of herbicides on aquatic weeds and water quality parameters under greenhouse and field conditions. Evaluate non-herbicidal methods of aquatic weed control such as herbivorous fish and light-shading dyes. Study and correlate aquatic plant life cycles, morphology, and cellular structure with selectivity to herbicides.

APPROACH: Develop management techniques to control aquatic weeds with a minimum of adverse effects on water quality, plankton and fish. Herbicides and water-soluble dyes will be evaluated, and field studies of the biological control agent, the white amur, will be continued. The biology of difficult-to-control aquatic weeds will be studied to determine environmental c.

PROGRESS: 80/01 TO 80/12. Studies were continued on the difficult-to-control, mat-forming green alga, Pithophora, with emphasis on the factors regulating its seasonal and spatial distribution in lakes in order to 1) develop timely and appropriate management techniques and 2) serve as a basis for studying other weedy filamentous algae of which little is known. Peak abundance of Pithophora biomass in an Indiana lake occurs in late summer and is associated with photosynthetic rates which increase from early spring to a maximum of 31.5 mg O₂/g dry wt/hr in September. A portion of the vegetative filaments with akinetes (spores) makes up the overwintering population and is still photosynthetically competent with O₂ evolution rates of 2.33 mg/g dry wt/hr when measured in December. Tests with a commonly used algicide, simazine, show reduced initial rates of photosynthesis; however upon removal of the alga from simazine treatment, even after 14 day exposures, photosynthetic rates rapidly recover to control rates. Simazine does not appear to be an effective algaicidal material for Pithophora control. Spatial distribution of the alga in the study lake indicates a high nutrient requirement. Half-saturation constants (K_s) at 20 degrees C relating filament growth to external concentrations of Nitrate-N is 1.23 mg l⁻¹ and for phosphate-phosphorus, 0.1 mg l⁻¹. This type of information is currently being expanded to develop water quality standards for local and state agencies to use in the control of this alga.

PUBLICATIONS: 80/01 TO 80/12
SPENCER, D.F., VCLPP, T.E. and LEMBI, C.A. 1980. Environmental Control of Pithophora oedogonia (Chlorophyceae) Akinete Germination. J. Phycol. 16:424-427.
LEMBI, C.A. 1980. Aquatic Weed Control - In Review. Weeds Today 11:4-6.

003.049 CFIS0059671
ENVIRONMENTAL ASPECTS OF SALMONELLICIDIS

MORSE E V; VETERINARY SCIENCE; PURDUE UNIVERSITY, LAFAYETTE, INDIANA. 47907.
Proj. No.: IND073019 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 71 To 30 JUN 76

OBJECTIVES: Assess environmental parameters influencing *Salmonella* survival and multiplication. Investigate *Salmonella* spp. as pollution monitors. Characterize salmonellosis in livestock and companion animals. Survey the presence of *Salmonella* in the food chain and processing environments. Study impact of livestock rearing practices on the prevalence, course and prevention of salmonellosis.

APPROACH: Standard methodologies for the collection, cultivation and identification of the Enterobacteriaceae (Ewing) will be followed. River water, bottom sediment and freshwater aquatic fauna (fish, mollusks and crustaceans) will be sampled for presence of salmonellae. Tissues and excreta from salmonellosis patients in the Purdue Large Animal Clinic as well as those animals involved in epizootics on farms will be collected and examined for salmonellae. Samples of fresh or frozen foods at the retail level will be collected (with Ind. State Board Health Staff) and assessed for salmonellae content. Field trips with animal/disease diagnostic lab personnel and extension specialists (Ani. Sci & Vet Sci.) to investigate husbandry practices relating to salmonellosis outbreaks in livestock.

PROGRESS: 78/01 TO 78/12. Antibigrams for 811 *Salmonella* (10 serotypes) were determined; 160 were from livestock infections and 651 from the environment, i.e., river water, fish, mussels, cranes and raccoons. Livestock strains were more resistant (25%) to ampicillin, tetracycline, kanamycin, neomycin, streptomycin and sulfonamides. Twelve antimicrobials were employed (Kirby-Bauer disc method). A raccoon and a river water isolate were nalidixic acid resistant. Livestock salmonellae are exposed to antimicrobials in feed or during therapy, and develop resistance. Environmental isolates have less drug contact and remain sensitive to most antibiotics.

PUBLICATIONS: 78/01 TO 78/12

- MORSE, E.V., GREENWOOD, D.E. and MEYERS, E.P. 1978. Experimental *Salmonella* infections in *Crossostomus xanthopterus* (Goldfish). *J. Environ. Sci. Health* A113 (4):325-335.
- MORSE, E.V., DUNCAN, M.A. and MYBOM, E.F. 1978. *Salmonella* serotypes isolated from the aquatic environment (Webash River, Indiana, 1973-1976). *Amer. J. Vet. Res.* 39:717-719.
- MORSE, E.V., KERSTING, K.W., SMITH, L.E., MYBROM, E.P. and GREENWOOD, D.E., Salmonellosis: Possible transmission from horse to human to dog of infection. *Amer. J. Pub. Hlth.* 68:487-489.
- MORSE, E.V. 1978. Salmonellosis and pet animals. *Proceed. Nat'l. Salm. Seminar. USDA. Washington, D.C.* pgs. 1-6.
- GOSSETT, K.A. 1978. A study of the effect of residence in fish on the virulence of salmonellae in white mice. M.S. Thesis. Purdue University, Lafayette, Ind. 52 p.

003.050 CRIS0083189
HOST-PARASITE RELATIONSHIPS BETWEEN THE CHANNEL
CATFISH AND *ICHTHYOPETRIIUS MULTIFILIIS*

HANSEN M F; FOEHRER G W; KLAASSEN B E; BICLCGY;
KANSAS STATE UNIVERSITY, MANHATTAN, KANSAS. 66506.
Proj. No.: KAN0021E Project Type: ANIMAL
HEALTH
Agency ID: CSRS Period: 14 JAN 81 To 30 SEP 82

OBJECTIVES: To develop methods for maintaining *I. multifiliis* by cryopreservation; to determine presence of a carrier state of this parasite on fish surfaces and develop an ELISA for detection of the parasite; to evaluate host resistance mechanisms and attempt to develop a means of immunization of catfish.

APPROACH: Cryopreservation methods used for other protozoans will be adapted for preservation of *I. multifiliis*. Survival time of the parasite will be measured using a fluorochromasia technique. A method for determining tomite numbers per liter of water will be established and used to study water in which there are infected fish. An ELISA will be established to study parasite density in waters harboring infected fish. The effect of stress on naturally

occurring and experimental infections will be evaluated. The humoral response will be characterized according to the types of antibodies produced, the development of a memory response, interaction of complement components with antibody and antigen and the cells involved in the immune response. Vaccines will be prepared from formal-treated and freeze-dried parasites and tested.

003.051 CRIS0079532
CELL CULTURE STUDIES ON CELL LINES DEVELOPED FROM
TISSUES OF AQUATIC ANIMAL

AMBORSKI G F; VETERINARY MICROBIO & PUB HLTH;
LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA.
70803.
Agency ID: CSVM0034-SVM Period: 01 JUL 78 To 30 JUN 80

OBJECTIVES: Prepare primary cell lines from tissues of aquatic animals. Characterize various cell lines from aquatic animals. Preserve suitable or promising aquatic animal cultures in liquid nitrogen. Utilize crayfish cell lines to screen for crustacean viruses.

APPROACH: Various cell lines will be prepared from vertebrate and invertebrate aquatic animals (utilizing standard techniques). Established aquatic cell lines will be obtained from additional cell repositories. The cell lines will be characterized as to growth potential, utilization for viral susceptibility and will be screened for use as target cells in studies with toxins obtained from aquatic pathogens.

PROGRESS: 79/01 TO 79/12. Aquatic cell lines (15) are being maintained in the Cell Culture Center of the School of Veterinary Medicine. Two of the cell lines, Brown Bullhead and Frog Tongue, were used as indicator systems to test the effects of purified bacterial toxins from *Aeromonas hydrophila*, an opportunistic aquatic bacterial pathogen. Utilization of a microtiter system was used to quantitate the toxin during various stages of purification. Toxin preparations were obtained from the LSU Amphibian Facility. To study the effects of the toxin at a more detailed cellular level, cells were labeled with ⁵¹Cr. Membrane damage due to the toxin was monitored by the release of ⁵¹Cr into the supernatant fluids. Efforts are being continued to develop crayfish and molluscan cell lines.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.052 CRIS0084125
TOXICITY OF *AEROMONAS HYDROPHILA* EXOTOXINS IN
CHANNEL CATFISH

THUNE R L; VETERINARY MICROBIOLOGY & PARASITOLOGY;
LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA.
70803.
Proj. No.: LAV-0206-SVM Project Type: ANIMAL
HEALTH
Agency ID: CSRS Period: 01 MAY 81 To 30 APR 84

OBJECTIVES: To determine the median lethal dose (LD₅₀) for *A. hydrophila* exotoxins in channel catfish fingerlings. To determine the role of endotoxin on exotoxin toxicity. To compare the pathology of toxin toxicity to natural *Aeromonas hydrophila* bacteremias.

APPROACH: A single exotoxin preparation grown in a defined medium will be harvested, divided into equal aliquots & frozen. Five groups of 15 channel catfish will be injected intramuscularly in series with a two-fold serial dilution of the original toxin, scored for mortalities, and the LD₅₀ value calculated by the method of Reed and Muench (1938). Endotoxin will be prepared by the method of Westphal and Jann (1965) and LD₅₀ values determined as for exotoxin. Six groups of 15 fingerling catfish will be inoculated with one of the following preparations: LD₅₀ dose of exotoxin; LD₅₀ dose of exotoxin with

LD(50) dose of endotoxin; LD(50) dose of endotoxin; and physiological saline. Hematological and histological pathology will be determined in fish which have been injected with varying doses of exotoxin and endotoxin with endotoxin, including long term effects of sublethal doses.

003.053 CRIS0083896
ULTRASTRUCTURAL CHANGES IN TELEOST GILLS: EFFECTS OF
SUBTLE ALTERATIONS IN THE ENVIRONMENT

HAUCK W N; TAYLOR B W; VETERINARY SCIENCE; LOUISIANA
STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Agency ID: CSVM0180-SVMPeriod: 01 JUL 80 To 30 JUN 81

OBJECTIVES: To develop techniques for ultrastructural examination of fish gills. To compare by light and electron microscopy, normal gill morphology to morphology in which fish have been subjected to specific environmental changes. To correlate morphopathology and environmental changes and propose a pathogenic basis for disease development. To examine random gill samples from clear and polluted fresh, estuarine and marine populations of both cultured and feral fish. These samples will be compared to those which have been previously examined.

APPROACH: Gills will be collected from laboratory cultured fish which have been exposed to pH and dissolved oxygen alteration, addition of ammonia and sewage effluent and increase in fish population density. Gills will be collected from apparently healthy and sick feral and propagated food fish. These samples will be processed and sectioned according to standard methods and examined with the light and electron microscope. An attempt will be made to quantify and correlate lesions with the damaging agent involved.

003.054 CRIS0083472
BIOLOGY AND CONTROL OF AQUATIC ANIMAL DISEASES

THUNE B L; VETERINARY SCIENCE; LOUISIANA STATE
UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB02163 Project Type: ANIMAL
HEALTH
Agency ID: CERS Period: 01 MAR 81 To 31 DEC 86

OBJECTIVES: Develop immunological procedures for studying, diagnosing and preventing aquatic animal diseases. Examine the role of environmental factors on aquatic animal diseases, particularly as they affect the host immune response. Examine the structure, biology and pathology of aquatic animal disease organisms.

APPROACH: Three major immunological methods will be explored for adaptation to aquatic animal systems: Lymphocyte stimulation, hemolytic plaque assay and phagocytosis. Assess the effects of temperature, low dissolved oxygen and accumulated nitrogenous waste on the immune system of channel catfish. The antigenic structure of the cell wall *A. hydrophila* will be examined. These preparations and others may then be used as immunogens and evaluated using the immunological techniques developed in Objective 1.

003.055 CRIS0080671
NUTRITION MANAGEMENT AND DISEASE OF MARINE ANIMALS

BAYER R C; ANIMAL & VETERINARY SCIENCE; UNIVERSITY OF
MAINE, ORONO, MAINE. 04469.
Proj. No.: ME08358 Project Type: STATE
Agency ID: SAES Period: 01 JUN 79 To 30 SEP 82

OBJECTIVES: Formulate and evaluate minimal cost lobster rations, study gaffkemia in lobsters including vaccine evaluation and study lobster pound management. Compounded lobster baits will also be evaluated.

APPROACH: Lobsters will be fed diets of various types and growth will be monitored by measuring weight in water and weight in air. Lobsters will be vaccinated with live bacteria so that survival can be measured.

PROGRESS: 80/01 TO 80/12. Practical diets formulated with brewer's yeast, fish meal, kelp meal, alfalfa and wheat flour were fed to adult and juvenile lobsters. The basal diet was supplemented with 20,000, 100,000 and 1,000,000 U.S.P. units of vitamin A per Kg of diet. Growth was greatest in lobsters fed 20,000 U.S.P. units of vitamin A per Kg with growth inhibition seen in lobsters fed the higher level supplements. Adult lobsters were injected with P 3 2 labelled *aerococcus viridans*, a fatal lobster pathogen, and the distribution of these bacteria in the animal's body was monitored. The bacteria were primarily phagocytized by the hepatopancreas.

PUBLICATIONS: 80/01 TO 80/12

GALLAGHER, M.L., HAYER, R.C., LEAVITT, D.F. and RITTENBURG, J.H. 1979. Effects of Protein Energy Ratio on Growth of Adult American Lobsters. Proc. 10th An Meet. World Mariculture Society.

GALLAGHER, M.L., RITTENBURG, J.H., HAYER, R.C. and LEAVITT, D.F. 1979. Incidence of *Aerococcus viridans* (var.) *homari* in Natural Crab Populations in Maine Coastal Waters. *Crustaceana* 37:316-317.

BAYER, R.C., GALLAGHER, M.L., LEAVITT, D.F. and RITTENBURG, J.H. 1979. A Radiographic Study of the Lobster (*Homarus americanus*) Alimentary Canal. Proc. 10th An. Meet. World Mariculture Society.

BAYER, R.C., ADRON, J.W., MACKIE, A.M., PIRIE, B.J. and RITTENBURG, J.H. 1980. Mechanisms of Food Detection and Feeding Behavior in Dover Sole. Fed. Proc. 38:500.

BAYER, R.C., GALLAGHER, M.L., LEAVITT, D.F. and RITTENBURG, J.H. 1980. Requirements for Diet Formulation for Adult Lobsters (*Homarus americanus*) Held in High Density Confinement. Abst. 72nd Annual Meeting ASAS, p. 186.

003.056 CRIS0070103
PISCINE ERYTHROCYTIC NECROSIS IN THE ATLANTIC COD

NICHOLSON B L; MICROBIOLOGY; UNIVERSITY OF MAINE,
ORONO, MAINE. 04469.
Proj. No.: ME08794 Project Type: STATE
Agency ID: SAES Period: 15 FEB 76 To 31 JUL 81

OBJECTIVES: Determine possible effects of PEN virus on the Atlantic cod. Isolate and begin characterization of PEN virus. Determine if PEN infects herring and other marine fish.

APPROACH: Hematological and other parameters will be monitored on uninfected, infected, and experimentally infected cod to determine possible deleterious effects on the infection. PEN virus will be isolated from infected fish and preliminary characterization initiated. Possible in vitro techniques for the isolation and study of the virus will be explored. Electron microscopic studies of other fish will be made to determine the host range of the virus.

PROGRESS: 80/01 TO 80/12. Procedures have been improved for the primary culture of cells from Atlantic cod (*Gadus morhua*) using a modified marine cell culture medium. Studies are continuing on the effects of piscine erythrocytic necrosis (PEN) virus on cod and cod erythrocytes. Emphasis is being placed on effects on oxygen carrying capacity and blood enzyme activities. Ultra structural studies on PEN virus have been extended. An improved method for fixation of samples for electron microscopy has been developed. The improved resolution afforded by this method has revealed more intricate details of the ultrastructure of PEN virus. Comparative ultrastructural studies of PEN viruses from trout and Atlantic salmon in North America and Europe have been

initiated.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.057 CRIS0070107
INFECTIOUS PANCREATIC NECROSIS IN ATLANTIC SALMON

NICHOLSON E I; MICROBIOLOGY; UNIVERSITY OF MAINE,
ORONO, MAINE. 04469.
Proj. No.: ME08793 Project Type: STATE
Agency ID: SAES Period: 01 JAN 76 To 30 SEP 81

OBJECTIVES: The general objective of the proposed study is to evaluate the susceptibility of Atlantic salmon to infectious pancreatic necrosis (IPN) and other potentially destructive fish viruses. In addition, techniques for the detection and identification of viruses infecting Atlantic salmon will be developed or improved. Specific objectives: Determine the susceptibility of Atlantic salmon to IPN virus. Evaluate the possible effects of mycoplasma contamination of fish cell cultures on the replication of IPN and other fish viruses.

APPROACH: Atlantic salmon fry will be experimentally infected with IPN virus at different stages of development and under varying environmental conditions. Fish will be monitored for clinical symptoms, immune response, histopathology and mortality rates. Various fish cell cultures will be experimentally contaminated with mycoplasmas isolated from other fish cell cultures and the effect on cell morphology, subculture ability, and ability to support virus replication will be determined.

PROGRESS: 80/01 TO 80/12. Infectious pancreatic necrosis virus (IPNV) is the etiologic agent of a serious disease of trout and other salmonid fishes. Recently, similar viruses have been isolated from a variety of marine fishes and shellfish. Numerous IPNV isolates are available that differ in various characteristics. Information on the antigenic relationships of these viruses is either lacking or inconclusive. In this study, neutralization kinetic rate constants (K) were determined for twelve, representative isolates from North America and Europe using two specific antisera. All isolates were neutralized to some degree; however, the technique revealed distinct antigenic differences between a number of isolates. Normalization of K rates (NK) revealed some clustering of antigenically similar isolates but this was not correlated with the geographical areas of isolation. Analysis of NK rates suggested that these isolates could be divided into a minimum of three, tentative antigenic groups. Reciprocal cross kinetic neutralization tests using additional antisera are in progress. This study demonstrated the usefulness of this technique for investigating the antigenic relationships of IPNV.

PUBLICATIONS: 80/01 TO 80/12
NICHOLSON, 1980. Growth of Fish Cell Lines on Microcarriers. Applied and Environmental Microbiology 39:394-397.
SCHNEIDER, E. and NICHOLSON, E.L. 1980. Bacteria Associated with Fin Rot Disease in Batchery Reared Atlantic Salmon. Can. J. Fish and Ag. Sci. 37:1505-1513.

003.058 CRIS0082308
SEROLOGICAL METHODS FOR DETECTION AND IDENTIFICATION OF VIRUS DISEASES OF FISH

NICHOLSON E I; MICROBIOLOGY; UNIVERSITY OF MAINE,
ORONO, MAINE. 04469.
Proj. No.: ME-0-2-121-0 Project Type: GRANT
Agency ID: CSRS Period: 01 SEP 80 To 31 AUG 83

OBJECTIVES: Develop improved serological methods for detection and identification of virus diseases of fish.

APPROACH: Develop a solid-phase enzyme-linked immunosorbent assay (SP-ELISA) and a solid-phase aggregation of coupled erythrocytes (SPACE) assay for detecting infectious pancreatic necrosis (IPN), infectious hematopoietic necrosis (IHN) and channel catfish (CCU) viruses. The relative sensitivities and practicality of each test will be determined.

003.059 CRIS0012668
AN EVALUATION OF WIDELY USED HERBICIDES ON AQUATIC PLANTS, FISH AND FISH-FOOD ORGANISMS

MENABBE C D; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: MIC100959 Project Type: HATCH
Agency ID: CSRS Period: 28 OCT 64 To 01 JAN 99

OBJECTIVES: Assess the influence of total alkalinity, pH and temperature of the water on the effectiveness of several widely used herbicides. Test the effect of weed control by chemical means on fish-food organisms. Evaluate fertilization as a method of controlling higher aquatic plants.

APPROACH: Preliminary work in the laboratory will include study of influence of water quality on effectiveness of various herbicides. Toxicity of herbicides to fish will be studied in conjunction with the laboratory, experiments. While some fertilization studies can be done in the laboratory, the major effort here will be in farm ponds and small lakes.

PROGRESS: 80/01 TO 80/12. Lake Lansing, Michigan was treated with sodium arsenite for aquatic weed control in 1957. Two 2.5 m cores from deep portions of the lake basin showed the historical consequence of this treatment. Maxima of 330-340 $\mu\text{g As g}^{-1}$ dry weight occurred at depth interval 0.15-0.30 m; background was 17-20 ppm As. An arsenic mass balance budget for the lake for June 1978 to June 1979 showed it lost more arsenic than it received from the watershed. Internal loading of the water from the sediments was occurring; the surface of the sediments in greater than 85% of the lake had concentrations 2-6 times background. From laboratory experiments, we hypothesize Fe^{3+} controls As concentration over aerobic sediments; As(III) increases in anoxic water with conversion of Fe^{3+} to Fe^{2+} and As(V) to As(III) at the sediment surface. As(III) in water decreases during prolonged anoxia by reaction with S^{2-} . As(III) and Fe^{2+} are oxidized upon aeration of anoxic water, and As(V) is taken out of solution with ferric iron in a manner similar to phosphate. Arsenic measurements in the lake over an annual cycle fit these expectations. Studies are underway to determine the impact of the annual arsenic cycle on fish food organisms of the lake.

PUBLICATIONS: 80/01 TO 80/12
BATTERSON, T.R. 1980. Arsenic in Lake Lansing, Michigan. Ph.D. Thesis. Mich. State Univ., East Lansing. 79 pp.

003.060 CRIS0076398
EFFECTS OF POLLUTANTS ON GILLS OF FRESHWATER FISHES

FRONM P O; PHYSIOLOGY; MICHIGAN STATE UNIVERSITY,
EAST LANSING, MICHIGAN. 48824.
Agency ID: CSVMV-0010 Period: 01 JUL 77 To 30 JUN 82

OBJECTIVES: Develop the isolated perfused gill preparation as a model for the study of the effect of pollutants on fish.

APPROACH: Experimental investigation of the permeability properties (flux of water across) isolated perfused gills and the effect of pollutants on same, a study of the salt transport capabilities (ATPase levels) in gills exposed to pollutants, and biotransformation of pollutants by gills during transit of materials from the ventilate to the blood vascular space. Test toxicologically some 'model' compounds which represent classes of chemical

compounds found in the process water from in situ gasification of coal.

PROGRESS: 80/01 TO 80/12. During 1980 research continued on development of the isolated trout gill preparation as a model for the study of the effects of pollutants on fish. Movement of tritiated water from a bath solution into the vascular compartment is a good qualitative measure of diffusive transfer capacity (P_{DA}) of the gill. P_{DA} is not constant but can be altered by changes in physical factors such as ventilation, total blood flow, blood pressure, pattern of blood flow and the exchange surfaces and by varying the number of lamellae (exchange surfaces) perfused. These factors which are regulated by humoral and neural means provides fish with elegant control of diffusional mass transport of materials across their gills. In acute experiments of 4 hours duration increasing the acidity of the bath from pH 7.2 to 3.5 by addition of sulfuric acid had no effect on P_{DA} but it did increase gill vascular resistance. This response was greater in gills perfused with saline alone than in those perfused with saline containing epinephrine, a potent dilator of gill vessels. In separate experiments with frogs it was found that acid stress caused a reduction in short-circuit current and electrical conductance of isolated skins but with intact animals there was no change in osmotic permeability upon exposure to acid conditions. The data supports the hypothesis that acid stress decreases influx of sodium ions into skins thereby reducing active (inward) sodium transport.

PUBLICATIONS: 80/01 TO 80/12

JACKSON, W.F. and FROMM, P.C. 1980. Intrinsic Hypoxic Vasoconstriction in Saline Perfused Trout Gills (*Salmo gairdneri*). *The Physiologist* 23(Abtract):175.

FROMM, P.C. 1980. A Review of Some Physiological and Toxicological Responses of Freshwater Fish to Acid stress. *Env. Biol. Fish.* 5:79-93.

JACKSON, W.P. and FROMM, P.C. 1980. Effect of Acute Acid Stress on Isolated Perfused Gills of Rainbow Trout. *Comp. Biochem. Physiol.* 67C:141-145.

003.061 CRIS0041849
LIFE HISTORY AND PHYSIOLOGICAL STUDIES OF AQUATIC AND MARGINAL WEEDS

QUIMBY JR P C; VOGI G B; USDA-ARS SOUTHERN WEED SCI LAB, STONEVILLE, MISSISSIPPI. 38776.
Proj. No.: 7402-20280-005 Project Type: INHOUSE
Agency ID: ARS Period: 15 NOV 74 To 15 NOV 79

OBJECTIVES: Study ecophysiology of duckweeds, hydrilla, alligatorweed, smartweeds, waterprimrose, cabomba, waterhyacinth, bluegreen algae, and redvine to aid control.

APPROACH: Field and laboratory studies include: light and emersion effects on alligatorweed budbreak; alligatorweed occurrence and spread; smartweed life-history; calcium/nitrogen nutrition of amaranths and lemna; cyanophyte nitrogen-fixing effects on duckweed, hydrilla, and cabomba. Biocontrol studies include; ecology and biogeography of native fauna on duckweed, waterprimrose, smartweed, redvine, and alligatorweed, and of *Disonycha* and *Agasicles* spp. to develop a basis for introduction of *D. argentinensis* on terrestrial alligatorweed.

PROGRESS: 74/11 TO 79/11. Growth analysis show that the exotic alligatorweed has no physiological advantage over native mild smartweed and creeping waterprimrose. Insects introduced for biocontrol have reduced alligatorweed about 30% in the lower Mississippi River basin and adjacent regions. Alligatorweed rooted to the soil in shallow waters is resistant to control. The alligatorweed stemborer is apparently favored by drought and has developed late-season populations for 100% infestation of alligatorweed as far north as Pine Bluff, AR. The alligatorweed flea beetle was shown to be very sensitive to toxaphene and methyl parathion; this sensitivity may partially explain failure of this biocontrol agent in the Yazoo-Mississippi Delta where insecticides are widely used. Growth of submerged

alligatorweed in light apparently depends on the activity of oxygen-producing photosystem II; in the dark, growth occurs only if plants are emerged with direct access to air or if exposed to hydrogen peroxide when submerged. Simazine at 10⁻⁵ M completely inhibited growth from submerged alligatorweed stem cuttings under artificial lighting. Hydrogen peroxide at 100 mg/L renewed at 48-hr intervals partially reversed the inhibitory effects of simazine on alligatorweed. The submerged alligatorweed system has been shown as a potential bioassay for low levels of simazine in water.

PUBLICATIONS: 74/11 TO 79/11

QUIMBY, P. C., JR., J. R. PETER AND S. C. DUKE. 1978. Photosystem II and hypoxic quiescence in alligatorweed. *Physiol. Plant* 44: 246-250.

KREASKY, J. B., P. C. QUIMBY JR. AND S. H. KAY. 1979. Dosage-Mortality response of the alligatorweed flea beetle (*Agasicles hygrophila*) and the nutsedge moth (*Bactra verutana*) to toxaphene and methyl parathion.

QUIMBY, P. C., JR., K. E. FRICK, R. D. WAUCHOPE AND S. H. KAY. 1979. Effects of cadmium on two biocontrol insects and their host weeds. *Bull. Environ. Contam. and Toxicol.* 22: 371-378.

VOGT, G. B., J. U. MCGUIRE, AND A. D. CUSHMAN. 1979. Probable evolution and morphological variation in South American disonychine flea beetles (Coleoptera: Chrysomelidae) and their amarantaceous hosts.

003.062 CRIS0065163
EFFECTS OF AN ALTERED TEMPERATURE REGIME AND CHEMICAL CONTAMINANTS ON THE AQUATIC ECOSYSTEM

WITT JR A; CAMPBELL R S; JONES J F; FORESTRY; UNIVERSITY OF MISSOURI, COLUMBIA, MISSOURI. 65211.
Proj. No.: M000171 Project Type: STATE
Agency ID: SAES Period: 19 APR 74 To 30 SEP 80

OBJECTIVES: Ascertain effect of altered thermal regime on incidence of diseased fish, growth of diseased fish, and their resistance to thermal stress. Ascertain effect of altered thermal regime on reproduction in fishes. Ascertain the degradation products of phthalic acid (PAEs) in the hydrosol and their effects on microbial processes. Ascertain effects on phthalic acid on aquatic insects in the hydrosol.

APPROACH: Fish sampled from thermal effluent and reservoir will indicate incidence of lymphocystis. Infected & healthy fish and experimentally for difference in growth & temperature stress. Caged control fish & fish in thermal effluent fed ad libitum. Reproduction cycle and fecundity determined from gonads. Eggs & larvae tested for differences in viability. Natural hydrosols & their microbial populations will be subjected to PAEs. Nitrogen, sulfur and phosphate cycles will be monitored to determine effects of PAEs. PAEs will be added to cultures of the blood worm and egg production, viability, and emergence will be monitored.

PROGRESS: 80/01 TO 80/12. However, some of our earlier work (Jennings 1979) was used and incorporated by the U. S. Army Corps of Engineers in their "Missouri River Bank Stabilization and Navigation Project Draft Feasibility Report and Draft EIS for the Fish and Wildlife Mitigation Plan" for the Missouri River. Life history aspects of the southern cavefish, from springs and caves of Camden County were studied. Length frequency distributions failed to delineate age groups, nor did the scales, indicating continuous growth in their constant environment. A sex ratio of 0.56 males to 1.0 females was found and did not vary with increasing length. Spawning appears to occur in May because of the decrease in the gonosomatic index. Females matured at 45 mm and egg number ranged from 20 to 80. Only one male, 58 mm, was mature, the internal anatomy was described by gross dissection and histological sectioning.

PUBLICATIONS: 80/01 TO 80/12

SMITH, V.J. 1980. Some Aspects of the Life History of the Southern Cavefish (*Typhlichthys subterraneus* Girard) in Missouri. M.S. Thesis 123 pp.

003.063

CRIS0069796

CONTROL OF WHIRLING DISEASE OF SALMONIDS

TAYLOR R L; VETERINARY MEDICINE; UNIVERSITY OF NEVADA, RENO, NEVADA. 89557.
Proj. No.: NEV00337 Project Type: STATE
Agency ID: SAES Period: 05 DEC 75 To 30 SEP 79

OBJECTIVES: Investigate the life cycle of *Myxosoma cerebralis*, the cause of whirling disease. Use these and other research findings as the basis for control of the disease.

APPROACH: Transmission experiments will be performed to determine the effects of temperature, external cysts on diseased fish and the stage of the disease that is contagious. The role of fish eating birds will be studied. Resistant strains of fish and drug treatment will be investigated as control methods. Attempts will be made to follow the development of infection through tissue sectioning.

PROGRESS: 71/10 TO 80/12. Cxytetracycline, Sulfamerzaine, Primaquine phosphate, Imidocarb dipropionate, Amprolium, Nicarbazine, Furpyrinol and Furazolidone were continuously fed to susceptible trout in known *M. cerebralis* contaminated water. None of the drugs prevented development of the disease but Furazolidone did reduce spore numbers in infected fish by 90%. However, effective drug levels of 86 mg/kg of body weight reduced the growth rate in medicated fish. Strains of trout (Pit River Rainbow and Eagle River Rainbow) which are resistant to *Ceratomyxa stasta* were found susceptible to whirling disease. Transmission studies showed that live or dead, mature or young *M. cerebralis* infected fish will transmit whirling disease. Further transmission studies showed for the first time that spores remain viable after passing through herrons and ducks and will then transmit the disease to susceptible fish. For the first time infection was demonstrated in a non-salmonid species, the Lahontan Mountain sucker, *Pantosteus lahontan*. Opercular cysts were demonstrated in infected fish. Tissue sectioning revealed numerous *M. cerebralis* spores inside the cysts. It was theorized that this is one method of transmission. A new spore concentration method that does not damage the immunogenicity of the organism was developed. This has been used in antigen preparation for the production of a specific hyperimmune serum against *M. cerebralis*. An enzyme-like immunosorbent assay (ELISA) test was developed for the serological identification of infected fish.

PUBLICATIONS: 71/10 TO 80/12

KCZEL, T.R., LOTT, R. 1980. Isolation of *Myxosoma cerebralis* (Whirling Disease) Spores from Infected Fish by Use of a Physical Separation technique. *Can. J. Fish. Aquat. Sci.* 37:1032-1035.

003.064

CRIS0065603

SALMON CULTURE - DEVELOPMENT OF NUTRITIONAL AND DISEASE CONTROL PROGRAMS

STECUT R G; ANIMAL SCIENCE; UNIVERSITY OF NEW HAMPSHIRE, DURHAM, NEW HAMPSHIRE. 03824.
Proj. No.: NH00227-S Project Type: STATE
Agency ID: SAES Period: 01 JUL 73 To 30 SEP 78

OBJECTIVES: Determine protein level required for feeding at a constant calorie to protein ratio. Determine minimum level of fishmeal without reducing growth. Determine the critical nutrients supplied by fishmeal. Develop an effective autogenous polyvalent bacterin of *Vibrio anguillarum* that will withstand laboratory and field challenge.

APPROACH: Because basically the study involves calorie-protein ratios, initially protein levels will be studied at a constant calorie-protein ratio. Sources of protein will be investigated, particularly in an attempt to lower the quantity of fishmeal used, and to make use of cheaper protein sources. Diets will be studied in both fresh and saltwater rearing programs, and results will be evaluated primarily by growth and feed conversion. Control of vibriosis in sea water reared salmon will be attempted in 2 ways: immunization of the fish using an autogenous bacterin, and investigation of anti-biotic efficacy against *Vibrio anguillarum*. Killed bacterins will be administered parenterally or orally, and the immune response measured by challenge. Antibiotic activity, screened initially in vitro, will be verified orally in vivo.

PROGRESS: 73/07 TO 78/09. Atlantic salmon (*Salmo salar*) were found to be as susceptible as coho salmon (*Oncorhynchus kisutch*) to Maine-New Hampshire strains of *Vibrio anguillarum* used in both injection and water transmission exposure. Exposure to $1-2.5 \times 10^5$ organisms/ml of one strain (569) in the water for 1 hr. killed fish of both species at 10°C and 15°C. Should similar water exposure conditions occur in Maine estuaries newly released Atlantic salmon smolts may encounter lethal levels of *V. anguillarum*. The organism causing bacterial kidney disease (KD) in salmonid fishes is a slow growing gram positive rod (perhaps genus *Corynebacterium*) on laboratory media supplemented with cysteine. However, these bacteria grow readily in rainbow trout gonad (RTG-2) cell cultures, using Eagles Minimum Essential Medium Plus 10% newborn calf serum, without antibiotics. Cultures initiated from laboratory media or diseased fish kidneys grow equally well and in six days essentially cover the cell monolayer. No valid data were obtained from the feeding experiment this year because the stock was decimated by kidney disease. This disease is not uncommon in fish culture and unfortunately there is no known cure or effective treatment. Treatment with the antibiotic terramycin and with a greatly elevated level of vitamin C (1000 mg/kg) were without effect. *Vibrio* sp. was isolated from lobsters (*Homarus americanus*) reared in captivity.

PUBLICATIONS: 73/07 TO 78/09

STROUT, R. G., E. S. SAWYER AND E. COUTERMARSH. 1978. Pathogenic vibrios in confinement-reared and feral fishes of the Maine-New Hampshire coasts. *J. Fish. Res. Board Can.* 35:403-408.
SAWYER, E., R. G. STROUT AND B. COUTERMARSH. 1979. Pathogenic vibrios comparative susceptibility of Atlantic salmon (*Salmo salar*) and Coho Salmon.

003.065*

CRIS0079854

FEEDING ECOLOGY OF FISHES UTILIZING MARSHES ALTERED FOR CONTROL OF SALT MARSH MOSQUITOES

SHISLER J; MOSQUITO RES & CONTROL; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ40503 Project Type: STATE
Agency ID: SABS Period: 01 JUL 70 To 30 JUN 80

OBJECTIVES: To study the feeding ecology of salt marsh fishes with emphasis on their role as mosquito predators.

APPROACH: Survey of fishes utilizing salt marsh altered for mosquito control. Study the food habits of the dominant species as determined from the survey in order to determine the most effective mosquito predator. Identification of larval fishes which occur in mosquito breeding areas because these may be important predators on the early mosquito instars.

PROGRESS: 80/01 TO 80/12. Fish populations were sampled throughout the year in both natural marshes and marshes that have been altered for mosquito control. Fish species composition varied between study sites with a typical freshwater assemblage common at sites with freshwater or lower salinities and typical estuarine assemblage at high salinities. *Fundulus heteroclitus*, *F. luciae* and *Cyprinodon variegatus* were dominant estuarine fish while freshwater dominate species were *F. daphanus*, *Gambusia affinis*, *Lepomis gibbosus* and *Notemigonus*

crysoleucas. Seasonal changes in both salinity and faunal populations were noted in impoundments.

PUBLICATIONS: 80/01 TO 80/12

ABLB, K.W., SBISLER, J.K. and TALBOT, C.W. 1979. Preliminary Survey of Fishes Utilizing New Jersey Marshes Altered for Control of Salt Marsh Mosquitoes. Proc. N.J. Mosq. Control Assoc. 66:103-115.
TALBOT, C.W., ABLB, K.W., SBISLER, J.K. and COCBEY, D. 1980. Seasonal Variation in Composition of Fresh and Brackish Water Fishes of New Jersey Mosquito Control Impoundments. Proc. N.J. Mosq. Control Assoc. 67:50-63.

003.066 CRIS0028020
NATURAL SEED OYSTER BEDS OF THE DELAWARE BAY

HASKIN B B; OYSTER CULTURE; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ32500 Project Type: STATE
Agency ID: SAES Period: 01 OCT 62 To 01 JAN 89

OBJECTIVES: Develop information on and conduct research leading to the goal of disease-free oysters in the Delaware Bay area.

APPROACH: Conduct such field and laboratory studies on MSX in oyster populations as required. Advise the Delaware Bay authorities of the best management practices to preserve good seed beds and develop new beds.

PROGRESS: 80/01 TO 80/12. The oyster planters of Delaware Bay depend almost exclusively on the State-controlled natural seed beds of the upper Bay for their supply of seed oysters which are planted on privately-leased beds in the lower Bay. Under this project our laboratory provides basic information on the seed beds and recommendations for their management to the State Division of Fish, Game and Shell-fisheries. In 1980 over 400,000 bushels of seed oysters were removed from the beds in the regular spring planting season. Based on our recommendations, two of the Beds, Egg Island and the Ledge, and a major portion of New Beds, were closed to the taking of seed because of a preponderance of small oysters of the 1978 and 1979 year classes. Following the spring-early summer dredging, a moderate to light general set of 1980 year class oysters occurred on the seed beds. MSX disease mortalities in the 1980 planted stocks were unusually heavy in the summer, fall and early winter of 1980-81. Mortalities in oysters on the lower seed beds were 1/2 to 1/3 those on the planted grounds immediately below the boundary, the Southwest Line separating seed beds and leased bottom. Based on these data and those of the preceding 20 years establishing that similar differential mortalities between seed beds and planting grounds have been the general rule.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.067* CEIS0028024
DISEASE-RESISTANT OYSTERS

HASKIN B B; OYSTER CULTURE; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ32504 Project Type: STATE
Agency ID: SAES Period: 01 AUG 64 To 30 JUN 82

OBJECTIVES: Verify the relative high resistance of Delaware Bay oyster stocks to MSX, increase the supply of such oysters, study and modify current procedures for artificial rearing of oysters, experimentally transmit MSX in the laboratory and increase the yield of market oysters by the control of predators.

APPROACH: Field experiments will be established to accomplish most of the objectives. Disease free oysters will be imported and planted where necessary, various chemicals will be tested for the control of shell-fouling and oyster drills. Laboratory procedures will be established to study artificial

rearing of oyster and to experimentally transmit MSX under controlled conditions so that the nature of this disease will be more fully known.

PROGRESS: 80/01 TO 80/12. Earlier reports have emphasized that the epizootic oyster disease, commonly called MSX, which first appeared in Delaware Bay in 1957, has been continuously present in the Bay since then. Its prevalence and intensity have fluctuated in cyclic fashion with 3 periods of low prevalence in 1962, 1971 and 1978. Intervening periods of high prevalence have not been consistently correlated with any environmental factor or set of factors. Survival of the Delaware Bay oyster industry has been based on the availability, at reasonable cost, of a moderately disease-resistant seed from the upper Bay natural beds. Our studies have shown, that, on long-term average, an oyster planter may expect to lose approximately 38% of his oysters to disease in the first year after planting. In good years, like 1978, this loss will drop to 15 - 20%. In bad years, like 1972 and 1980, the disease loss alone approaches 50%. This disease loss in 1980, coupled with poor growth and condition in the surviving oysters, resulted in a disastrous year for the planters. Our work in this project enabled us to evaluate the 1980 losses and place them in long-term perspective. Our more rigidly selected, laboratory-reared stocks of resistant oysters held up well under the 1980 disease pressure with mortality rates in these experimental stocks at 1/5 to 1/2 those of the native resistant seed stock.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.068 CRIS002990
BIOLOGY AND CONTROL OF AQUATIC WEEDS

BIEMER D; SOIL & CROP; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ15180 Project Type: BATCH
Agency ID: CSRS Period: 12 JAN 68 To 30 SEP 83

OBJECTIVES: Learn more about the life histories and ecological requirements of problem aquatic weed species; study the effects of herbicides on aquatic weeds in relation to dosage rate, stage of growth of plant, herbicide formulation, and ecological conditions under which the plant is growing and to formulate safe, effective, and economically feasible control measures for aquatic weeds.

APPROACH: Problem aquatic weed species will be studied in their natural habitats and under controlled conditions in the laboratory, greenhouse, and experimental ponds; and the response of aquatic weeds to various herbicides will be determined under various conditions in trials to be conducted in the greenhouse and in the field.

PROGRESS: 80/01 TO 80/12. Further investigation of seed germination in white water lily (*Nymphaea odorata*) has shown that the observed dormancy in freshly harvested seed is due to some intrinsic physiological mechanism and is not due to impermeability of the seed coat. Mechanical disruption of the seed coat has no effect on germination. Crowding of intact seed in a small volume of water or chilling the seed at 4 degrees C overcomes dormancy. The positive effect of crowding appears to be the result of a buildup of dissolved ethylene in the water. Varying the concentrations of dissolved CO₂ and O₂ in the water does not affect germination. Freezing and air drying of seed for short periods of time (even for a few hours of drying) renders the seed incapable of germination. The investigations also showed that the seeds of *Nymphaea odorata* have a definite light requirement for germination to occur.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

NATURALLY OCCURRING MOSQUITO LARVICIDES

LALONDE R T; BIOLOGY CHEMISTRY & ECOLOGY; CCL OF ENVIRON SCI & FORESTRY, SYRACUSE, NEW YORK. 13210.
 Proj. No.: NYZ-2213-02-003 Project Type: STATE
 Agency ID: OCI Period: 01 JUN 78 To 31 AUG 80

OBJECTIVES: Naturally occurring substances from algae are known to inhibit the development of mosquito larvae into the adult stage. These substances show signs of acting selectively. The primary objectives of the research are to isolate and identify such mosquito larvicides produced by the freshwater green alga *Cladophora* and then after develop them as mosquito control agents.

APPROACH: Various forms of chromatography will be employed as separation procedures. The separation will be monitored by the composite sample bioassay using *A. aegypti* as the test organism. Spectral techniques will be used for identification. Evaluation of control effectiveness will be carried out in the laboratory and in the field.

PROGRESS: 79/10 TO 80/08. The objective of the project was the identification of plant-produced agents having activity against mosquito larvae. The fresh water green alga *Cladophora glomerata* produces active saturated fatty acids identified by spectral means as capric [10:0], lauric [12:0], myristic [14:0] and palmitic [16:1 (9c)] acids. The LD(50) values of these acids in the order just given are: 14, 7, 4 and 3 ppm respectively against the standard test organism *A. triseriatus*. The most active acids 12:0, 14:0 and 16:1 (9c) were found to be released by the powdered alga at pH 8.5, the pH of Lake Ontario and the St. Lawrence River. N-(2-Methylpropyl)-(E,E)-2,4-decadienamide was found to be an active mosquito larvicide (LD(50) 2 ppm) from the terrestrial plant *Achillea millefolium*. Another fatty acid amide isolated and identified from the same plant is (E,E)-2,4-decadienpiperidide whose LD(50) is 13 ppm. The same level of activity was observed for (E,E)-2,4-decadienpyrrolidide and piperine. Several fatty acid isobutyramides were synthesized and tested for antilarval activity. An order of antilarval activity comparable to that of N-(2-methylpropyl)-(E,E)-2,4-decadienamide was observed when the skeletal chain length contained 14-16 members (including nitrogen) and when at least one double bond was conjugated with the amide carbonyl.

PUBLICATIONS: 79/10 TO 80/08

- LA LONDE, R.T., MORRIS, C.D., WONG, C.F., GARDNER, L.C., ECEERT, D.J., KING, D.P. and ZIMMEEMAN, R.H. 1979. Response of *Aedes triseriatus* larvae to fatty acids of *Cladophora*. *J. Chem. Ecol.* 5:371.
 LA LONDE, R.T., SLAYBACK, J.R.H., HOFSTEAD, S.J., WONG, C.F., MORRIS, C.D. and GARDNER, L.C. 1979. GC-MS detected disfunctional carboxylic acids released by dried *Cladophora* at the pH of Lake Ontario and the St. Lawrence.
 LA LONDE, R.T., WONG, C.F., HOFSTEAD, S.F., MORRIS, C.D., and GARDNER, L.C. 1980. N-(2-Methylpropyl)-(E,E)-2,4-decadienamide. A mosquito larvicide from *Achillea millefolium* L. *J. Chem. Ecol.* 6:35.

BACTERIAL KIDNEY DISEASE IN RAINBOW TROUT: PATHOGENESIS, IMMUNITY, AND EFFECT OF WATER HARDNESS

CARLISLE J C; AVIAN & AQUATIC ANIMAL MEDICIN; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
 Proj. No.: NYCV426382 Project Type: ANIMAL HEALTH
 Agency ID: CSRS Period: 18 FEB 79 To 30 SEP 81

OBJECTIVES: To define the early events in BKD pathogenesis: route to entry, site(s) of multiplication and method(s) of dissemination through the body. To determine the effect of water hardness on susceptibility of rainbow trout to BKD. To characterize the chronology of the humoral and cellular immune response to BKD. To compare the

immune response to BKD in hard and soft water. To challenge a group of susceptible fish by maintaining them in water from a tank of BKD-infected fish, thus stimulating a natural horizontal exposure.

APPROACH: Rainbow trout of 30 gm mean body mass, kept in 95% recirculated dechlorinated tap water at 14°C, will be divided into 3 groups of 200 fish. The first group will be infected with *Krenobacterium salmoninarum* by intraperitoneal inoculation. The second will be infected by constant exposure to the effluent of the first group. The third group will be uninfected. Half of each group will be kept in soft water of 5 mg/L total hardness (TH), the other half in hard water of approximately 175 mg/L TH. Postmortem examinations will be conducted on all dead or moribund fish and on fish sacrificed every other day for the first two weeks and weekly thereafter for ten weeks. Immune status will be determined weekly using, microagglutination, immunodiffusion, indirect immunofluorescence, leukocyte migration inhibition, antigen binding, and in vivo delayed type hypersensitivity.

PROGRESS: 79/01 TO 79/12. Preliminary studies on Bacterial Kidney Disease (BKD) have demonstrated the possibility of infecting rainbow trout fingerlings by feeding kidney tissue from infected brook trout. Approximately 50% developed fatal clinical disease. A second feeding produced no further cases. Transferring the apparently unaffected fish to one-half strength sea water did not induce overt disease. In clinically diseased fish the causative bacteria were demonstrable in frozen kidney sections and impression smears stained with FITC labeled anti-BKD serum. The sections proved more sensitive. Enzyme labeled anti-BKD serum has been obtained but not tested. Preliminary trials have shown that Walleye fry and fingerlings can be infected with the viruses of Infectious Pancreatic Necrosis (IPN) and Infectious Haematopoietic Necrosis (IHN). Titers of recovered virus were in some cases higher than that of the inoculum in fish infected by intraperitoneal injection and by bath exposure. Lesions typical of IHN were produced in several walleye and about equal numbers of the rainbow trout that were exposed in parallel. In cooperation with the Tunison Laboratory of Fish Nutrition, rainbow trout and Atlantic salmon fry were reared on diets containing varying levels of magnesium and calcium. The combination of low magnesium and adequate or high calcium produced poor growth, and muscle and kidney degenerative lesions. The effect was enhanced in soft water. IPN virus was isolated from 2 diagnostic cases.

PUBLICATIONS: 79/01 TO 79/12

- CARLISLE, J.C., SCHAT, E.A. and ELSTON, R. 1979. Infectious Haematopoietic Necrosis in Rainbow trout in a semi-closed system. *J. Fish. Dis.* 2:511.

INVEST. OF THE ROLE OF LARVAL AMERICAN OYSTERS (*CRASSOSTREA VIRGINICA*) AS CARRIERS OF OYSTER DISEASE

ELSTON R; LEIBOVITZ L; AVIAN & AQUATIC ANIMAL MEDICIN; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
 Agency ID: CSVM-426-386 Period: 01 JAN 80 To 01 JAN 82

OBJECTIVES: To determine if 2 known pathogens of adult oysters infect or can be carried by larval oysters. To attempt to isolate and characterize a virus observed as a virus-like particle in larval oyster tissues.

APPROACH: Infectious organisms will be isolated from adult oyster tissue. These will be inoculated into culture of oyster larvae. Larvae will be monitored with histological and electron microscopical techniques. Larval tissue extract will be applied to primary cultures of adult oyster cells.

PROGRESS: 80/01 TO 80/12. Attempts were made to induce disease in larval American oysters, *Crassostrea virginica* with *Perkinsus marinus* and *Minchinia nelsoni* which are well recognized pathogens of the adult oyster. Histological and ultrastructural examination of experimental animals did not reveal

any signs of infectivity. Attempts were made to isolate an oyster virus in primary cultures of oyster heart tissue. Although the cell culture system seemed to work satisfactorily, evidence of in vitro infection was not detected. A fluorescent antibody test for *Perkinsus marinus* has been partially developed. The antibody reagent appears to be specific and while titers obtained were not as high as hoped for, the test appears to be promising. A bacterial disease of European and American oysters (*Ostrea edulis* and *O. virginica*) from Maine and Massachusetts was characterized. Surface attaching *Vibrio* spp. caused perforations in periostracum, ligament erosion and abnormal deposition of calcium carbonate. The bacteria were characterized biochemically and specific antibody was produced.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.072
DISEASES OF AQUATIC ANIMALS

CRIS0068826

GILLESPIE J E; LEE K M; LEIBOVITZ L; MICROBIOLOGY;
CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-43J-380 Project Type: STATE
Agency ID: SAES Period: 01 NOV 74 To 31 DEC 80

OBJECTIVES: Develop a program to determine the viral flora of shellfish and salmonids that serve as a source of food for man and animals. Particular importance and study will be attached to viruses associated with disease. Establish the impact of human and animal pathogens residing in shellfish of the New York City Bight area on the health and welfare of man.

APPROACH: Apply virological cultural methods and immunological techniques in performing qualitative and quantitative measurements for virus in shellfish and salmonids. Establish the nature of the host-parasite relationship in shellfish--virological, bacteriological, mycological, and parasitological.

PROGRESS: 75/01 TO 80/12. An abstract of the most important phase of his studies is as follows: "The pathogenesis of infectious pancreatic necrosis virus (IPNV) infection in brook trout and rainbow trout was examined using intraperitoneal inoculation and exposure to virus in feed and water. Fish were sampled sequentially and the distribution of virus determined by virus isolation, histopathology, and immunofluorescence. Following intraperitoneal inoculation virus entered the peritoneal cavity and was found consistently in the blood beginning 24 hours after the injection. Viremia undoubtedly aided in the spread of virus and by 2 DPI virus had interacted with the pancreatic exocrine cells. Replication in these cells resulted in the production of IPNV specific antigen, necrosis of infected cells, and spread of infectious virus to adjacent tissue. Areas of viral replication were at first multifocal but tended to merge as they grew. Eventually most of the acinar tissue became involved and only small pockets of normal acinar cells remained. Twelve-week old brook trout survived with only a small amount of functional exocrine pancreas and limited virus replication continued in this tissue for weeks. Extensive virus replication appeared to take place only in the pancreas although viral antigen and slight pathological changes were found in the renal interstitium and livers of some fish.

PUBLICATIONS: 75/01 TO 80/12
SWANSON, R.N. and GILLESPIE, J.H. 1979.
Pathogenesis of infectious pancreatic necrosis in Atlantic salmon (*Salmo salar*). *J. Fish. Res. Bd., Canada* 36 (5):587-59.
SWANSON, R.N. 1981. Studies on the Pathogenesis of Infectious Pancreatic Necrosis and a Description of Three Recent Isolates of IPNV from Northeastern United States. Ph.D. Thesis. Cornell University, Ithaca, New York.

003.073
ECOLOGY OF PURPLE LOOSESTRIFE (*LYTHRUM SALICARIA*)

CRIS0076580

MALECKI R A; RICHMOND M E; NATURAL RESOURCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147327 Project Type: STATE
Agency ID: SAES Period: 01 OCT 78 To 30 SEP 81

OBJECTIVES: Three seasons of field study are proposed to describe the development, growth and phenology of purple loosestrife; determine the impact of loosestrife on a marsh ecosystem; investigate methods for the control of loosestrife.

APPROACH: Plant collections will be made during the growing season to document development and phenology of loosestrife. Its ecological interaction with other plant and animal species in a marsh ecosystem will be approached through use of aerial photographs, enclosures, and transect sampling. Possible control methods to be tested include water level manipulation, mowing, burning, and mechanical removal.

PROGRESS: 80/01 TO 80/12. A third year of field study was completed in central New York. Survival, growth, and flower phenology measurements of seedlings naturally established in 1978 continue to provide data on the life history of this species. Testing of control methodology is involving the use of the chemical glyphosate, mechanical cutting, a combination of cutting and burning, and water level manipulation were also continued. Of the various methods tested, treatment with the herbicide, glyphosate, is proving to be the most promising. Work was also continued in looking at the ecological interaction of loosestrife with both wetland plants and animals. Competition experiments were conducted using a variety of plant species including cattail, phragmites, rice cut-grass, Japanese millet and reed canary grass. Transect surveys were also conducted to compare utilization of loosestrife dominated wetlands versus cattail with respect to muskrat activity as well as use by marsh wrens, blackbirds, and bitterns.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.074
DISEASES OF SHELLFISH

CRIS0067069

LEIBOVITZ L; MEYERS T R; ELSTON R; VETERINARY MEDICINE; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-426381 Project Type: STATE
Agency ID: SAES Period: 01 NOV 74 To 06 OCT 79

OBJECTIVES: Diagnose shellfish diseases and public health hazards associated with consumption of shellfish. Experimentally reproduce specific pure infections in disease-free shellfish under controlled laboratory conditions. Study the pathogenesis, immune response and range of specific environmental influences related to experimental diseases in the above studies. Develop, from the above studies, methods of prevention, control and eradication of those diseases of shellfish of economic and public health importance. The development of an educational program for the shell fish industry, the veterinary college and professional disease specialists for the shellfish industry.

APPROACH: During regular monthly visits to Long Island shellfish cooperators, materials will be collected and these will be brought back to the Veterinary College for bacteriological processing. Organisms isolated will be used in carrying out research related to the above objectives. Findings will be related to the shellfish industry as part of the extension activities.

PROGRESS: 79/01 TO 79/12. In the previous report, the characteristics of spontaneous outbreaks of vibriosis in commercial hivalve shellfish hatcheries was reported. Work during the current period dealt with experimental vibriosis in oyster (*Crassostrea virginica*) larvae and in a model hatchery culture system. First, the functional anatomy of normal

larvae was defined in order to interpret the pathologic responses. The later study yielded much new information relative to the velum, digestive tract, body cavities and other functional and morphologic features. Experimental exposure of larvae to defined doses of pure cultures of *Vibrio* spp. isolated from spontaneous field infection was studied. The mortality, morbidity and pathologic responses were described. The progress and specificity of the bacterial infection was monitored by immunofluorescence. A microbiologic study of the course of the disease in an experimental model hatchery vessel was conducted. The results indicated that larvae selectively removed *Vibrio* organisms from the larval cultural medium, the earliest and highest bacterial concentrations were associated with bottom deposits, and such concentrations were retained in the bottom deposits for the longest time. Little difference was noted in *Vibrio* concentrations between top and bottom conical samples. Single dose exposure produced a short period of self-limiting mortality. Repeated daily exposure produced continuous high mortality.

PUBLICATIONS: 79/01 TO 79/12

LEIBOVITZ, L. 1979. A study of vibriosis at a Long Island shellfish hatchery. New York Sea Grant Publication No. NYSG-ER-79-02. New York Sea Grant Institute, 99 Washington Ave., Albany, New York 12246.

LEIBOVITZ, L. and ELSTON, R. 1979. Detection of vibriosis in hatchery larval oyster cultures: Study of interrelationships of diagnosis and management variables in an experimental model. Proc. Joint Ann. Mtg. Nat. Shellfish.

ELSTON, R. 1979. Anatomy, histology and ultrastructure of larval Crassostreid Veligers. Proc. Joint Ann. Mtg. Nat. Shellfish Assoc. and Shellfish Inst. of N. Amer. Vancouver, B.C., Canada.

ELSTON, R. and LEIBOVITZ, L. 1979. Detection of vibriosis in hatchery reared larval oysters: Correlation between clinical, histological and ultrastructural observations in experimentally induced diseases. Proc. Joint Ann. Mtg. Nat.

ELSTON, R. 1979. Economically important larval bivalve diseases and their control. *Rivista Italia di Piscicoltura e Ittiopatologia*. A. XIV, N.2:47-55.

003.075*

CRIS0073629

ESTUARINE INVERTEBRATE BEHAVIOR; AN INDEX OF SUBACUTE TOXICITY OF AQUATIC HERBICIDES

BARTHALMUS G T; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.

Proj. No.: NC05397

Project Type: STATE

Agency ID: SAES

Period: 15 JUN 77 To 31 DEC 78

OBJECTIVES: Determine the chronic, subacute behavioral effects of 2,4-D herbicide on grass shrimp, *Palaemonetes pugio* Holthuis; to explore the feasibility of assessing xenobiotic-induced behavioral dysfunctions of aquatic vertebrates and invertebrates by application of behavioral toxicology techniques.

APPROACH: Dosages of 2,4-D which produce no lethality or locomotor dysfunction for 7 days following a 3 day post-collection period will be determined for adults and larvae. Then, the phototactic behavioral reflexes of dark adapted and dosed shrimp will be tested daily in compartmentalized chambers illuminated by a horizontally directed, intensity controlled monochromatic light stimulus with a duration of 5s at 15s intervals for 5 replications. Shrimp in the compartment nearest the light will be designated photo-positive. Swimming speeds of larvae will be determined in Petri dishes by measuring distances traveled per unit time.

PROGRESS: 77/07 TO 78/12. The effect on adult females, three larval stages, and eggs of the grass shrimp, *Palaemonetes pugio*, exposed to subacute doses of the herbicide Weedar-64 (registered trademark) (Am. Chem., Inc.), containing 49.3% of the dimethylamine salt of 2,4-dichlorophenoxyacetic acid, was tested. Auxiliary ingredients, mainly water, were

assumed to be non-toxic. Alteration of phototaxis was chosen as the indicator of an effect on adults and larvae; eggs were examined for percent hatch. Photoacetic patterns of larvae and adults receiving 100 ppm Weedar-64 daily were recorded for 12 days. Positive phototaxis was reduced by 2,4-D in all three larval stages tested. Sensitivity varied with developmental stage (stage 1 was most sensitive). Stage 1 larval responses were altered more by 2,4-d exposure than by aging, but for stages 3 and 7, larval ages influenced phototaxis more than doses. Adults were unaffected. The doses tested did not affect the hatching of eggs.

PUBLICATIONS: 77/07 TO 78/12

MOYER, C.A.J. 1978. Effect of the herbicide 2,4-d on the phototactic response of the grass shrimp, *Palaemonetes pugio*. M. S. Thesis. N. C. State University, Raleigh. 33 p.

003.076

CRIS0068229

A COMPARATIVE STUDY OF THE FINE STRUCTURE OF APOSTOME CILIATES

BRADBURY P C; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.

Proj. No.: NC05338

Project Type: STATE

Agency ID: SAES

Period: 01 JUL 75 To 30 SEP 82

OBJECTIVES: Compare the fine structure of three different genera of apostome ciliates that attack the crustacean exoskeleton in three different ways.

APPROACH: These ectoparasites have taken the first steps toward endoparasitism, and their visible cytological characteristics during their attack and feeding on the exoskeleton may help to explain how endoparasitism has arisen in this order. The fine structure will be examined and described for: The unique cyst surrounding *Terebrospira chattoni*, the parasite itself both before and during the invasion of the exoskeleton of a shrimp and the changes in the cyst from the surface through the strata of exoskeleton to the endocuticle, the attachment of the apostome Conidophrys to the cuticular hairs of the shrimp and the complex connections of this ciliate's cytostome to the exoskeleton of the hair, and the elaborate feeding apparatus of *Arcophrys rooor* and the attack on the exoskeleton of the shrimp which appears to involve intracellular pumping.

PROGRESS: 80/01 TO 80/12. Despite the visible differences between Conidophrys and the other genera of apostome ciliates, Jankowski's studies of the infraciliature of the pilisuctorian tomite convinced him that Conidophrys belonged with the Apostomatida rather than the Trichostomatida. Electron microscopy confirms Jankowski's view of the affinities of Conidophrys, but electron microscopy also reveals the unique fine structure of the trophont and the cytostome. Like other apostome tomites, the tomite of Conidophrys possesses a rosette, kinetodesmata made up of stacks of individual kinetodesmal fibrils, canaliculi extending from the ventral surface into the interior and surrounded by dense inclusion bodies, and a kinetid with component fibrils arranged as in other apostome genera. However, electron microscopy of the trophont indicates that its fine structure is unlike that of trophonts of other apostome genera. The very young trophont is without an infraciliature and continuously secretes a cyst wall about itself that grows with the organism. The trophont's only attachment to its host is the intimate connection between the cytostome and a hair of the crustacean. The cytostome is formed of delicate tubules that pass through disorganized cyst and cuticular materials to the lumen of the hair. The tubules are continuous with pores or diverticula that pass into the trophont's cytoplasm. Ingestion is by micropinocytosis. There are no obvious stored food vacuoles.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

003.077 CRIS0072394
EURASIAN WATERMILFOIL IN CURRITUCK SOUND: ITS CONTROL
AND POTENTIAL USE

HUISH M T; KERBY J B; ZOOLOGY; N CAROLINA STATE
UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05379 Project Type: STATE
Agency ID: SAES Period: 01 JAN 77 To 31 DEC 78

OBJECTIVES: Ctain fishery relationships to Eurasian
Watermilfoil. Evaluate "edge effect" of Eurasian
Watermilfoil control on recreation and commercial
fishing..

APPROACH: This is a portion of an overall project
with this title. In this portion, age, growth,
feeding habits, and distribution of recreational
fishes will be determined using standard fishery
methods. Sampling will entail the use of various
types of nets, seines, and rotenone. Samples will be
taken at least quarterly and will be designed to
detect differences which can be attributed to the
presence or absence of watermilfoil. Standard water
chemistry data will be taken at least quarterly and
will be designed to detect differences which can be
attributed to the presence or absence of
watermilfoil.

PROGRESS: 77/01 TO 78/12. The effects of
water-milfoil (*Myriophyllum spicatum*) infestation on
fish populations in Currituck Sound were studied.
Rotenone samples of three coves before (1959-65) and
after (1977) infestation indicated that both weight
and number of fish per hectare increased after
infestation, but that the average weight per
individual decreased from 0.0250 to 0.008 kg. The
population structure changed, with ictalurids and
yellow perch having the greatest increases in numbers
and largemouth bass and white perch the greatest
decreases. Ictalurids and centrarchids (other than
bass) exhibited the greatest increases in weight per
hectare, while largemouth bass and "other" fish
showed the greatest decreases. Numbers of largemouth
bass were not significantly different between pre-and
post water-milfoil samples. A comparison of areas
dense in milfoil with an area of Potamogeton
suggested that no adverse effects on the fish
populations could be attributed to milfoil.

PUBLICATIONS: 77/01 TO 78/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.078 CRIS0068204
HELMINTH PARASITES OF VERTEBRATES IN NORTH CAROLINA

MILLER G C; ZOOLOGY; N CAROLINA STATE UNIVERSITY,
RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC03517 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 75 To 31 DEC 78

OBJECTIVES: Study the incidence and host parasite
relationships of certain fish in estuaries and ponds
of N. C. Augment our knowledge of the effect of
environmental factors such as higher temperatures on
incidence of parasites.

APPROACH: Fish will be collected in part in
cooperation with other investigations of estuaries
and ponds. After preliminary analyses for abundance
and ecological interest certain parasites will be
studied intensively by collection of their hosts.
Analysis of incidence and pathological evidence will
be used to evaluate the significance of the parasite
to the host.

PROGRESS: 75/07 TO 78/12. Information has been
published on the incidence and seasonal distribution
of caryophyllaeid tapeworms in North Carolina
freshwater fishes. Studies on unisexual and bisexual
infections of *Schistosoma mansoni* have shown striking
differences in the integument of the isolated female
in unisexual infections as revealed by the scanning
electron microscope. Maternal transmission of
Pharyngostomoides procyonis, a trematode parasite of
raccoons, has been documented and studies continue on
the entire life cycle. The prevalence of dog
heartworms in Wake, Durham, and Orange Counties, NC
was studied in both privately-owned free-ranging

dogs. Of 121 dogs examined, 37.7% were infected.

PUBLICATIONS: 75/07 TO 78/12

GRIMES, L.W. and MILLER, G.C. 1975. Caryophyllaeid
cestodes in the creek chubsucker, *Erimyzon
oblongus* (Mitchill) in North Carolina. J.
Parasit. 61:973-974.

GRIMES, L.W. and MILLER, G.C. 1976. Seasonal
periodicity of three species of caryophyllaeid
cestodes in the creek chubsucker, *Erimyzon
oblongus* (Mitchill) in North Carolina. J.
Parasit. 62:434-441.

EVANS, T. Unisexual and bisexual infections of
Schistosoma mansoni.

MARSHALL, M. Digenetic trematodes of Ecuadorian
bats.

ROWLEY, B. The prevalence of heartworms in
privately owned and free-ranging dogs in Wake,
Durham, and Orange Counties, NC. M.S. Thesis.

003.079 CRIS0076647
STUDY OF PATHOLOGY OF FISHES FROM LAKE HYCO, NORTH
CAROLINA

MILLER G C; ZOOLOGY; N CAROLINA STATE UNIVERSITY,
RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05419 Project Type: STATE
Agency ID: SAES Period: 31 JUL 78 To 31 DEC 79

OBJECTIVES: Determine species, incidence,
distribution, and seasonal effects of fish pathology
in Lake Hyco and determine if there are any seasonal
effects on the fish diseases if present, evaluate the
role of pathogens in the overall fish population of
the lake, and recommended possible control methods if
detrimental fish pathology is found.

APPROACH: Bass, bluegill, crappie, catfish, and other
fishes of interest will be collected at previously
established monitoring stations and will be examined
for diseases. All pathogens will be identified when
possible with special attention given to damaging
forms. Species to be examined will be collected at
each of four transects on a bi-weekly basis to
determine if any diseases in the fish are affected by
seasonal changes. Attempts will be made to keep some
fish alive in the lab to see if heavy infections, if
present, affect their behavior. The study will follow
the customary guidelines of collection, preservation
and identification.

PROGRESS: 78/06 TO 79/12. Four hundred and twenty
three fishes of the families Centrarchidae, Percidae,
Ictaluridae, and Clupeidae from Lake Hyco, NC were
examined for pathology and parasitism. Thirty-one
species of parasites were recovered including: 16
species of monogenetic and three species of digenetic
trematodes; four species of cestodes; three species
of nematodes; one species acanthocephalan; and four
species of parasitic copepods. New host and locality
records were noted for some of the parasites and host
location within the lake was shown to affect the
prevalence of some species and intensity of others.
Host sex was shown to affect the prevalence of one
monogenean, and the mean intensities of a larval
trematode and larval cestode in the bluegill. The
behavioral differences between the sexes during the
reproductive season probably influences the
recruitment of parasites. The digenetic
Posthodiplostomum minimum from the bluegill; the
cestode plerocercoids of *Proteocephalus* sp.; and the
nematodes, *Spinitectus* spp. were studied for seasonal
distribution. Neither the incidence nor intensity of
these parasites showed any significant seasonality.
The green sunfish and the channel catfish were
also examined for periodicity of parasitism. Neither
these hosts showed seasonality in Hyco Lake. No
definitive pathogenicity was noted in any of the host
species as a result of parasitism.

PUBLICATIONS: 78/06 TO 79/12

DAY, S.P. 1978. Parasites of some fishes from Hyco
Lake, North Carolina. M.S. Thesis.

WHITENER, D.W. 1979. The seasonal distribution of
parasites of some fishes from Hyco Lake, North
Carolina. M.S. Thesis.

003.080 CRIS0080000
SUSCEPTIBILITY TO I. MULTIFILIS OF CHANNEL CATFISH
EXPOSED TO SUBLETHAL CONCENTRATIONS OF COPPER SO

EWING S A; LIVING M S; VETERINARY PARASITOLGY & PUB
HITE; CALIFORNIA STATE UNIVERSITY, STILLWATER,
CALIFORNIA. 74074.
Proj. No.: OEL01754 Project Type: GRANT
Agency ID: CSRS Period: 04 JUN 79 To 30 SEP 81

OBJECTIVES: A. Determine the infective dose of I,
multifilis necessary to obtain reproduction.
Determine the effect of exposure to sublethal
concentrations of copper sulfate on susceptibility of
channel catfish fingerlings to I. multifilis
infections produced in Objective A.

APPROACH: Ichthyophthirius will be maintained in the
laboratory and experimental infections produced in
channel catfish. Catfish fingerlings will be exposed
to various concentrations of dissolved copper. Fish
will then be exposed to the infective dose of I. as
previously established and the variations in
susceptibility to the parasite will be recorded and
analyzed.

PROGRESS: 80/01 TO 80/12. Several field isolations of
Ichthyophthirius multifilis have been made and some
of these have been successfully passaged in channel
catfish in the laboratory. We still have difficulty
in maintaining any strain for more than 3 passages
and our objective of standardizing exposure levels is
still unrealized. Progress has been made toward
establishing the LC 50 of Cu⁺⁺ for channel catfish.
The influence of this toxicant on susceptibility to
I. multifilis is under investigation.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.081 CRIS0010094
INFECTIOUS DISEASES OF SALMONID FISHES

FRYER J L; MICROBIOLOGY; OREGON STATE UNIVERSITY,
CORVALLIS, OREGON. 97331.
Proj. No.: CEE00815 Project Type: STATE
Agency ID: SAES Period: 01 JAN 66 To 02 SEP 81

OBJECTIVES: Complete the development of the IHN
attenuated water borne viral vaccine; complete the
work directed toward the detection and prevention of
infectious pancreatic necrosis virus in salmonids;
investigate the serological and immunological
properties of the causative agent of bacterial kidney
disease in salmonid fish; continue the diagnosis and
study the epizootiology of fish diseases emphasizing
the viruses.

APPROACH: Attenuation of the IHN virus vaccine
strain is not complete. It is our intention to
continue on with serial passage until maximum
attenuation has occurred without detectable loss in
antigenicity. The distribution of IPN virus on Oregon
is now reasonably well understood. The remainder of
the effort in this study will emphasize serological
typing or grouping of these viruses, by cross
neutralization and plaque reduction. We will
determine the feasibility of developing either a
bacterin or vaccine for the causative agent of
bacterial kidney disease. This will be done by first
examining isolates for serological differences.
Secondly, determine if immunity to this agent is
humoral, cellular or both. Finally, examine the
antigen(s) of this organism which play a role in
immunity. Diagnosis and epizootiology of infectious
diseases of fish has been under continuous
investigation by this research group since its
inception and shall be continued.

PROGRESS: 80/01 TO 80/12. It has been shown that two
different antibody populations exist in the serum of
hyperimmune rainbow trout. These are a high molecular
weight immunoglobulin (HMW Ig) and a low molecular
weight immunoglobulin (LMW Ig). The HMW Ig is a
tetramer with a sedimentation coefficient of
approximately 14S and a molecular weight of 620,000
daltons. The LMW Ig has a sedimentation coefficient of
10S and a molecular weight of 490,000. The amino acid

composition of the two are different as are their
isoelectric points. Renibacterium salmoninarum has
been accepted as the nomenclature for the etiologic
agent of bacterial kidney disease. Work concerning
the physiology, serology and pathogenicity of this
organism is continuing. Selected isolates of
Lactobacillus sp. which have been isolated from fish
are being characterized. At present all these
isolates appear to be closely related biochemically,
but are different from other species of Lactobacillus
and Lysipelothrix. Cell wall and genetic composition
of the isolates are being determined. A comparison of
the factors responsible for the persistence of IPNV
in three established cell lines from trout and salmon
has been made. Viral persistence in all three cell
lines is mediated by the production of defective
interfering virus. Depending on the host cell
species, additional factors such as interferon and
virus resistant cell types may also contribute to the
maintenance of viral persistence in vitro.

PUBLICATIONS: 80/01 TO 80/12
O'LEARY, P.J. 1981. A Partial Characterization of
High and Low Molecular Weight Immunoglobulin in
Rainbow Trout (Salmo gairdneri). Ph.D. Thesis.
Oregon State University, Corvallis, Oregon, 72
pp.
BEDRICK, R.P. 1980. Persistent Infection of
Salmonid Cell Lines with Infectious Pancreatic
Necrosis Virus: A Model for the Carrier State in
Trout. Ph.D. Thesis. Oregon State University,
Corvallis, Oregon, 97 pp.
SANDERS, J.E. and FRYER, J.L. 1980. Renibacterium
salmoninarum Gen. Nov., sp. Nov., the Causative
Agent of Bacterial Kidney Disease in Salmonid
Fishes. Internatl. J. of Systemat

003.082 CRIS0060650
DIAGNOSIS OF FISH DISEASES

FRYER J L; MICROBIOLOGY; OREGON STATE UNIVERSITY,
CORVALLIS, OREGON. 97331.
Proj. No.: CEE00231 Project Type: STATE
Agency ID: SAES Period: 01 JUL 70 To 01 JAN 99

OBJECTIVES: The purpose of this project is to provide
diagnosis and treatment of infectious diseases of
fish and inspection and certification of fish and
fish eggs for interstate transport and import from
and export to foreign countries.

APPROACH: See item No. 24.

PROGRESS: 79/01 TO 79/12. Service Project - no report
required.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.083 CRIS0078695
DETECTION OF PISCINE ERYTHROCYTIC NECROSIS VIRUS IN
OREGON FISHES

FRYER J L; MICROBIOLOGY; OREGON STATE UNIVERSITY,
CORVALLIS, OREGON. 97331.
Proj. No.: CEE00051 Project Type: ANIMAL
HEALTH
Agency ID: CSRS Period: 27 MAR 79 To 26 MAR 82

OBJECTIVES: Attempt to establish the distribution of
PENV within the State of Oregon. The geographical
distribution will be determined, and the range of
commercially important species of fish which become
infected will be ascertained. The method of
transmission will be studied to determine if the
virus is passed vertically and/or horizontally. If
the agent is transmitted horizontally, effort will be
made to identify the reservoir(s) of infection.
Studies concerning transmission will also include
experiments to show whether selected important
species of fish not found to be naturally infected
are, in fact, susceptible to this virus. The
development of more accurate and sensitive techniques
for the detection of PENV and the exploration of
methods for the artificial propagation of the virus
will be examined.

APPROACH: Will use existing methods for detection of PENV, which includes examination of blood smears by light microscopy, and new techniques may be developed during this project. Confirmation of the presence of the virus requires electron microscopic observation of the virions in blood samples. Detection of the disease state will also be accomplished by histopathological examination of tissues from fish. Preliminary experiments will concentrate on vertical transmission by examination of ovarian fluid and eggs from spawning adults.

PROGRESS: 80/01 TO 80/12. A survey was undertaken to determine the incidence of viral erythrocytic necrosis (VEN) among hatchery reared salmonids in the state of Oregon. Thirty-five different stocks of fish were examined. Included were steelhead trout (*Salmo gairdneri*), coho (*Oncorhynchus kisutch*), chum (*O. keta*), chinook (*O. tshawytscha*), and kokanee (*O. nerka*) salmon. Inclusion bodies typical of VEN were found in the red blood cells of fish from 9 of the 35 stocks examined. Chum salmon were most heavily infected. Inclusion bodies were also detected in blood from coho and spring chinook salmon and steelhead trout. This is the first report of natural infections of these three species. Progeny of selected populations of VEN infected adults were examined and cytoplasmic inclusions were found in erythrocytes of chum and coho juveniles. This observation indicates that vertical transmission may be one method by which the virus is disseminated. Preliminary data indicates that this virus may be responsible for mortality in juvenile salmonid fish. Viral erythrocytic necrosis was also detected in a population of Pacific herring (*Clupea harengus*) which were being held by commercial bait retailers.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.084 CRIS0076338
MICROBIOLOGICAL ASSESSMENT OF RIVER WATER CONTAMINATION

LECNG J A; MICROBIOLOGY; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00402 Project Type: HATCH
Agency ID: CSRS Period: 01 APR 78 To 31 DEC 82

OBJECTIVES: Since 1973, there has been at least one major viral epizootic in Oregon fish hatcheries each year. This research proposal is concerned with the microbiological quality of the water released into the Oregon watershed after a viral epizootic and the potential impact of releasing this virus-containing water on the wildlife fed by this water.

APPROACH: Determine the rate of virus survival in the field after an epizootic using the following methods: Hatchery effluent sampling and virus concentration by membrane filtration. Assay for virus infectivity in tissue culture. Develop more sensitive assays for infectious virus using known chemical enhancers of viral infectivity. Determine whether IBNV and IPNV can infect animals other than Salmonid fishes and produce a disease state. Determine whether fish viruses may interact with other viruses to yield an attenuated viral strain or a strain which is now more infectious for other animals.

PROGRESS: 80/01 TO 80/12. This project is concerned with the microbiological quality of the water released into the Oregon watershed from fish hatcheries during a viral epizootic and the impact of releasing this virus-containing water on the wildlife fed by this water. In the grant period 10-1-79 to 9-30-80 we made the following progress: We have extended our observations that infectious hematopoietic necrosis virus of salmonid fish can also grow in insect cells. The virus produces no change in the insect cell but large quantities of virus are released by the infected cell line. Thus, a possible insect reservoir for the virus may exist. We have also found that the virus that is produced by the insect cell line is altered in three of the five virion proteins. We are currently determining if the alteration in viral protein is due to a difference in the way the insect cell processes the viral protein

or in the way the insect host selects for the replicating viral strain. The sensitivity of the assay for virus detection in tissue samples from diseased fish is dependent upon the cell line used in the assay. (See paper attached, submitted to J. Fish. Res. Bd. Can., 1980.) We have determined that UV-irradiation of water can be used to reduce the titer of virus in that water by 1,000 fold.

PUBLICATIONS: 80/01 TO 80/12

SCOTT, J., FENDRICK, J., and LECNG, J. 1980. Growth of infectious Hematopoietic Necrosis Virus in Mosquito and Fish Cell Lines. *Wasmann J. of Biology* 38(1,2):21-29.

HEDRICK, R.P., LEONG, J.C. and FRYER, J.L. 1981. Establishment and Maintenance of the Carrier State in Salmonids with Infectious Pancreatic Necrosis Virus in the Sixth FDA Symposium on Aquaculture. *Human Services Publication*. Ed.

FRYER, J.L., MCCAIN, B.E. and LEONG, J.C. 1980. A Cell Line Derived from Rainbow Trout (*Salmo gairdneri*) Hepatoma. *Proc. Jap. Soc. Fish Pathol. Tokyo*.

LEONG, J. and FRYER, J.L. 1980. Microbiological Assessment of River Water Contamination by Fish Hatchery Effluent. Office of Water Research and Technology Publication. WRFI 66, 43 pp.

003.085 CRIS0075766
DEVELOPMENT OF A SUBUNIT VACCINE TO THE SALMONID VIRUS, IBNV, BY MOLECULAR CLONING

LEONG J A; MICROBIOLOGY; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00094 Project Type: GRANT
Agency ID: CSRS Period: 04 JUN 79 To 30 SEP 83

OBJECTIVES: The proposed research is aimed at developing an effective subunit viral vaccine for Infectious Hematopoietic Necrosis Virus (IBNV). The gene sequence for the viral protein that induces a protective immune response in fish will be cloned by recombinant DNA technology. A practical and inexpensive method for producing large quantities of pure viral antigen will be developed.

APPROACH: The IBNV viral antigen that induces neutralizing antibody will be prepared as a vaccine. Since the preparation of a viral subunit vaccine from purified virus grown in a tissue culture system is costly, an inexpensive method for producing large quantities of pure viral antigen will be developed. The viral gene coding for the specific neutralizing viral antigen will be isolated and cloned in bacteria by recombinant DNA technology. A recombinant plasmid containing the desired viral gene in a mode expressible in bacteria will be selected and used to synthesize pure viral antigen in bacteria.

PROGRESS: 80/01 TO 80/12. The proposed research is aimed at developing an effective subunit viral vaccine for infectious hematopoietic necrosis virus (IBNV). The specific aims for funding year 1980 were the isolation of the IBNV viral antigen that induces neutralizing antibody in fish, characterization of this viral antigen, and comparison of viral antigens in different strains of IBNV. We have made the following progress: The glycoprotein virion component of IBNV (Round Butte) has been purified and characterized by SDS-polyacrylamide gel electrophoresis. The major glycoprotein component has an apparent molecular weight of 68,000. In addition, two bands running at 62,000 and 56,000 were also observed. These are apparently virion glycoprotein with fewer carbohydrate groups attached to the virion polypeptide. The glycoprotein component does vary slightly between strains of IBNV isolated from California, Alaska, Washington, and Oregon. Growth of IBNV in different piscine cell lines does lead to small differences in the glycoprotein migration pattern by SDS-gel electrophoresis.

PUBLICATIONS: 80/01 TO 80/12

LEONG, J. 1981. Strains of Infectious Hematopoietic Necrosis (IBNV) Virus May be Identified by Structural Protein Differences. (Abstract). Symposium on Fish Biologics: Serodiagnostics and Vaccines.

HSU, Y., ENGELKING, H.M. and LEONG, J.C. 1981.
Virion Protein Differences Among Strains of IBNV.
Submitted to J. Gen Virology.

OBJECTIVES: Improve methods to detect and diagnose pathogenic microorganisms and parasites of fishes and selected native species of mollusca, and establish base line data on the role of feral fishes in the spread of diseases to cultured salmonids and other fishes.

003.086 CRIS0069126
HISTOPATHOLOGIC AND HISTOCHEMICAL INDICES OF
SUBLETHAL PESTICIDE TOXICATION IN FISH

ANTHONY A; NEFF W H; BIOLOGY; PENNSYLVANIA STATE
UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA. 16802.
Proj. No.: PEN02211 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 76 To 30 JUN 81

OBJECTIVES: Develop Histochemical bioassay methods of sublethal pesticide toxication in fish; investigate biochemical and physiological correlates of sublethal pesticide toxication in fish in relation to course of pathogenesis, survival potential and toxicant resistance.

APPROACH: Fish will be exposed to sublethal concentration of four pesticides. Atrazine, Carbaryl, 2,4-D and Parathion. Acid and formalin exposure will serve as "stress toxicant" reference standards. Tissues from major organ systems will be analyzed using differential and histochemical staining procedures. cytometric and analytical cytophotometric indices will be used as text parameters in evaluating the utility and sensitivity of histochemical methods for detecting sublethal pesticide toxication. Supplemental biochemical and physiological studies will also be undertaken to validate histochemical assays of pesticides and elucidate their mode of action.

PROGRESS: 80/01 TO 80/12. Laboratory tests were conducted to investigate histopathologic and histochemical changes in various tissues of brook trout ('Salvelinus' 'fontinalis') exposed to sub-lethal dosages of the pesticides: atrazine, carbaryl, parathion and 2,4-dichlorophenoxyacetic acid. Analytical histochemical methods were employed to provide measures of regulatory aspects of metabolism as well as end products of synthesis. Among the important contributions of the study was the demonstration that quantification of nucleic acid responses in specific brain, liver, kidney and endocrine tissue compartments permits the detection of incipient stages of toxication and provides information on the pharmacological basis of toxicant induced pathogenesis. For example, it was found that with carbaryl toxication neuronal RNA levels were evaluated in the optic tectum and depressed in cerebellar Purkinje cells. With parathion toxication RNA was elevated in both cerebrcortical and cerebellar compartments. Thus, the higher toxicity of parathion stems from a generalized increase in excitability of brain neurons, whereas carbaryl appears to be more site-specific with respect to toxin-mediated impairment of neuronal functioning.

PUBLICATIONS: 80/01 TO 80/12

ICBULARIK M. G. 1980. Comparative incidence of histopathology in white perch ('Roccus americanus') and Atlantic tomcod ('Microgadus' 'tomcod') collected from water intake screens of Hudson river nuclear reactor plants. M.S.

ANTHONY A., et al. 1980 Microspectrophotometric analyses of water toxicant induced changes in nucleic acid and mucopolysaccharide levels of Stannius corpuscle cells of brook trout. Proc. Pa. Acad. Sci. 54(1):109.

003.087 CRIS0078243
DETECTION TRANSMISSION AND PATHOGENESIS OF DISEASE
ORGANISMS IN AQUACULTURE SPECIES

CHANG P W; YATES V J; WOLKE R E; ANIMAL PATHOLOGY;
UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: R10A413 Project Type: ANIMAL
HEALTH
Agency ID: CSRS Period: 10 JAN 79 To 30 SEP 83

APPROACH: Methods of diagnosis employed in human medicine, such as ELISA test, fluorescent antibody technique, lymphocyte transformation and counter-electrophoresis will be explored and adopted to the field of fish diseases. Surveillance of pathogenic agents among feral marine fishes by means of isolation and serological methods will be carried out. Also the pathogenesis and pathogenicity in salmonid fishes of microorganisms isolated from feral fishes will be determined.

PROGRESS: 80/01 TO 80/12. Studies on the pathogenesis of gram negative bacterial infection in mammals have shown a generalized intravascular coagulation precipitated by bacterial endotoxin. In fish, changes characteristic of endotoxemia are not well studied. It is suspected that endotoxin could play a similar role in fish as in mammals. Preliminary experiments have been completed with goldfish and brook trout to test this hypothesis that endotoxin by itself is pathogenic in fish. The endotoxin from *Salmonella typhimurium* caused extensive necrotic lesions in the kidneys of goldfish. Further, these lesions were associated with fibrin microthrombi, a characteristic result of endotoxin induced disseminated intravascular coagulation. Injection of *Yersinia ruckeri* endotoxin killed goldfish within three days and caused necrosis in the kidney as a result of intravascular coagulation. The fish also displayed a shock like condition analogous to endotoxin shock seen in mammals. Injection of *Yersinia ruckeri* and *Pseudomonas fluorescens* endotoxin also resulted in the death of brook trout. The total blood cell count, differential blood count, prothrombin time, fibrinogen concentration, serum complement concentration and histopathology will be carried out in fish with endotoxemia and compared with normal fish. The etiology of Hematopoietic neoplasia in soft-shelled clams, *Mya arenaria* has been studied. The causative agent appears to be a virus. Further work in transmission is being carried out.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.088 CRIS0080305
DIAGNOSIS AND PATHOGENESIS OF DISEASES AND PARASITES
IN MAJOR MOLLUSCAN AQUACULTURE SPECIES

DURFEE W K; WOLKE R E; ANIMAL PATHOLOGY; UNIVERSITY
OF RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: R100414 Project Type: GRANT
Agency ID: CSRS Period: 20 APR 79 To 30 SEP 80

OBJECTIVES: Establish the natural of the causative agents of naturally occurring diseases of the: American oyster (*Crassostrea virginica*), hard clam or quahog (*Mercenaria mercenaria*), soft-shell clam (*Mya arenaria*), and bay scallop (*Argopecten irradians*) in Rhode Island waters. Evaluate the interrelationship of environment and infectious agents in the etiology of diseases of these species. Develop methods of diagnosis & prevention, & thereby control & possibly eradicate specific diseases in these species.

APPROACH: Specimens representing natural populations of the candidate species will be obtained seasonally from selected areas. Samples area selection criteria will consist of water & bottom pollution, shellfish population (kind, density, & age) & repeatability for sampling. New diagnostic techniques for aquatic diseases will be tested.

PROGRESS: 80/01 TO 80/12. Tissue samples of *Argopecten irradians*, *Crassostrea virginica*, *Mercenaria mercenaria*, and *Mya arenaria* were examined for indications of the presence or absence of diseases and/or parasites. Shellfish samples from four natural populations were obtained in the Summer and Fall of 1979 and in Winter and Spring of 1980. Harvest sites were identified earlier; 75 specimens

(when possible) were harvested at each site.
Conclusions: 1) *Mya arenaria* harbor a trematopoletic neoplasm. Culture stocks should originate elsewhere. 2) *Aequipecten irradians* population is severely parasitized by Trematodes, rickettsia-like organisms, and coccidians. 3) *Crassostrea virginica* was not heavily parasitized and the lack of two major diseases, "Dermo" and "MSX" would make this population a likely source for aquaculture. 4) Amorphous basophilic inclusions (ABI's) were found in *Mercenaria mercenaria* but with this exception this species was the least parasitized of the four studied. Cooperators in the Division of Fish and Wildlife, R.I. Department of Environmental Management played vital roles in identifying sites in R.I. estuaries from which culturable species of shellfish could be repeatedly sampled.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.089
ICBTHYOPATHOLOGY

CRIS0059180

WOLKE R E; ANIMAL PATHOLOGY; UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: RI00406 Project Type: STATE
Agency ID: SAES Period: 01 SEP 70 To 30 SEP 80

OBJECTIVES: Development of a Histopathology Laboratory offering diagnostic services to aquaculture projects. Use of laboratory facilities to survey and study both naturally occurring and laboratory induced diseases of fish. Collection of normal and abnormal tissue sections from marine & fresh water fish to serve as source material for teaching and future research projects.

APPROACH: Collection of normal and diseased fish from private, state, federal and University aquaculture projects and from natural environments. Clinical, pathological, gross and histopathological examination of all specimens. Description and classification of all disease processes.

PROGRESS: 70/09 TO 80/09. Since its inception in 1970, the Marine Pathology Laboratory (MPL) has assisted annually university, governmental, industrial, and private agencies in the diagnosis, treatment and prevention of fish and other aquatic animal disease problems. This service and other research projects has resulted in over 18,000 aquatic animal accessions as histopathologic paraffin blocks and slides. The collection is filed as to morphologic lesion or etiology in an easily used retrieval system. In addition, there is an extensive collection of gross and histopathologic kodachromes similarly filed for teaching and research purposes. All necessary equipment for light and electron microscopic tissue preparation, measurement of immune response (electrophoresis, densitometry), isolation of pathogenic organisms and determination of blood chemical parameters has been acquired. The laboratory has the largest collection of normal and diseased fish tissue on the Eastern Seaboard. This collection is made available to visiting scientists.

PUBLICATIONS: 70/09 TO 80/09
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

003.090
IDENTIFICATION OF SUB-OPTIMAL ENVIRONMENTAL PARAMETERS AFFECTING AQUACULTURE

CRIS0073855

WOLKE R E; DUNN J L; MEADE T L; ANIMAL PATHOLOGY; UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: RI00412 Project Type: HATCH
Agency ID: CSRS Period: 07 NOV 77 To 01 OCT 81

OBJECTIVES: Mount a multidisciplinary approach to the elucidation of sub-optimal environmental parameters responsible for inefficient growth, poor reproduction and increased disease incidence in aquaculture production system. Identification and clarification of these critical parameters will be followed by

appropriate investigation of remedial measures.

APPROACH: Initial effort will be restrictive and designed to develop tests capable of indicating early stress in the fish, develop tests capable of measuring early suppression of piscine immune response, and investigate the actual effect of altered water and nutritional factors thought to be protective or advantageous to fish in closed systems.

PROGRESS: 80/01 TO 80/12. The cellular and humoral components of the fishes immune system are well developed and reflect environmental alterations. Further, they are probable sensitive indicators of sub-optimal parameters affecting fish culture. To this end, during 1980, we expanded our testing battery by developing the methodology and capabilities to measure the following immune indicators of stress and increased susceptibility in finfish: Cellulose electrophoresis, Gel electrophoresis, Agglutination, Precipitation, Serumlysozymes, Hemolytic plaque, MIF, Macrophage Phagocytic index, Serum Fe and Fe binding capacity, Immuno florescence, Immuno electrophoresis.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.091*
ANALYSIS OF PREDATION OF *MERCENARIA MERCENARIA* BY DECAPOD CRUSTACEANS

CRIS0070455

EVERSOLE A G; ENTOMOLOGY & ECONOMIC ZOOLOGY; CLEMSON UNIVERSITY, CLEMSON, SOUTH CAROLINA. 29631.
Proj. No.: SC00205 Project Type: STATE
Agency ID: SAES Period: 01 JUL 76 To 30 SEP 80

OBJECTIVES: Determine the predators (i.e. decapod crustaceans) of seed clams; determine the important factors influencing predation; investigate alternate methods for controlling predation; and evaluate these methods in pilot culturing systems.

APPROACH: Collecting potential predators and evaluate stomach contents; examining rates of predation by principal predators under controlled laboratory conditions when variables such as size of prey and predators are altered, water temperature is varied and different substrate composites are used; and finally, to test prospective methods of reducing predation in field conditions.

PROGRESS: 80/01 TO 80/09. *Mercenaria mercenaria* maintained in protected trays provided estimates of annual mortality rates for clams 3-5 and 1-5.5 years of age. Clams 3-5 years old averaged 51.12 mm SL (range, 31.6-72.2 mm) at planting and 58.53 mm SL (38.0-74.7 mm) two years later. Clams 1-5.5 years old starting at 24.74 mm SL (11.7-35.3 mm) reached 64.45 mm SL (50.1-78.0 mm) after 4.5 years growth. Annual mortality rates without predation were 1.43% and 1.98% for clams age 3-5 and 1-5.5, respectively.

PUBLICATIONS: 80/01 TO 80/09
NO PUBLICATIONS REPORTED THIS PERIOD.

003.092
CULTURE AND MANAGEMENT OF SELECTED GAME FISHES

CRIS0074335

WILSON J L; FORESTRY & WILDLIFE; UNIVERSITY OF TENNESSEE, KNOXVILLE, TENNESSEE. 37916.
Proj. No.: TEN00521 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 77 To 30 SEP 81

OBJECTIVES: Develop new management techniques and cultural methods for improving yields of game fishes in Tennessee waters by: Evaluating the feasibility of using selected non-native (exotic) species and/or hybrid fishes, and improved fish habitat management practices.

APPROACH: Ponds, raceways, and other holding facilities will be constructed to evaluate the potential of such fish as grass carp, mirror or other carps, tilapia, striped bass, hybrid sunfish, hybrid catfish, and other non-native species. Monospecific

culture of selected fishes will be compared to polycultural techniques to determine production (kg/hectare). The use of different stocking rates, fertilization practices, and supplemental feeds will be evaluated as management practices. Culture techniques for hybrid sunfish and other selected species will be determined and their potential for use in pond environments will be assessed. New management techniques for improving yields in game fish populations by habitat manipulation will be assessed. Research problems would include the evaluation of the effects of aquatic vegetation control on fish production; the effects of aquatic pesticides on yield of game fishes in ponds, streams, and reservoirs; the identification and control of fish parasites and diseases in game fishes; and the evaluation of biological agents as biofilters of waste materials in aquatic systems.

PROGRESS: 80/01 TO 80/12. Data collection for two pond studies were completed and the data are being analyzed. In one study, over 250 Florida largemouth bass have been tagged and released in two different impoundments. All were weighed and measured; scales were removed to determine age composition of the population. In the second study, fingerling striped bass were stocked in two small impoundments to determine survival and growth. To date, 47 young-of-year and yearlings have been collected; indications are that survival is directly related to fingerling size and data of stocking. In a two-year investigation to determine food habits, movements, and general life history of striped bass, approximately 400 fish have been collected. Preliminary analyses indicate young-of-year striped bass utilize zoo plankton, principally midge larvae, as the primary source of food for some time subsequent to stocking. There is evidence of similar food habits for white bass, leading to the assumption of interspecific competition. A study has been initiated to evaluate the effects of fish attractors in Norris Lake.

PUBLICATIONS: 80/01 TO 80/12

MINTON, J.W. 1980. Bioenergetics of Sauger in Watts Bar Reservoir, Tennessee. M.S. Thesis. The University of Tennessee, Knoxville. 75 pp.
WADDLE, H.E., COUTANT, C.C. and WILSON, J.L. 1980. Summer Habitat Selection by Striped Bass, *Morone saxatilis*, in Cherokee Reservoir, Tennessee, 1977. *Ornl Env. Sci. Publ. No. 1360*. 195 pp.

003.093 CRIS0070519
ADAPTATION FACTORS AND CONTROL OF AQUATIC WEEDS

NEWTON E J; MARTYN R D; PLANT SCIENCE; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06225 Project Type: STATE
Agency ID: SAES Period: 30 APR 77 To 05 APR 81

OBJECTIVES: Investigate environment stress factors on the growth and development of aquatic weeds. Determine biomass production, distribution, and life cycles of aquatic weeds. Determine adaptation characters (morphological and physiological) of aquatic weeds to wet-dry, cold-hot and photoperiodic cycles. Determine effectiveness and mode of action of herbicides and growth regulators for aquatic weed control.

APPROACH: Aerial photographs of lakes Livingston and Conroe will be taken monthly by the Remote Sensing Center to monitor growth and distribution of aquatic weeds. Measurement of temperature, oxygen content, light intensity, nutrient levels will be determined the day after photographs are taken. Perennating organ development effected by environmental stress factors will be monitored quantitatively, and roles of light, temperature, nutrients, herbicides, and growth regulators on development will be investigated under laboratory conditions.

PROGRESS: 79/01 TO 79/12. Research has been conducted along 3 avenues this past year. First, the separation and concentration of phenol storing cells (phe) from waterhyacinth leaves and the chromatographic identification of the phenolic acids (pa) within. We believe these cells are responsible, in part, for the

high degree of disease resistances found in waterhyacinth. The second major avenue has been in the use of remote sensing data for mapping the aquatic vegetation in Lake Conroe Reservoir. The base line vegetation map has been made and the vegetation levels will be monitored quarterly over the next two years in an effort to determine the efficiency of the grass carp as a biological control agent. The third line of research has involved the interaction of sugars and dormancy in duckweed. Differences in the levels of the trisaccharide, raffinose were associated with the breaking of dormancy with cold treatments.

PUBLICATIONS: 79/01 TO 79/12

CODY, Y.S. 1979. Separation of intact phenol cells from waterhyacinth leaves, characterization of their phenolic content and the effect of some phenolic acid on two potential biocontrol agents. M.S. Thesis, Texas A and M Univ., College Station
CODY, Y.S. and MARTYN, R.D. 1979. Separation of phenol cells from waterhyacinths and the effect of some phenolic acids on the growth of two potential biocontrol agents. *Phytopathology* 69:1025.
SHELTON, D.R. 1979. The effect of sugars on turion germination and growth of *Spirodela polyrrhiza* (L.) Schleiden. M.S. Thesis, Texas A and M Univ., College Station. 86 p.

003.094* CRIS0083473
PRELIMINARY STUDIES ON CRAWFISH AND FRESHWATER SHRIMP DISEASES

SIS R F; LEWIS D H; LEE B J; VETERINARY ANATOMY; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06531 Project Type: ANIMAL HEALTH
Agency ID: CSRS Period: 04 MAR 81 To 03 MAR 82

OBJECTIVES: The objectives are to assess the effects of water hardness on shell calcium content, shell morphology and colonization of chitinoclastic bacteria on *Procambarus* sp. and *Macrobrachium rosenbergii* and characterize the hemocytes of *Procambarus* sp. (crawfish) and correlate types with water hardness.

APPROACH: Percent shell calcium content will be determined from atomic absorption analysis. Shell morphology will be described by scanning electron microscopy and electron X-ray microprobe analysis. Colonization of bacteria will be quantified using standard bacteriologic techniques. Hemocytes will be histologically identified and enumeration studies will be done with a Coulter Counter.

003.095 CRIS0074988
MICROBIAL AND PARASITIC DISEASES OF SHRIMP AND FISH

LEWIS D H; VETERINARY MICROBIOLOGY; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Agency ID: CSVM-0500 Period: 01 SEP 77 To 31 AUG 79

OBJECTIVES: The project is part of a coordinated program directed toward commercial development and quality assurance for the shrimp industry in the United States. Identify and determine drug susceptibility of bacteria associated with fish kills and disease problems of cultured shrimp determine uptake, persistence and host response of laboratory shrimp to select pathogenic bacteria and virus.

APPROACH: Cultured shrimp will be examined for pathogenic bacteria, gill parasites and virus. Antibiotics will be studied with regard to stability in water and food, uptake by absorption and by oral routes and tissue half life. Pathogens isolated from shrimp will be subjected to antibiotic susceptibility.

PROGRESS: 80/01 TO 80/12. The project was designed to enhance capabilities for controlling health problems of cultured shrimp and fish. One phase of the project was directed toward developing cell culture methods which would be useful in screening for viral agents. A primary cell culture technique, based upon the cultivation of shrimp cardiac tissue was developed and will be used in conjunction with electron microscopic and serologic techniques to screen for viral agents in suspect tissues. Another phase of the project related to studying the immune response of shrimp. Shrimp exposed to *Vibrio anguillarum* developed hemolymph bacteriolysins 24-48 hours after exposure. The bacteriolysin titers persisted for 5 days. As bacteriolysin titer diminished, phagocytic activity increased. The enhanced phagocytic activity following stimulation by the vibrio bacteria persisted for at least 4 weeks.

PUBLICATIONS: 80/01 TO 80/12

- LLOBRERA, A.T. 1980. Antibiotic Administration by Osmotic Infiltration in Fresh Water Shrimp, *Macrobrachium rosenbergii*. M.S. Thesis. Texas A and M University, College Station. 31 pp.
- HENDERSON, A.A., STICKNEY, R.R. and LEWIS, D.H. 1980. Immune Hypersensitivity in Intensively Maintained Tilapia Species. Transactions of the American Fisheries Society 109:244-247.
- CANNON, M.S., MOLLENHAUER, B.H., EURELL, T.E., LEWIS, D.H., CANNON, A.M. and THOMPSON, C. 1980. An Ultrastructural Study of the Leukocytes of the Channel Catfish, *Ictalurus punctatus*. Journal of Morphology 164:1-23.
- CANNON, M.S., CANNON, A.M., EURELL, T.E. and LEWIS, D.H. 1980. An Ultrastructural Localization of Peroxidase Activity in Neutrophilic Leukocytes of *Ictalurus punctatus*. Can. Journal of Zoology 58:1139-1143.

003.096

CRIS0078514

DISEASE MANAGEMENT IN CULTURED CATFISH

LEWIS D H; VETERINARY MICROBIOLOGY; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06388 Project Type: ANIMAL HEALTH
Agency ID: CSES Period: 01 MAR 79 To 30 SEP 81

OBJECTIVES: Identify early warning indicators of environmental stress assess role of environmental deterioration on uptake and persistence of bacteria involved in septicemia, identify factors associated with pathology of bacterial septicemia in cultured catfish.

APPROACH: Catfish will be temperature acclimated and exposed to ammonia at concentrations associated with chronic toxicity. The fish will be necropsied at various time intervals, serum samples analyzed for cortisol and for protein alterations, tissues examined by light and scanning electron microscopy and histochemistry, acclimated fish will be exposed to bacteria and tissues monitored by culturing tissues and fluorescent antibody techniques. and assessment will be made of histopathologic changes in target tissues.

PROGRESS: 80/01 TO 80/12. The role of mucus in protecting catfish against *Ichthyophthirius multifiliis* and columnaris was studied. Catfish were immunized to killed cysts and immature trophozoites by bath immersion technique. At timed intervals afterwards, mucus was removed from the fish and tested for specific antibody by indirect immunofluorescence techniques. Mucus antibody was detected 4 days after exposure. Specific mucus antibody was detected within 48 hr after antigenic exposure in fish that had been previously immunized. Mucus antibody to *Flexibacter columnaris* could not be demonstrated consistently.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

003.097

CRIS0079787

DISEASE MANAGEMENT IN CATFISH AQUACULTURE

LEWIS D H; VETERINARY MICROBIOLOGY; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06421 Project Type: GRANT
Agency ID: CSRS Period: 04 JUN 79 To 30 SEP 82

OBJECTIVES: Identify early warning indicators of environmental stress. Identify factors associated with host susceptibility and pathology of bacterial hemorrhagic septicemia in cultured catfish. Develop and evaluate countermeasures for reducing the incidence of bacterial hemorrhage septicemia in cultured catfish.

APPROACH: Fish will be exposed to conditions of temperature and ammonia stress and an effort made to identify early warning indicators of stress by monitoring for alterations in hematologic and blood chemistry parameters and for tissue changes as revealed by light, scanning and transmission electron microscopy. Bacterial isolates will be subjected to antigenic analysis and screened for presence of plasmids in an attempt to identify microbial factors associated with pathogenicity of the agents. Fish will be exposed to agents under various conditions of stress and appropriate histologic and biochemical parameters monitored to identify factors associated with host susceptibility to the bacteria. An effort will be made to demonstrate value of immunization in protecting catfish against bacterial infections.

PROGRESS: 80/01 TO 80/12. Research activities were primarily oriented toward: (a) defining blood cells associated with host defense mechanisms and (b) developing an improved technique for detecting early stages of infection in the catfish. Ultrastructural studies conducted on the leukocytes revealed the presence of heterophils (neutrophils), small lymphocytes, monocytes and thrombocytes. Eosinophils and basophils were not observed. Glycogen, present in all leukocytes, is most abundant in heterophils and less abundant in monocytes. Heterophils possess oval or elongate granules which often contain a crystalline or striated structure, small tubules which resemble smooth endoplasmic reticulum, and cristae which traverse the long axes of mitochondria. Cytoplasmic granules of the heterophils exhibit peroxidase activity at light and electron microscopic levels. The presence of peroxidase-positive granules in the neutrophil serve as a marker for identification of the cell and indicate antibacterial and phagocytic functions for this cell.

PUBLICATIONS: 80/01 TO 80/12

- HENDERSON, A.A., STICKNEY, R.R. and LEWIS, D.H. 1980. Immune Hypersensitivity in Intensively Maintained Tilapia Species. Transactions of the American Fisheries Society. 109:244-247.
- CANNON, M.S., MOLLENHAUER, B.H., EURELL, T.E., LEWIS, D.H., CANNON, A.M. and THOMPSON, C. 1980. An Ultrastructural Study of the Leukocytes of the Channel Catfish, *Ictalurus punctatus*. Journal of Morphology 164:1-23.
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- LEWIS, D.H. 1981. Enzyme Labelled Antibody Microscopy for Differentiating Enteric Redmouth from Motile Aeromonas Septicemia. Canadian Journal of Fisheries and Aquatic Sciences 38. In Press.
- MARKS, J.E., LEWIS, D.B. and TREVINO, G.S. 1980. Mixed Infection in Columnaris Disease of Fish. JAVMA 177:811-814.

003.098

CRIS0063404

MICROBIAL DISEASES AND IMMUNE RESPONSE OF CATFISH

LEWIS O H; GRUMBLES L E; HIDALGO R J; VETERINARY MICROBIOLOGY; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.

Proj. No.: TEX06011 Project Type: BATCB
Agency ID: CSRS Period: 13 DEC 76 To 30 NCV 81

OBJECTIVES: Investigate causes of mortality associated with catfish culture in Texas, evaluate the effect of temperature and ammonia concentration on humoral and cellular immunity and susceptibility of catfish to select microbial diseases of catfish. Field test an aeromonas vaccine.

APPROACH: Fish and water samples from areas where disease episodes occur will be subjected to laboratory analysis using techniques applicable to diagnosing fish diseases. Fulfill objective 2, circulating antibody components will be monitored using quantitative immunoelectrophoresis and immunocompetent cells monitored by immunocytochemistry techniques. In immune and non-immune fish being maintained at various temperatures and concentrations of ammonia. Serologic and lethal dose-response measurements will be made on experimental fish maintained under those conditions and exposed to infectious agents. Objective 3 will involve preparation and evaluation of vaccine through cooperative efforts with state and other select hatchery facilities.

PROGRESS: 80/01 TO 80/12. Catfish possess a well developed immune system, and protective antibodies to a variety of potentially serious pathogens can be elicited. Studies on antibody production and the general nature of immune response reveal that catfish are immunocompetent at 2 weeks of age and that antibodies to a single administration of *Aeromonas hydrophila* bacterin persist for at least 12 weeks. Catfish are susceptible to infection with *Yersinia ruckeri*, the causative agent of enteric redmouth disease of salmonids. Infection of catfish with the agent results in a disease resembling motile aeromonas septicemia. A technique for rapid detection of the agent based upon immunoenzyme microscopy was developed.

PUBLICATIONS: 80/01 TO 80/12

MARKS, J.E., LEWIS, D.B. and TREVINO, G.S. 1980.

Mixed Infection in Columnaris Disease of Fish. JAVMA 117:811-814.

MARKS, J.E. 1980. Immunization of Largemouth Bass to Columnaris (*Flexibacter Columnaris*). M.S. Thesis, Texas A&M University, College Station, 85 pp.

BENDERSON, ARZAPALO, A., Stickney, R.R. and LEWIS, D.B. 1980. Immune Hypersensitivity in Intensively Maintained Tilapia Species. Transactions of the American Fisheries Society 109:244-247.

CANNON, M.S., MOLLENBAUER, B.B., EURELL, T.E., LEWIS, D.B., CANNON, A.M. and THOMPSON, C. 1980. An Ultrastructural Study of the Leukocytes of the Channel Catfish, *Ictalurus punctatus*. Journal of Morphology 164:1-23.

CANNON, M.S., CANNON, A.M., EURELL, T.E. and LEWIS, D.B. 1980. An Ultrastructural Localization of Peroxidase Activity in Neutrophilic Leukocytes of *Ictalurus punctatus*. Canadian Journal of Zoology 58:1139-1143.

003.099

CRIS0065145

PATHOLOGY AND PATHOGENESIS OF CATFISH DISEASES

CAMP B J; VETERINARY PATHOLOGY; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.

Proj. No.: TEX06032

Project Type: HATCH

Agency ID: CSRS

Period: 07 FEB 75 To 30 SEP 80

OBJECTIVES: Define the pathogenesis of channel catfish virus disease, collaborate with other workers by making pathological analyses of diseased catfish used in experiments on the effects and nature of bacterial infections (ex: *Aeromonas liquefaciens*) (Department of Veterinary Microbiology) and toxic chemicals or water pollutants (Department of Veterinary Physiology and Pharmacology), and investigate through pathologic procedures the nature and cause of spontaneous diseases of pond-reared and wild catfish in collaboration with other researchers studying diseases of catfish.

APPROACH: Histological, electron-microscopic and immunopathologic technique will be used to investigate the nature of the lesions, the pattern of their development and their modification in experiments involving manipulation of the age of the fish, environmental temperature and immunological status of the fish. Fish infected experimentally with disease-producing bacteria, toxic chemicals or dying from unknown causes will be examined by selected pathologic techniques to define the nature of the disease produced, such data derived from this work being recorded and used in originating and/or made available for planning and implementing other experiments in catfish diseases.

PROGRESS: 78/01 TO 78/12. Immature catfish were fed a diet containing Sb(2)(05) at a level of 2000 ppm for 56 days to study the uptake and distribution of Sb. Then the fish were fed an Sb free diet for 28 days to measure the rate of elimination of Sb from body fluids and tissues. The following mean concentrations of Sb for certain tissues were as follows for the 56 and 28 day periods, respectively: liver, 80 and 53 ppm; kidney, 3.7 and 3.0 ppm; skeletal muscle, 1.5 and 1.0 ppm; spleen, 1.8 and 2.7 ppm. Packed cell volume of the fish decreased during the ingestion of Sb and the PCV returned to normal values during the elimination phase of the study. There was an increase in the average weight of the spleen of catfish fed the Sb(2)(05).

PUBLICATIONS: 78/01 TO 78/12

NO PUBLICATIONS REPORTED THIS PERIOD.

003.100

CRIS0070377

MODE OF ACTION AND INFLUENCE OF ENVIRONMENTAL FACTORS ON THE TOXICITY OF SEVERAL AQUATIC HERBICIDES

HATZIOS K K; HATZIOS K K; PLANT PATHOLOGY & PHYSIOLOGY; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.

Proj. No.: VA-0612269

Project Type: HATCH

Agency ID: CSRS

Period: 01 JUL 76 To 30 JUN 81

OBJECTIVES: The effects of temperature, pH, light, bicarbonate ions and algal cell densities on the performance of chelated cupric ions, diquat, diuron, simazine, and combinations of these aquatic herbicides will be examined. The mode of action of the herbicides at cellular and sub-cellular levels will be studied to facilitate comprehension of aberrations in physiological functions of plants exposed to the compounds.

APPROACH: Since these compounds are inhibitors of photosynthesis, photosynthesis and growth of *Chlorella sorokiniana* and electron transport in isolated chloroplasts will be used to determine toxicity. The possibility of chlorophyll degradation by these herbicides and the role of photosensitized reactions in this destruction will be examined. Attempts will be made to determine active and non-active site binding of the herbicide molecules and their influence on lipid peroxidation.

PROGRESS: 80/01 TO 80/12. The work on the mode of action of the 1,3,4-thiadiazolyl herbicidal derivatives was completed and a summary of that work was presented in the fifth international congress on photosynthesis during last summer. From that work it was concluded that photosynthesis is the main metabolic process inhibited by these herbicides in plants. R-25788 (N, N-diallyl-2,2-dichloroacetamide) is a chemical used commercially to protect corn (*Zea mays* L.) from injury caused by the thiocarbamate herbicides EPIC and butylate. Our knowledge on the mode of action of the antidote R-25788 is limited. It has been proposed that R-25788 increases the rate of metabolism of these herbicides in corn. Indirect evidence to support this hypothesis was obtained in our studies initiated this past summer in the greenhouse. The herbicide tebuthiuron resembles structurally a group of chemicals known as 1,2,3-benzothiadiazoles, which are strong inhibitors of metabolic enzymes called mixed-function oxidases. Mixed-function oxidases have been implicated in catalyzing the oxidation of the sulfur atom of the thiocarbamate herbicides in corn. Growth responses of

corn seedlings treated with combinations of tubethuron and EPTC or Butylate in the presence of the antidote R-25788, were indicative of synergistic interactions of these chemicals. Thus, it appeared that R-25788 may act by increasing the activity of the mixed function oxidase system that sulfoxidizes EPTC and butylate in corn.

PUBLICATIONS: 80/01 TO 80/12

HATZIOS, K.K. 1981. Synergistic Interactions of Tebuthiuron with Eradicane (EPTC + R-25788) and Sutan + (Butylate + R-25788) and Its Implications on the Mode of Action of the Herbicide Antidote R-25788. Abstracts Weed Sci. Soc. of

003.101

CRIS0043655

PHYSIOLOGICAL STUDIES OF AQUATIC AND DITCH BANK WEEDS IN THE PACIFIC NORTHWEST

MARQUIS L Y; USDA-ARS WEED CONTROL RES; IRRIGATED AGRIC RES & EXT CNTR, PROSSER, WASHINGTON. 99350. Proj. No.: 5806-20280-004 Project Type: INHOUSE Agency ID: AIS Period: 04 FEB 77 To 04 FEB 82

OBJECTIVES: Define various aspects of the physiology and biochemistry of aquatic and marginal plants and their control to assist in devising new and improved methods for managing such vegetation without undue impact on the environment.

APPROACH: Study the absorption, translocation, and metabolism of reed canarygrass and creeping red fescue to help define and manipulate susceptibility and resistance between the two species, Assay soil and/or plant material qualitatively and quantitatively for allelopathic compounds and isolate and characterize these substances. Determine nutrient requirements of sago pondweed and related species and the relative importance of roots and foliage for absorption.

PROGRESS: 80/01 TO 80/12. The molecular fate of 14C-fluridone was examined in two hydrosols (extracted from local irrigation canals) and in the water above those soils. During the course of the experiment an average of 10% of the total 14C applied to the soils desorbed into the water. Seven months after treatment 86 to 93% of the radioactivity in the water comprised one acidic metabolite (the only fluridone metabolite detected in this study). This compound was purified by solvent fractionation, thin layer chromatography and high performance liquid chromatography and characterized by mass spectrometry. Based on comparison with an authentic standard the metabolite was identified as 1,4-dihydro-1-methyl-4-oxo-5-(3-(trifluoromethyl)phenyl)-3-pyridine carboxylic acid. This metabolite was also found tightly bound to both soils and accounted for about 60% of the total 14C in each soil after 12 months. The remainder of the 14C in the soils was either fluridone (approximately 30%) or an undefined insoluble residue (approximately 10%). The distribution and fate of 2,4-D was examined in greenhouse-grown 'Concord' grape plants. One mature leaf of each plant was treated with 1 µl of 1000 ppm or 500 ppm (14C) 2,4-D for periods of 1, 2, or 3 weeks. After 3 weeks approximately 33% of the 14C absorbed by the treated leaves had moved into the portion of the shoots above these leaves but basipetal translocation was negligible.

PUBLICATIONS: 80/01 TO 80/12

MARQUIS, L.Y., COMES, R.D. and YANG, C.P. 1979. Selectivity of Glyphosate in Creeping Red Fescue and Reed Canarygrass. Weed Res. 19:335-342.

003.102

CRIS0072335

EFFECTS OF ANTIMYCIN ON STREAM INSECTS

HILSENHOFF W L; ENTOMOLOGY; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706. Proj. No.: WIS02303 Project Type: STATE Agency ID: SAES Period: 01 JUL 74 To 31 DEC 78

OBJECTIVES: Determine acute toxicity of antimycin to about 50 common species of stream insects. Determine effects of pH and temperature on rates of mortality caused by antimycin. Determine chronic effects of antimycin on emergence of stoneflies, mayflies, and caddisflies. Study effects of antimycin in a stream treated by Department of Natural Resources personnel to eliminate rough fish.

APPROACH: Initial toxicity experiments will be carried out at concentrations of 1, 10, 100, and 1000 parts per billion (ppb) in 5 liter polyethylene containers and compared to a control. Final replicated tests will be run at twofold dilutions within the range of 0 to 100% mortality. Tests will be conducted at 2°C or 20°C at pH 8.0 or pH 7.0 with mortality recorded over a 5-day period. Effects of treatment of the Rock River will be studied by sampling benthos in treated and untreated sections before and after treatment. Drift samples in treated and untreated sections will be compared.

PROGRESS: 78/01 TO 78/12. The toxicity of antimycin to 38 species of Wisconsin stream insects was evaluated in static, aerated bioassays utilizing antimycin exposures typical of stream treatments used to kill fish. Several species of Trichoptera, Ephemeroptera and Plecoptera were very sensitive to fish killing concentrations of antimycin (EC-50 less than 50 ppb). Beetles (*Psephenus herricki*, *Optioervus fastiditus*, *Stenelmis crenata*, *Helichus striatus*), dragonfly nymphs (*Neurocordula molesta*, *Gomphurus vastus*), damselfly nymphs (*Argia apicalis*), fishfly larvae (*Nigronia serricornis*), and snipe fly larvae (*Atherix variegata*) were relatively unaffected by antimycin (EC-50 greater than 1,000 ppb). Early instars of *Tipula* spp. and *Ephemerella* sp. were more sensitive to antimycin than later instars. Exposure to antimycin produced greater mortality at 19 degrees C than at lower temperatures in several species, even though exposure times were reduced at the higher temperature. Post-exposure observations indicated mortality may be delayed more than five days, particularly at reduced temperatures. Large differences in antimycin sensitivity were found for different species belonging to the same family (hydroptychid caddisflies, perlid stoneflies). Emergence of several species of stream insects was reduced or prevented by exposure of the mature larvae or nymphs to sublethal concentrations of antimycin.

PUBLICATIONS: 78/01 TO 78/12

KOTILA, P.M. 1978. Effect of antimycin on stream insects in field and laboratory trials. Ph.D. Thesis, Univ. of Wisconsin-Madison. 107pp.

KOTILLA, P.M. and HILSENHOFF, W.L. 1978. Effects of antimycin on stream insects. Wis. Water Resources Center Tech. Rep. 78-05, 55pp.

003.103

CRIS0044499

BIOLOGICAL CONTROL OF WEEDS WITH PATHOGENS

CORDO H A; DELOACH C J; CEARUDATTAN R; BIOLOGICAL CONTROL OF WEED LAB, HURLINGHAM, ARGENTINA. Proj. No.: 0420-20263-003 Project Type: INHOUSE Agency ID: ARS Period: 19 MAY 78 To 19 MAY 83

OBJECTIVES: Control the aquatic weed waterhyacinth in the United States by the use of plant pathogens introduced from South America.

APPROACH: In cooperation with the Dept. of Plant Pathology, Univ. of Florida, collect teliospores of the rust *Uredo eichhorniae* from waterhyacinth in the field, search for alternate hosts of this and other rusts from Pontederiaceae, correlate rust density in the field with climatic factors, locate epicenters of *U. eichhorniae*, and determine the cross-infectivity and host range of *U. eichhorniae* and of *Uromyces pontederiae* from *Pontederia*. Spores of *U. eichhorniae* will be sent to the quarantine facility at the Univ. of Florida for further testing.

PROGRESS: 79/01 TO 79/12. Ecological studies continued on the plant pathogenic rust, *Uredo eichhorniae* on waterhyacinth and the araujia mosaic virus on *Araujia* and *Norrenia odorata*. The geographic range and seasonal abundance was measured in

different climatic areas of Argentina.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.104 CRIS0041269
BIOLOGICAL CONTROL OF WEEDS

DELOACH C J; BIOLOGICAL CONTROL OF WEED LAB,
BURLINGHAM, ARGENTINA.
Proj. No.: 0420-20263-002 Project Type: INHOUSE
Agency ID: AFS Period: 15 JUL 74 To 08 MAR 82

OBJECTIVES: Find, test, and evaluate the natural enemies of weeds of rangelands, row crops, and aquatic environments that can be used to control weeds of importance in the United States.

APPROACH: Locate stands of rangeland, row-crop, and aquatic weeds in South America, and collect the insects and other organisms damaging the plants. Evaluate the impact of these organisms on the plants, and determine their life cycles, ecologies, and host ranges. Obtain stocks of suitable natural enemies free from parasites and pathogens and ship them to the United States as needed.

PROGRESS: 80/01 TO 80/12. Rangeland weeds: Biological testing began on 3 insects to control broomweed (*Gutierrezia*), an aegeriid moth *Carmenta* sp., a weevil *Melipus mesodozencis*, and a buprestid beetle *Dactylozodes* sp. Testing began on a lepidopterous bark feeding larva for control of whitebrush (*Aloysia gratissima*). Aquatic weeds: Testing was completed on the flea beetle *Disonycha argentinensis* to control terrestrial alligatorweed. A cold-tolerant strain of the alligatorweed flea beetle, *Agasicles hydrophila*, was shipped to the U.S. Insects parasites: Parasites of *Plusia* sp. and the fall armyworm were shipped to the U.S. Dung beetles: Ten promising species of scarab beetles were collected for controlling livestock dung. Plant germplasm: A total of 457 accessions of several species and many races of dallisgrass (*Paspalum* sp.) were shipped to the U.S.

PUBLICATIONS: 80/01 TO 80/12
DELOACH, C.J., D.J. DELOACH, and B.A. CCRDC.
Observations on the Moth, *Samea multiplicalis*, on Waterlettuce in Argentina. *J. Aquatic Plant Manage.* 17(1) (1979):42-44.

003.105 CRIS0044705
ORGANISMS ASSOCIATED WITH AQUATIC WEEDS AND THE BIOLOGICAL CONTROL WATER-HYACINTH IN EGYPT

FAYAD Y B; CENTER I D; MINISTRY OF AGRICULTURE,
CAIRO, EGYPT.
Proj. No.: 8005-20280-073 Project Type: GRANT
Agency ID: AFS Period: 08 JUL 78 To 07 JUL 83

OBJECTIVES: Identify organisms of potential use for the biological control of waterhyacinth, hydrilla, Eurasian watermilfoil, and other aquatic weeds and introduce two Argentine weevils into Egypt for the biological control of waterhyacinth and evaluate their effectiveness.

APPROACH: Survey the organisms associated with aquatic weeds in Egypt, identify those species which are herbivores or pathogens, determine their apparent degree of specificity based upon the number of hosts from which they are collected in the aquatic community, and evaluate their potential effectiveness in the biological control of their host plant. Release and monitor population development of two species of weevils in an effort to effect control of waterhyacinth at specific sites in Egypt, including studies of the biology of the insects and the plants. Determine the biological and physical factors responsible for promoting or preventing a successful biological control program.

PROGRESS: 79/12 TO 80/11. Surveys for natural enemies of waterhyacinth have found no species which would possibly be useful biocontrol agents in the U.S. It has been recommended that this portion of the project

be discontinued and surveys on *M. spicatum* be given higher priority. Host specificity studies in quarantine have verified that *Neochetina eichborniae* and *N. bruchi* are host specific. Field releases have been made, the insects have become established, and studies designed to evaluate the effectiveness of this method of control have begun.

PUBLICATIONS: 79/12 TO 80/11
NO PUBLICATIONS REPORTED THIS PERIOD.

003.106 CRIS0043028
BIOLOGICAL CONTROL OF EURASIAN MILFOIL AND OTHER AQUATIC WEEDS

SPENCER N; BIOLOGICAL CONTROL OF WEED LAB, ROME,
ITALY.
Proj. No.: 0203-20262-002 Project Type: INHOUSE
Agency ID: ARS Period: 01 JUL 75 To 30 JUN 80

OBJECTIVES: Search out and study the natural enemies of Eurasian milfoil and other aquatic weeds. Emphasis will be put on those weeds of importance in the United States and whose native range includes Europe, North Africa and the Near East. Plant feeding insects will receive major emphasis.

APPROACH: Locate stands of aquatic weeds in Europe and other areas to which they are indigenous, and survey and collect insects and other organisms on the plants. Evaluate the impact of these organisms on the plants; study their biologies; and determine their host ranges. Obtain stocks of suitable natural enemies free from parasites and pathogens and ship them to the United States as needed.

PROGRESS: 75/01 TO 78/03. A final report on an East African survey for hydrilla and its biotic enemies was submitted by the contractor, Mr. Bob Pemberton. A copy of the report may be obtained from the performing organization. Work was conducted on the host specificity of *Parapoynx stictotata*, a potential biocontrol agent for eurasian watermilfoil, *Myriophyllum spicatum*. The insect does not have the host specificity required to utilize it in a biocontrol program. A survey of the extent of *M. spicatum* and *Hydrilla* in Europe has been conducted.

PUBLICATIONS: 75/01 TO 78/03
NO PUBLICATIONS REPORTED THIS PERIOD.

003.107 CRIS0043340
CONTROL AND ERADICATION OF AQUATIC WEEDS IN LAKES AND IMPOUNDED WATERS

AHMED M; KHAN M Y; COMES R D; MINISTRY OF FOOD & AGRICULTURE,
KARACHI, PAKISTAN.
Proj. No.: 8002-20280-054 Project Type: GRANT
Agency ID: ARS Period: 03 JAN 77 To 02 JAN 82

OBJECTIVES: Develop biological, chemical, and integrated methods for control of aquatic weeds that infest and seriously reduce the productivity of a high percentage of the fish-producing waters of Pakistan.

APPROACH: Survey fishing waters for weeds and to select testing sites. Import phytophagous fish and stock test sites. Determine optimum stocking rates, times and fish size. Observe feeding preferences, rates of weed control, and effects on indigenous fish. Investigate herbicides for weed control, alone and in a program integrated with fish. Observe, describe, and quantitate both desirable and adverse effects of herbicides and fish on the aquatic environment. Determine benefits of weed control in terms of production of indigenous fish and imported phytophagous species.

PROGRESS: 80/01 TO 80/12. Two applications of paraquat at 5.5 lb/A each (total 11 lb/A) during a single growing season controlled *Typha* about 65% and *Phragmites* about 90%. Regeneration of both genera was faster on a shallow water site where the water did not fluctuate than on a site where the water level was lowered about 3 feet before application and

raised to the normal level one month after treatment.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.108
CONTROL OF AQUATIC WEEDS

CRIS0043122

BADAR-UD-DIN; ABMAD N; COMES R D; UNIVERSITY OF
PUNJAB, LAHORE, PAKISTAN.
Proj. No.: 8002-20280-072 Project Type: GRANT
Agency ID: AFS Period: 13 APR 76 To 31 DEC 81

OBJECTIVES: Determine if the phytotoxin produced by
the waterhyacinth blight organism *Alternaria*
eichhorniae can be used in a program to control
water-hyacinth.

APPROACH: Extract, characterize, and establish the
chemical structure of the phytotoxin obtained from
the pathogen *Alternaria eichhorniae*. Design a control
program for waterhyacinth using the phytotoxin
derived from *A. eichhorniae*. Determine the effects of
the phytotoxin on the aquatic organisms, with
particular concern for growth and reproduction of
fish and other aquatic fauna, and the toxicity of the
phytotoxin to other aquatic vegetation.

PROGRESS: 80/01 TO 80/12. Although *Alternaria*
eichhorniae was not found growing on water hyacinth in
Punjab and Sind Provinces, *A. alternata*, *Fusarium*
spp., *Aspergillus* spp., *Cephalosporium* spp., and
Curvularia spp. were found. A culture of lyophilized
A. eichhorniae (collected at Bangalore, India) was
obtained from the American Type Culture Collection,
Rockville, Maryland. Like the culture from the
International Mycological Institute in England, the
new culture did not sporulate when placed on PDA
slants or in PD broth. Species of aquatic plants
collected in Punjab and Sind Provinces included
Ammannia auriculata Willd., *Ammannia baccifera* Linn.,
Ammannia multiflora Roxb., *Bramia monnieri* (L.)
Penn., *Centella asiatica* (L.) Urban, *Gonostegia*
pentandra (Roxb.) Miq., *Mentha longifolia* (L.) Buds.,
Phyla nodiflora (Linn.) Greene, *Sparganium ramosum*
Huds. and *Veronica anagallis aquatica* Linn.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

003.109
BIOLOGICAL CONTROL AGENTS OF *HYDRILLA VERTICILLATA*

CRIS0045755

CENTEE T D; INST OF BIOLOGICAL CONTROL; COMMONWLT
AGE BUR-FARNEAM BOUSE, SLCUGH, UNITED KINGDOM.
Proj. No.: 7004-20280-006-A Project Type:
COOPERATIVE AGREE.
Agency ID: AFS Period: 14 SEP 79 To 30 SEP 81

OBJECTIVES: Obtain information on biological agents,
primarily insects, found to have a suppressing effect
on *Hydrilla verticillata* in its native habitat in
Africa and to assess the suitability and effectiveness
of candidate agents for use in the U.S.

APPROACH: Conduct surveys in East Africa for
potential biological control agents. Conduct field
and laboratory experiments to assess the host
specificity of candidate organisms. Obtain sufficient
taxonomic and biological information on the organisms
to support more intensive investigation in the U.S.
Introduce living organisms into quarantine facilities
in the U.S. for extended tests of host specificity and
effectiveness.

PROGRESS: 79/12 TO 80/12. A cooperative agreement
with the Commonwealth Institute of Biological Control
has been arranged to provide for surveys of potential
biological control agents of hydrilla (*Hydrilla*
verticillata) in East Africa. This work will be
carried out from their laboratory in Muguga, Kenya.
Because of delays resulting from negotiations with
the host country, work has only recently begun and
there is not yet any significant progress to report.

PUBLICATIONS: 79/12 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

4. Ecology and Environment

004.001
FATE AND EFFECTS OF ATRAZINE IN SALT MARSH ECOSYSTEMS

CRIS0069880

DAVIS D E; BOTANY & MICROBIOLOGY; AUBURN UNIVERSITY,
AUBURN, ALABAMA. 36830.
Proj. No.: ALA-05-0043 Project Type: STATE
Agency ID: SAES Period: 02 FEB 75 To 01 MAR 76

OBJECTIVES: Determine in model ecosystems of
increasing complexity: The amount and form of
atrazine residues and metabolites in various
components of the systems, effects of atrazine on the
biological components. Determine for stable
ecosystems in the field the effects of atrazine on
the biological components. Compare atrazine effects,
residues, and metabolites in the field with those in
model ecosystems.

APPROACH: Amounts and kinds of residues and
metabolites will be determined for: *Spartina*
alterniflora grown in solutions containing atrazine
labeled with ¹⁴C in the ring and for *Sesarma*
reticulata fed leaves from these plants and for
detritus produced from leaves of this plant and in
fiddler crabs fed this detritus. Similar studies will
be made for each component of an intact model
ecosystem including a carnivore. Throughout the
studies detailed observations will be made on the
effects of atrazine on each of the components of the
model ecosystems. Microecosystems will be treated on
Sapelo Island, GA and the results will be compared
with those from the model ecosystems.

PROGRESS: 80/01 TO 80/12. No progress report this
period.

PUBLICATIONS: 80/01 TO 80/12
PLUMLEY, F.G., DAVIS, D.E., MCENERNEY, J.T. and
EVEREST, J.W. 1980. Effect of a Photosynthesis
Inhibitor, Atrazine, on the Salt Marsh Fiddler
Crab, *Uca pugnax* (Smith). *Estuaries* 3:217-223.

004.002
POND FERTILIZATION AND LIMING

CRIS0078980

BOYD C E; FISHERIES & ALLIED AQUACULTURE; AUBURN
UNIVERSITY, AUBURN, ALABAMA. 36830.
Proj. No.: ALA00497 Project Type: BATCH
Agency ID: CSRS Period: 02 APR 79 To 30 SEP 84

OBJECTIVES: Determine the solubilities of different
phosphorus fertilizers in pond waters. Evaluate fluid
fertilizers for use in sport fish ponds. Investigate
use of low rates of calcium hydroxide for liming
ponds which have excessive overflow during winter and
spring.

APPROACH: Solubilities of phosphorus compounds will
be determined by measuring the loss of phosphorus
from samples of these compounds placed on fertilizer
platforms in ponds. Compounds will be tested in ponds
representing a range of water quality. Effects of
different ratios and rates of application of fluid
fertilizer on bluegill production will be evaluated
in ponds. Effects of calcium hydroxide applications
on total hardness and total alkalinity will be tested
in ponds which have excessive overflow during winter
and spring.

PROGRESS: 80/01 TO 80/12. Dissolution rates for
phosphate fertilizers settling through 1.8m of water
at 29 degrees F were: superphosphate, 4.6%; triple
superphosphate, 5.1%; monoammonium phosphate, 7.1%;
mixed 8-8-8 fertilizer, 11.4%; mixed 20-20-5
fertilizer, 11.9%; diammonium phosphate, 16.8%.
Nitrogen was highly soluble (61.7 to 98.8%) from

settling granules of sodium nitrate, calcium nitrate, ammonium nitrate, ammonium sulfate, and two mixed fertilizers, but not (5.1 to 11.7%) from ammonium phosphates. Five pond fertilization programs (44.8 kg/ha per application of 20-20-5 mixed fertilizer, 20.2 kg/ha per application of triple superphosphate, 10.1 kg/ha per application of triple superphosphate, 10.1 kg/ha per application of diammonium phosphate, and 7.3 kg/ha of a liquid fertilizer with a grade of 13-25-0) all resulted in similar sunfish yields. The cost of fertilization may be greatly reduced by using the low triple superphosphate treatment 10.1 kg/ha, diammonium phosphate, or liquid fertilizer.

PUBLICATIONS: 80/01 TO 80/12

- HUNT, D. and BOYD, C.E. 1980. Alkalinity Losses Resulting from Ammonium Fertilizers Used in Fish Ponds. *Trans. Amer. Fish. Soc.* 110:81-85.
METZGER, R.J. and BOYD, C.E. 1980. Liquid Ammonium Polyphosphate as a Fish Pond Fertilizer. *Trans. Amer. Fish. Soc.* 109:563-570.
MUSIG, Y. and BOYD, C.E. 1980. Comparison of Orthophosphate and Polyphosphate as Fertilizers for Fish Ponds. *Aquaculture* 20:135-138.

004.003

CRIS0069486

STREAM AND IMPOUNDMENT ECOLOGY

LAWRENCE J M; BAYNE D E; BOYD C E; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.

Proj. No.: ALA-27-0005 Project Type: STATE
Agency ID: SAES Period: 01 NOV 75 To 30 OCT 85

OBJECTIVES: Conduct research on the effects of man's activities on the ecology of streams and impoundments.

APPROACH: Qualitative and quantitative aspects of the ecology of an area in a stream or impoundment affected by man's activities will be compared to those aspects of the ecology of an adjacent or nearby area that is relatively unaffected. In some cases "before-and after" studies will be utilized to determine the effects of man's activities on the ecosystem in question.

PROGRESS: 80/01 TO 80/10. Sampling on a periodic basis for water quality and quantitative analyses of phyto-zooplankton was continued through 1980 in river areas within Alabama that were adjacent to or below steam electric generating plants and paper mills. Collection of water quality, phyto-zooplankton and macroinvertebrate information on West Point Lake Ala-Ga was continued through 1980. The studies of correlations between primary productivity and phyto-plankton production, zooplankton production and fish production are being continued. Relationships between macroinvertebrate production and water level fluctuations are also being studied. Dye studies of flow characteristics of released textile effluents in the Tennessee River indicated a rather rapid dilution along a restricted flow pattern in the inner channel. Research is underway to determine levels of heavy metals and chlorinated hydrocarbons in sediment, macroinvertebrates, fishes, reptiles and mammals located in or adjacent to small streams draining municipal, agricultural and forested watersheds. A study was completed on the effects of submersed fan (water) circulators on phytoplankton abundance, community structure and certain water quality variables in commercial catfish ponds.

PUBLICATIONS: 80/01 TO 80/10

- LAWRENCE, J.M. 1980. Interim Report to Container Corporation of America. A Biological Study on the Conecuh-Escambia River in the Vicinity of Brewton, AL. Auburn Univ., AL. 35 pp.
LAWRENCE, J.M. and BAYNE, D.R. 1980. Phase Report. Limnology Study of West Point Lake Ala-Ga. Corps of Engineers, Mobile District. Auburn Univ., AL. 60 pp.
LAWRENCE, J.M. and WEBBER, E.C. 1980. Final Report to Burns and McDonnell. Aquatic Biology Study on a Raw Water Intake Structure in the Tombigbee River. Auburn Univ., AL. 53 pp.

LAWRENCE, J.M. 1980. Final Report to Monsanto Textile Company. Effluent Concentration Patterns in Tennessee River Below the Waste-Treatment Outfall from Monsanto's Decatur, Alabama plant. Auburn Univ., AL 12 pp.

004.004

CRIS0045926

PROTECTION, REHABILITATION, AND ENHANCEMENT OF ANADROMOUS FISH HABITAT IN THE PACIFIC NORTHWEST

MEEHAN W R; EVEREST F B; BRYANT M D; PACIFIC NW FOREST & RGE EXP STA, JUNEAU, ALASKA. 99801.
Proj. No.: PNW-1705 Project Type: INHOUSE
Agency ID: FS Period: 02 JUL 79 To 02 JUL 84

OBJECTIVES: Synthesize present knowledge of anadromous salmonids; determine species and habitat requirements; determine structure and distribution of existing populations; train managers, cooperators, and the public; develop or revise fish management guidelines. Develop new techniques and methods to rehabilitate and enhance anadromous fish habitat. Validate and implement management programs to ensure a continuing supply of anadromous fish to meet public needs.

APPROACH: Determine the habitat requirements of anadromous salmonids throughout their range in the Pacific Northwest and Alaska. Determine the effects of land use activities on anadromous fish habitat. Provide methods for the rehabilitation and enhancement of anadromous fish habitat.

PROGRESS: 79/10 TO 80/09. Three years of season-long livestock grazing at a moderate stocking rate did not indicate profound changes in anadromous fish habitat. Preliminary analyses of data indicate that steelhead trout standing crops may be inversely correlated with years of livestock grazing. Field sampling in this 5-year study will terminate in the fall of 1980, and more definitive conclusions will be made after final data analysis. Materials deposited in stream channels by landslides may be harmful or beneficial to fish production depending on the size and stability of deposited material and the species of fish affected. Composition of anadromous trout populations in disturbed areas shifted to a higher proportion of underyearlings. Not only was standing crop of henthic invertebrates reduced in disturbed areas, but size of organisms was also reduced. Studies of organic debris in streams have shown that debris entering streams naturally becomes an important component of the stream ecosystem and aids in bank stability. Logging debris promotes bank instability and accelerates streambed erosion. In conjunction with these studies, new techniques for sampling streams and fish populations have been developed and refined. These include a freeze-branding device for marking juvenile salmonids, a waterlevel device for measuring stream profiles and gradients, and a method for recording cumulative radiant insolation using an integrated solar counter.

PUBLICATIONS: 79/10 TO 80/09

- EVEREST, F.B., MCLEMORE, C.E. and WARD, J.F. 1980. An Improved Tri-tube Cryogenic Gravel Sampler. USDA Forest Serv. Res. Note PNW-350, 8 pp., Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.
CUSHING, C.E., MCINTIRE, C.D., SEDELL, J.R., CUMMINS, K.W., MARSBALL, G.W., PETERSON, R.C. and VANNOTE, R.L. 1980. A Multivariate Approach to Stream Classification Using Physical-chemical Variables. *Arch. Hydrobiol.* 88:1-4.
BRYANT, M.D. and WALEOTTEN, W.J. 1980. Carbon Dioxide Freeze-branding Device for use on Juvenile Salmonids. *Prog. Fish-Cult.* 42(1):55-56.
WALEOTTEN, W.J. and BRYANT, M.D. 1980. An Instrument to Measure Stream Channel Gradient and Profiles. USDA Forest Serv. Res. Note PNW-345, 5 pp., Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.
CARDINAL, P.J. 1980. Habitat and Juvenile Salmonid Populations in Streams in Logged and Unlogged Areas of Southeastern Alaska. M.S. Thesis. Montana State Univ., Bozeman. 115 pp.

004.005 CRIS0065495
EFFECTS OF LOGGING ON ARIZONA TROUT AND THEIR HABITAT
IN THE WHITE MOUNTAINS OF ARIZONA

KYNARD B E; MATTER W; SCHOOL OF NATURAL RESOURCES;
UNIVERSITY OF ARIZONA, TUCSON, ARIZONA. 85721.
Proj. No.: ARZT-170425-68-16 Project Type:
MCINTIRE-STENNIS

Agency ID: CSRS Period: 01 JUL 74 To 30 SEP 79

OBJECTIVES: Evaluate the effects of logging on
Arizona Trout and their habitat.

APPROACH: This will be done by comparing population
dynamics parameters (growth rate, age structure, and
population density) of the Big Bonito trout
population before and after logging, comparing insect
community structure and biomass pre and post logging,
and comparing stream for changes in bottom
composition and temperature maximums pre and post
logging. Also, another stream will be used as a
further control for natural changes.

PROGRESS: 80/01 TO 80/12. Data collection was
completed and detailed analysis for the project
completion report is ongoing. Evidence continues to
indicate that logging within the Big Bonito Creek
Watershed has not significantly altered fine sediment
levels or fish and benthic invertebrate populations.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.006 CRIS0077998
THE EFFECTS OF LOGGING: GRAZING ON STREAMS IN THE
WHITE MOUNTAINS

MATTER W; SCHOOL OF NATURAL RESOURCES; UNIVERSITY OF
ARIZONA, TUCSON, ARIZONA. 85721.
Proj. No.: ARZT-173484-12-44 Project Type:
MCINTIRE-STENNIS

Agency ID: CSRS Period: 01 JUL 78 To 30 SEP 78

OBJECTIVES: Assess the effects of logging and grazing
on stream quality and biota in the white mountain
area of Arizona.

APPROACH: Collect and analyze physical, chemical and
biological data from selected field sites including
logged and grazed areas. A near natural state
reference stream will act as a basis for comparison.

PROGRESS: 80/01 TO 80/12. Three similar study streams
were selected and sampled during June, September, and
October, 1980; Paradise Creek of the White River
drainage, Big Bonito Creek of the Black River
drainage, and the West Fork of the Little Colorado
River, all within Apache County, Arizona. The Big
Bonito watershed has been logged, the Paradise Creek
watershed supports cattle grazing, and the Little
Colorado River drains the Mt. Baldy Wilderness Area
(thus, representing a near-natural state stream).
Parameters measured in each stream included general
water chemistry, small particle sediment, and density
and taxonomic composition of benthic invertebrates,
invertebrate drift, and fish. Sample analysis is not
complete, but some generalizations can be made: 1.
all streams are weakly buffered and slightly
alkaline; 2. Trichoptera, Diptera, and Ephemeroptera
predominate in the Benthos; 3. Invertebrate drift
exhibits a distinctly nocturnal increase and is
predominated by Trichoptera and Ephemeroptera; 4.
amino apache, a native trout, is common only in Big
Bonito Creek; brown-trout (*S. trutta*) predominate the
other sites. Sampling will resume in the Spring,
1981.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.007 CRIS0045718
POLYCULTURAL PRODUCTION OF FISH IN FARM PONDS

NEWTON S B; GIFFORD J R; AGRICULTURE; UNIVERSITY OF
ARKANSAS, PINE BLUFF, ARKANSAS. 71661.
Proj. No.: 7002-20380-001-A Project Type:
COOPERATIVE AGREE.

Agency ID: ARS Period: 07 SEP 79 To 30 SEP 83

OBJECTIVES: Develop management techniques for
polycultural fish production in farm ponds that are
adaptable to and will provide maximal fish yields for
small acreage farmers.

APPROACH: Existing cooperators farm ponds of 2 acres
or less with controlled stocking of channel catfish,
largemouth bass, bluegills, buffalo, and fathead
minnows will be evaluated relevant to costs for
labor, chemicals, fish for stocking, controlled
feeding, pond fertilization as based on age of pond,
water source, disease problems, etc., and total
production yields. Biotic and abiotic parameters in
the ponds will be monitored for environmental changes
and impact. Pond cage studies, coupled with intensive
feeding, will be made to maximize harvestable catfish
yields. grass carp, *Tenopharyngodon idella*, will be
tested for vegetation control in farm ponds in an
attempt to reduce the need for chemicals and increase
farm pond total fish yields.

PROGRESS: 80/01 TO 80/12. This farm pond production
study is on schedule with twelve ponds in South
Central Arkansas prepared for a 3-5 year population
development period. Data collection will commence
during the spring 1981 following the stocking of all
ponds with channel catfish, buffalo, grass carp,
bluegill, largemouth bass and fathead minnows.
Techniques of pond fertilization and fish feeding
will be employed along with the use of cages in four
of the ponds. Fish harvest will be recreational and
commercial methods with production information
collections based upon three different management
approaches.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.008* CRIS0003201
WEED CONTROL IN RICE PRODUCTION

SMITH R J; AGRONOMY; UNIVERSITY OF ARKANSAS,
FAYETTEVILLE, ARKANSAS. 72701.
Proj. No.: ARK00419 Project Type: STATE
Agency ID: SAES Period: 01 MAR 70 To 28 FEB 75

OBJECTIVES: Develop more effective chemical,
cultural, mechanical, biological, and combination
methods of controlling weeds in rice, and in crops
grown in rotation with rice.

APPROACH: Evaluate and compare new herbicides and
mixtures with standard ones. Determine the effects of
weeds and herbicides on yield and quality of rice.
Study the interactions of various control methods
with the physiology, ecology, morphology, and anatomy
of rice, and of annual and perennial weeds.
Characterize the effects of selected herbicides on
succeeding crops, fish, and other aquatic animal
life. Determine the fate of herbicides, applied to
rice, in the rice crop, soil, and water, and in other
crops grown in rotation with rice.

PROGRESS: 80/01 TO 80/12. Herbicide programs for rice
controlled weed complexes better than standard
propanil, molinate or phenoxy. Herbicides that
combined effectively with propanil for weed control
and safety to rice included thibencarb, butachlor,
oxadiazon, pendimethalin, and acifluorfen. Many of
these new treatments substitute applications of
propanil or molinate and single applications of 2,4,
I, -D silvex or 2,4-D. Tank mixtures of propanil +
MCPA or propanil + acifluorfen controlled weeds
growing on leaves and were effective substitutes for
propanil + 2,4,5-T. Cropping-herbicide systems
controlled red rice; important in this system was
control of red rice in rotated crops. Effective
treatments in soybeans were ppialachlor, metolachlor,
and tank mixtures of these with
pendimethalin; ppi profluralin, UFI-S734, RE-28269
and MON 097; ppe directed paraquat alone, and tank
mixed with 2,4-DB; ppe directed BAS 9052; and ppe

overdrop mefluidide + bentazon. Effective in grain sorghum were ppi metolachlor, alachlor, propazine, propazine + metolachlor and alachlor. CGA spores controlled nothern jointvetch in rice and soybeans; CGJ controlled winged waterprimrose in rice; both effectively combined in a weed-pest management system. All season competition of dayflower reduced rice yields 15-20%, but competition for up to 80 days had no effect. Midseason applications of glyphosate controlled most weed species growing in rice field flooding and draining canals.

PUBLICATIONS: 80/01 TO 80/12

- SMITH JR., R.J. 1980. Rice. pp. 118-124. In: Suggested Guidelines for Weed Control USDA Agric. Handbook 565, 330 pp.
- SMITH JR., R.J. 1980. Progress Report on Weed Control in Rice. Abstracts 19th Annual Meeting Arkansas Agricultural Pesticide Association. pp. 11-12 (Abstract).
- SMITH JR., R.J. and SULLIVAN, J.D. 1980. Reduction of Red Rice Grain in Rice Fields by Winter Feeding of Ducks. Arkansas Farm Research. 29(4):1-3.
- TEMPLETON, G.E., SMITH JR., R.J., and KLCMPARENS, W. 1980. Commercialization of Fungi and Bacteria for Biological Control. Biocontrol News and Information. 1(4):291-294.

004.105* CRIS0045580
A SURVEY FOR PATHOGEN FOR AQUATIC WEEDS IN CALIFORNIA FOR USE IN BIOLOGICAL CONTROL

DUNIWAY J M; ANDERSON L W; AGRICULTURAL EXPEP. STATION; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.

Proj. No.: 5090-20282-006-A Project Type: COOPERATIVE AGREE.
Agency ID: AES Period: 23 AUG 79 To 30 JUN 82

OBJECTIVES: Conduct a survey to discover pathogens that have potential for development as biological control agents for several important submersed aquatic weeds.

APPROACH: Collect, identify, and culture pathogenic-type organisms found on elodea, milfoil, hydrilla, pondweeds, coontail, and algae in the Davis area and other selected localities. Determine the characteristics of infection, transmission, virulence. Study promising phytopathogens for purposes of augmentation, release, and other manipulations.

PROGRESS: 80/01 TO 80/12. Aquatic weeds were sampled at a number of sites in Central and Northern California, usually at 2-4-week intervals during the past growing season and at less frequent intervals during the dormant season. The survey emphasized submersed weeds and algae, but nonsubmersed weeds were also sampled where disease symptoms were apparent. Submersed weeds did not appear to be killed or otherwise generally affected by diseases in the field, but occasionally they had small necrotic or discolored local lesions. Many fungi and a few bacteria were observed and/or isolated from such lesions, and after artificial inoculations in a greenhouse, a few fungi reproduced lesions somewhat like those observed in the field, especially in Eurasian watermilfoil. However, the inoculations have not yet shown that local lesions have a negative impact on weed growth and many of the attempted inoculations failed. Efforts are underway to improve the weed culture and inoculation methods. Some stands of emersed weeds had more apparent symptoms of disease, and several fungi known to be plant pathogens were isolated from apparently diseased specimens of cattail, bullrush and parrots feather.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.010* CRIS0066346
OSMOREGULATORY RESPONSES OF DESERT PUPFISH: A STUDY MODEL OF PHYSIOLOGICAL ADAPTATION TO ENVIRONMENT

BODA J M; ANIMAL PHYSIOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-APH-3225-H Project Type: HATCH
Agency ID: CSRS Period: 10 SEP 74 To 30 DEC 80

OBJECTIVES: Investigate the physiological mechanisms of adaptation by fishes with emphasis on the maintenance of osmotic and ionic balances.

APPROACH: Two species of desert pupfish, one adapted to extrema and variable conditions of environmental temperature and salinity (*C. macularius*), the other restricted to fresh waters (*C. radiosus*) will be employed as laboratory models. Initially, mechanistic differences in the abilities of the eggs and embryos of the two species to tolerate environmental extremes will be investigated in detail. Later, developing fry and adults will be studied.

PROGRESS: 74/10 TO 80/12. This project was terminated July 1979. The major results of this project include: Establishment of husbandry techniques and environmental requirements for the maintenance of two populations of desert pupfish (*Cyprinodon macularius* and *C. radiosus*) in a laboratory situation for several generations. *C. macularius* is a particularly suitable experimental animal model for the study of embryogenesis. *C. radiosus* is a difficult species to maintain in the lab because of low reproductive capacity. Comparisons of tolerances to environmental salinity and other environmental variables for the two species (and hybrids) have demonstrated such tolerances (or their lack) is inherent within the specific population as measured by the success and nature of embryogenesis and hatching of viable larvae. Environmental salinity, temperature, specific organic ions (especially sodium and calcium) have important influences on the rates of embryogenesis and the development of body form. There are interactions between these three environmental variables and there are differences between the two species in their responses to such factors. For example, the quantitative requirement for calcium ion is greater at high salinity, at excessively low salinity (near distilled water), at high temperature, and for *C. radiosus* for the several environmental conditions.

PUBLICATIONS: 74/10 TO 80/12
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

004.011* CRIS0078835
PHYSIOLOGY AND ECOLOGY OF THE ASIATIC CLAM, CORBICULA SP., IN THE SACRAMENTO-SAN JOAQUIN DELTA

BODA J M; ANIMAL PHYSIOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-APH-3716 Project Type: STATE
Agency ID: SAES Period: 01 FEB 79 To 30 OCT 84

OBJECTIVES: Provide detailed physiological and ecological information on the asiatic clam, *Corbicula* sp., as a basis for management or economic exploitation of the species.

APPROACH: Laboratory studies of individual changes of body composition, growth, and metabolism and field studies of population changes and productivity will be used to evaluate the ecology of *Corbicula* in the Sacramento-San Joaquin delta.

PROGRESS: 80/01 TO 80/12. Caged populations of freshwater clams (*Corbicula manilensis*) consisting of labeled individuals of known size and estimated tissue composition (based upon tissue analysis of other individuals collected at the same time and location) have been placed in several microenvironments of the San Joaquin Delta. Samples of the caged populations, as well as clams from the same areas, are being collected periodically throughout the year for an evaluation of growth rates and changes of tissue composition (wet and dry weights, tissue calorics, total nitrogen, glycogen concentration). The purpose is to establish baseline

values and potentially useful procedures to allow the use of these clams as bioindicators of the quality of the Delta waters. Tissue composition of lyophilized tissues collected from resident populations during 1978 and 1979 are being analysed to establish equations for the prediction of tissue compositions from simple field measurements

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

004.012 CRIS0009144
BIOLOGICAL CONTROL OF MOSQUITOES IN CENTRAL AND
NORTHERN CALIFORNIA

GARCIA R L; BIOLOGICAL CONTROL; UNIVERSITY OF
CALIFORNIA, BERKELEY, CALIFORNIA. 94720.
Proj. No.: CA-B*-BIC-2428 Project Type: STATE
Agency ID: SAES Period: 09 AUG 66 To 31 JUL 73

OBJECTIVES: Comprehensively evaluating the ecologies and efficacies of existing natural control, introducing certain foreign parasitic, predatory, or pathogenic species, measuring consequent performance in succeeding years, augmenting the efficacies of existing or introduced natural enemies by environmental manipulations, and assist in the development of integrated control programs against certain mosquito species by investigation of those biological and environmental control agents or practices that will best lend themselves to this end.

APPROACH: One or more aquatic environments will be selected where major mosquito problems exist and where the best opportunities lie for developing a biological control phase of an integrated control program.

PROGRESS: 80/01 TO 80/12. *Bacillus thuringiensis* var. *israelensis* (Bti) seems almost entirely selective for many species of mosquitoes and blackflies. Studies against 59 species of nontarget organisms representing 6 classes, 19 orders, and 32 families of aquatic organisms revealed no observable toxic effects. In 1980 a total of 14 species of nontarget organisms were tested with one chironomid, *C. matusus* and one Simulium sp. showing susceptibility similar to that of mosquito larvae. Laboratory experiments demonstrated that commercial formulations of Bti reach equilibrium in a column of water within one hour and remain suspended and potent for 5-6 and 1-2 days, respectively. Tests were conducted to determine the efficacy of Bti under different aquatic regimes against mosquito larvae. Surface area and depth were investigated with results indicating depth to be an important variable which may have to be taken into consideration in certain field applications. Further tests revealed mortality rates for a given amount of Bti are affected by the number of larvae under treatment, with the efficacy of Bti decreasing as the population sizes increase. Field trials with Bti (Biochem formulation) against *Anopheles franciscanus* were conducted in two locations in Marin County. Both tests showed mortality rates as high as 100% and with dosage rates as low as 0.5 kg/ha. Other field trials conducted in maturing rice fields in Colusa County, California proved successful in controlling *Anopheles freeborni* and *Culex tarsalis*.

PUBLICATIONS: 80/01 TO 80/12

GARCIA, R. and DES ROCHEERS, B. 1980. Preliminary Field Trials With *Bacillus thuringiensis* var. *israelensis* Against *Aedes dorsalis* and *Culex tarsalis* in Salt Marshes. Proc. and Pap. 48th Ann. Conf. Calif. Mosquito and Vector

GARCIA, R., DES ROCHEERS, B. and TOZER, W. 1980. Studies on the Toxicity of *Bacillus thuringiensis* var. *israelensis* Against Organisms Found in Association With Mosquito Larvae. Proc. and Pap. Ann. Conf. Calif. Mosquito and Vector

004.013* CRIS0075881
ENVIRONMENTAL AND ECOLOGICAL INFLUENCES ON GENETIC
VARIABILITY

FOIN T C; ECOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS,
CALIFORNIA. 95616.
Proj. No.: CA-D*-ECL-3669-H Project Type: BATCH
Agency ID: CSRS Period: 20 JUL 78 To 30 SEP 83

OBJECTIVES: This project is intended to identify the ecological and environmental correlates of genetic variability in grassland and marine ecosystems. This will help us to identify the role of genetic variation in mediating population response to environmental and ecological conditions. If the results are similar, analysis of two widely different ecosystems should produce generalizations applicable both to agricultural and natural ecosystems.

APPROACH: In both systems we shall routinely measure levels of genetic variation in enzymes using gel electrophoresis; the ecological structure of the community; and relative environmental and trophic stability. With these data we can identify what conditions are most closely associated with high genetic variability. This long-term (several years) study is principally located in the northern California coastal grassland and in the tropical Pacific. The project is currently coordinated with personnel at the University of Hawaii, the University of Washington, and the Departments of Genetics and Agronomy and Range Science at U.C. Davis.

PROGRESS: 80/01 TO 80/12. This program currently consists of two parts. One is the direct measurement of genetic variability in a family of tropical marine gastropods. By and large, little work in research has been undertaken in this past year, although two manuscripts bearing on this work have been completed and submitted within the year. The other part of the program is the ecological assessment of a perennial grass species, *Anthoxanthum odoratum*. The program currently emphasizes the ecological aspects of increase of this species in a coastal grassland at Sea Ranch, Sonoma County, to define the limits of adaptability of a species well-known for its genetic variability. Three students are now working on this program: two abstracts and one paper have been produced in the past year. The principal result to emerge is that *Anthoxanthum* is highly successful along the coast in a variety of environments. There appears to be a strong correlation between *Anthoxanthum* abundance and soil water availability, conditioned on the presence of other perennial species which are potential competitors.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

004.014 CRIS0084311
VARIABILITY IN PHYSICAL REGIME OF LAKE TITICACA:
RELATION TO BIOLOGICAL PROCESSES

POWELL T M; ECOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS,
CALIFORNIA. 95616.
Proj. No.: CA-D*-ECL-4136 Project Type: STATE
Agency ID: SAES Period: 01 JUN 81 To 30 SEP 83

OBJECTIVES: Seek multiyear data to estimate the energy budget for Lake Titicaca, Peru-Bolivia. Use the energy budget to compare this high altitude tropical lake to large, temperate lakes. The physical regime of tropical lakes may be more variable than that found in temperate latitudes. Test this view and determine the extent to which an uncertain and variable physical regime is reflected in the populations of aquatic organisms. Such uncertainty could be reflected in quite variable primary production and fish catch.

APPROACH: We intend to use three sources of data to evaluate the terms in the energy budget: first, a program of field measurements; second, data collected and recorded by Peruvian and Bolivian scientists; third, remote sensed data from satellites.

004.015 CRIS0058986
ECOLOGY OF MOSQUITOES ASSOCIATED WITH CALIFORNIA RICE
FIELDS

WASHINGTON, K.K.; ENTOMOLOGY; UNIVERSITY OF CALIFORNIA,
DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ENT-2746-H Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 71 To 30 SEP 79

OBJECTIVES: To develop ecological and biological data
that would lead to integrated control programs for
mosquitoes associated with California rice fields,
with emphasis on cultural or biological methods of
control.

APPROACH: By studying the seasonal variability in
mosquito larval predation by natural and introduced
fish and invertebrate predators; by studying the
seasonal variability in the abundance and
physiological state of the adult female population in
relation to strategy of control and to their ability
to serve as noxious pests; to investigate the
feasibility of cultural means to control mosquitoes.

PROGRESS: 79/01 TO 79/09. Entomological and
sociological studies yielded information on public
tolerance to mosquitoes. Physiological age, blood
feeding pattern and lipid content were studied in the
adult mosquitoes. Newer sampling methods for larvae
and adults were developed. Biological control studies
were conducted with three fishes, one nematode, one
fungus and several flatworms. Low volume chlorpyrifos
and several insect growth regulators as larvicides
were studied for chemical control.

PUBLICATIONS: 79/01 TO 79/09
WASHINGTON, R.K., WESTERDAHL, B.B., FUKUSHIMA, C.K.,
FETTER-LASKO, J.L., BROWN, J.K., COLLINS, F.B.,
HANNA, G. and NAGAMINE, L.R. 1978. The Ecology of
Mosquitoes and Mosquito Control Agents in
California. Mosquito Control Research

004.016 CRIS0070096
BIOLOGICAL INDICATORS OF ENVIRONMENTAL QUALITY IN
CALIFORNIA LAKES AND STREAMS

RESH, V.B.; ENTOMOLOGY & PARASITOLOGY; UNIVERSITY OF
CALIFORNIA, BERKELEY, CALIFORNIA. 94720.
Proj. No.: CA-B*-ENT-3806-H Project Type: HATCH
Agency ID: CSRS Period: 29 MAR 76 To 30 SEP 81

OBJECTIVES: Develop the concept of biological
indicators of environmental quality as applied to
California's lake and stream environments. Analyze
the effect of potential impacting activities (e.g.
geothermal energy development, organic and heavy
metal effluents) on the energy transfer processes in
aquatic ecosystems.

APPROACH: Streams and lakes throughout California
will be selected for study. A statistically-sound
sampling regime will be developed for quantitative
biotic collections and measurements of key water
chemistry and physical parameters. Diversity indices,
production estimates, and bioassay procedures will be
applied in specific cases. A matrix data arrangement
will be developed in which biological information,
water chemistry measurements, and physical parameters
can be used in preparing predictive models of the
dynamic interactions occurring in these environments.

PROGRESS: 80/01 TO 80/12. Research concerning the use
of the indicator organism concept in evaluating water
quality in California lakes and streams is being
concentrated in three main projects: the effect of
geothermal energy development and operation as well
as the effect of geochemical origin on aquatic biota,
the effect of drought conditions on stream and spring
systems, and the effect of the addition of mosquito
control recirculation ditches on salt marsh biota.
Results thus far indicate that: In geothermal energy
control studies, two species of caddisflies (Insecta:
Trichoptera) *Gnatsia nigricula* Mel. and *Helicopsyche*
borealis (Hagen) can be used in monitoring programs;
during low rainfall years selected populations have
higher numbers of individuals in the Spring, probably
due to reduced impact of spate activity; mosquito
control recirculation ditches may increase abundance

and diversity of salt marsh fish communities but
alter seasonal patterns of arthropod communities and
distribution patterns of specific arthropod
populations. Research is being continued in each of
these projects.

PUBLICATIONS: 80/01 TO 80/12
WATERS, W.E. and RESH, V.B. 1979. Ecological and
Statistical Features of Sampling Insect
Populations in Forest and Aquatic Environments.
In: Contemporary Quantitative Ecology and Related
Ecometrics (Patil, G.P. and RESH, V.B., BALLING,
S.S., BARNBY, M.A. and COLLINS, J.N. 1980. What
is the Ecological Impact of Mosquito Control
Recirculation Ditches on San Francisco Bay
Marshlands? Calif. Agric. 34:38-39.
BARNBY, M.A. and RESH, V.B. 1980. Distribution of
Arthropod Populations in the Relation to Mosquito
Control Recirculation Ditches and Natural
Channels in the Petaluma Salt Marsh of San
Francisco Bay. Proc. Calif. Mosq. Vect. Contr.
HART, D.D. and RESH, V.B. 1980. Movement Patterns
and Foraging Ecology of a Stream Caddisfly Larva.
Canad. J. Zool. 58:1174-1185.
RUSSELL, P.P., RESH, V.B. and FLYNN, T.S. A
Continuous Flow Bioassay Technique for Assessing
the Toxicity of Oil-shale-related Effluents:
Preliminary Results with Two Species of Caddisfly
Larvae. Proc. 1st EPA Shale Symposium: Sampling,

004.017 CRIS0066286
DISPOSITION OF CHEMICAL POLLUTANTS IN AQUATIC
ORGANISMS

CROSBY, D.G.; ENVIRONMENTAL TOXICOLOGY; UNIVERSITY OF
CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ETX-3260-H Project Type: HATCH
Agency ID: CSRS Period: 06 SEP 74 To 30 SEP 85

OBJECTIVES: Develop techniques for determining
pollutant disposition in aquatic species; measure
bioconcentration and metabolism of chemical probes
(priority pollutants) in economically important
aquatic (aquaculture) species; correlate chemical
with biological properties to allow prediction; and
apply results to field situations.

APPROACH: Unrestrained representative aquatic species
will be exposed to nontoxic levels of selected
priority pollutants; bioconcentration will be
measured chemically or radiometrically, collected
metabolites will be separated and identified, and
formation measured. Physical/chemical properties will
be correlated with concentrations and phylogeny and
predictable trends tested with other probes and
species. Results will be applied to the organisms in
the field by chemical analysis.

PROGRESS: 80/01 TO 80/12. The fresh water clam,
Corbicula manilensis, was cultured in the laboratory
and exposed to hexachlorobenzene (HCB) as a chemical
probe. The specially-constructed glass metabolism
chamber allowed a constant exposure level of about
0.45 ppb and 90% accountability for HCB. HCB uptake
was rapid and reached a plateau after 50 hrs at 11.5
ppb in *Corbicula* fat, but depuration into HCB-free
water was very slow. No evidence of metabolic
degradation was seen. A survey of other chemical
probes possibly more readily degraded by molluscs
suggested o-toluidine (2-methyl-aniline) as a
candidate, and preliminary chemical work on
analytical systems for it and its potential
metabolites is in progress. A laboratory and
procedure were established for trace analysis of
priority pollutants in water and aquatic animal
tissue. Striped bass (*Morone saxatilis*) were
collected as indicator species from several areas of
Northern California, and muscle, liver, and ovary
were analyzed by gas chromatography for background
chlorinated substances.

PUBLICATIONS: 80/01 TO 80/12
DIME, R.A. and CROSBY, D.G. 1980. Screening of
Organic Contaminants in Relation to Aquaculture
at Firebaugh, San Joaquin Valley. Report to
California Department of Water Resources.

004.018 CRIS0064884
STREAMSIDE BUFFER STRIPS FOR PROTECTING AQUATIC
ORGANISMS FROM LOGGING EFFECTS

ERMAN D C; FOREST RESEARCH UNIT; UNIVERSITY OF
CALIFORNIA, BERKELEY, CALIFORNIA. 94720.
Proj. No.: CA-F*-FRU-2916-MS Project Type:
MCINTIRE-STENNIS
Agency ID: CSRS Period: 28 JAN 74 TO 30 SEP 82

OBJECTIVES: Determine the response of stream
macroinvertebrates to various buffer strip designs.

APPROACH: Streams will be located that have different
buffer strips left after logging. Quantitative
artificial substrate samplers (concrete balls 5 cm in
diameter) will be placed in these streams so that
invertebrates can be efficiently collected.
Invertebrates will be compared by weights and species
from stream sections that have different buffer strip
designs.

PROGRESS: 80/01 TO 80/12. Sorting and identification
of benthic macroinvertebrates from 26 streams is
underway. Seven streams with narrow buffers that were
examined in 1976 are included in the analyses.
Preliminary results are available from detailed
extraction of plant pigments found on similar bottom
type in all streams. Although pigment quantities vary
among unlogged and logged streams, these differences
cannot be easily interpreted as resulting from timber
harvesting activities. Relationships among
chlorophyll a, total pigment complex, light, stream
temperature and algal biomass are under study.
Compensating changes in algal biomass or pigment
concentration in response to light and temperature
suggest that most other routine studies cannot
adequately relate stream chlorophyll changes with
perturbation.

PUBLICATIONS: 80/01 TO 80/12
NEWBOLD, J.D., ERMAN, D.C. and EBY, K.B. 1980.
Effects of Logging on Macroinvertebrates in
Streams With and Without Buffer Strips. Can. J.
Fish. Aquat. Sci. 37:1076-1085.

004.019* CRIS0076425
EFFECTS OF STAMPEDE RESERVOIR ON UPSTREAM FISH
POPULATIONS OF SAGEHEN CREEK

ERMAN D C; FOREST RESEARCH UNIT; UNIVERSITY OF
CALIFORNIA, BERKELEY, CALIFORNIA. 94720.
Proj. No.: CA-F*-FRU-3649-B Project Type: HATCH
Agency ID: CSRS Period: 07 SEP 78 TO 30 SEP 80

OBJECTIVES: Determine the cause of upstream movement
of suckers in Sagehen Creek following impoundment and
determine if other changes in fish composition are
occurring, particularly trout populations in areas
formerly uninhabited by suckers.

APPROACH: Seasonally, we will sample fish by
electrofishing from the reservoir upstream. Density
and standing crop estimates will be compared to
pre-impoundment baselines data (1952 to 1961).
Suckers will be tagged to determine movement
patterns. Physiological condition will be assessed to
see if upstream fish are under more stress than those
downstream. An underwater observation tank will be
used to observe behavior of trout and suckers in case
suckers have an adverse effect on trout distribution.

PROGRESS: 80/01 TO 80/12. Tahoe sucker in Webber Lake
were found in different depth and habitat zones
depending on their size (age). They also fed on
different benthic invertebrates depending on size.
Juveniles sucker were gregarious by day in shallow
water but at night fed as individuals. Adult fish
lived in deep zones by day and migrated to shallow
water at night to feed. Food of sucker in Webber Lake
was mostly chironomid larvae, an amphipod and
molluscs while in Stampede Reservoir they ate mostly
chironomid larvae and pupae and some zooplankton
(from the benthos). The differences in diet between
systems was a function of differences in food
availability. In Sagehen Creek, sucker confined to a
section at the underwater observation tank fed
actively only in mid afternoon. The action of their

feeding cleared away fine sediment and organic matter
from bottom substrates. Invertebrates drift seemed
increased by their feeding although further tests are
needed for verification.

PUBLICATIONS: 80/01 TO 80/12
MARRIN, D.L. 1980. Food Selectivity and Habitat
Utilization by Introduced Trout and Native
Non-game Fishes in Subalpine Lakes. M.S. Thesis.

004.020 CRIS0084225
CRAYFISH IN CALIFORNIA RICE FIELDS: DIET, IMPACT ON
RICE PRODUCTION AND POSSIBLE RETURNS IN HARVEST

GOLDMAN C B; INST OF ECOLOGY; UNIVERSITY OF
CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ECL-4127 Project Type: STATE
Agency ID: SAES Period: 01 MAR 81 TO 30 SEP 83

OBJECTIVES: To establish feeding habits of crayfish
in rice fields with emphasis on their relationship to
rice plants, insects, weeds and rice straw. To
determine the extent of crayfish population
development in California fields. To investigate the
effect of crayfish on rice production and field
damage. To examine the feasibility of a commercial
fishery in the rice fields.

APPROACH: Extensive mark and recovery methods and
behavioral observations will be done in rice fields.
Stomach content analysis and observations will also
be conducted in the lab. Population data will be
correlated with figures on rice production and field
damage. The feasibility of a fishery will be
established from population data and simulated
harvest.

004.021 CRIS0084226
APPLIED LIMNOLOGY AND FISHERIES STUDIES IN TROPICAL
LAKES

RICHMOND P J; INST OF ECOLOGY; UNIVERSITY OF
CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ECL-4129 Project Type: STATE
Agency ID: SAES Period: 01 MAR 81 TO 30 SEP 86

OBJECTIVES: To estimate the seasonal and year-to-year
variability in production of fish food. Past studies
indicate that deep tropical lakes have high
production but indicate a pattern of unpredictable
fluctuations in production. If so, fish production is
also likely to vary. Management practices should be
designed with this variability in mind. Lake Titicaca
is typical of large, deep tropical lakes and the
results obtained can be extended to an important
class of lakes.

APPROACH: Echo sounding and trawl techniques for
estimating the variation in distribution and standing
stock of fish species; correlation between plankton
production and pelagic fish stocks; analysis of the
data to evaluate possible development and regulation
of the fishery.

004.022 CRIS0065667
DEVELOPMENT OF FISH PROTECTIVE SYSTEMS FOR WATER
INTAKES

AMORCHO J; LAND, AIR & WATER RESOURCES; UNIVERSITY
OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-LAW-3056-B Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 74 TO 30 DEC 79

OBJECTIVES: Develop practical schemes for protecting
marine life at water intakes to lessen the adverse
environmental effects of water diversions. Large
diversions of water from rivers, lakes, and oceans
for irrigation and water supply and for powerplant
cooling cause grave ecological problems due to the
loss of fish and fish eggs and larvae.

APPROACH: Hydraulic studies using scale models of intakes to develop intake configurations which produce flow patterns which will efficiently direct fish away from intakes. Development of a pilot installation (using moving and fixed screens and louvers) in which tests are made with fish and fish eggs and larvae. Investigation of the use of very large sand filters for river water diversions. Such a scheme would use very small openings and very low velocities. Thus, freely swimming and suspended organisms would be excluded from the diverted water.

PROGRESS: 79/01 TO 79/12. A report describing hydraulic tests on a distorted scale model of the intake to the Peripheral Canal of the California Aqueduct from the Sacramento River was published. The model simulated 5.5 miles of the Sacramento River plus a river diversion channel and approximately one mile of fish screens. It was constructed to a horizontal scale of 1:240 and a vertical scale of 1:60. The model had a moveable bed; ground walnut shells of a uniform size were used to simulate bedload sediments. A minicomputer was used to control the model operation, allowing unsteady flow conditions to be simulated. Both the upstream flow and downstream river stage could be varied as a function of time to simulate unsteady upstream flows and fluctuations in river levels due to tidal effects. The model tests indicated that problems related to bedload sediments are minimized if the fish screens are located in an off-stream channel rather than along the river bank. A larger, undistorted model of the intake and adjacent river reach at a scale of 1:50 was completed. The hydraulics of various fish screening schemes are currently under study. These include: the one-mile long off-river fish screen placed in a channel parallel to the river; a "saw-tooth" fish screen configurator spanning at 1000-ft wide channel; drum screens with vertical axes in an off-river channel.

PUBLICATIONS: 79/01 TO 79/12

EARTMAN, W.J., AMOROCHEC, J. and DEVRIES, J.J. 1979. Peripheral Canal Intake Studies. 1. Distorted River Channel Model. Volumes I and II. A Report to Department of Water Resources, State of California. Department of Land, Air

004.023* CRIS0066814
THE USE OF SELECTED AQUATIC ORGANISMS FOR PURPOSES OF AQUACULTURE (FOOD PRODUCTION)

KNIGHT A W; LAND, AIR & WATER RESOURCES; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. \$5616.
Proj. No.: CA-D*-LAW-3350-B Project Type: EATCH
Agency ID: CERS Period: 05 NOV 74 To 30 SEP 80

OBJECTIVES: Determine the tolerances, growth dynamics, food preference, egg hatchability of selected pest organisms. Utilize existing pest organisms such as tadpole shrimp and cladophora algae for beneficial purposes such as low cost protein source.

APPROACH: Initially information will be obtained relating to the environmental needs of the organisms under consideration. Later we will manage environmental factors in order to maximize the production of the potential protein material for purposes of either a domestic animal food (i.e., chicken or catfish food) or a protein supplement for humans.

PROGRESS: 80/01 TO 80/12. Preparation of manuscripts resulting from our work with the Malaysian prawn (*Macrobrachium rosenbergii*) continues. These manuscripts focus on physiological aspects of our research and will be submitted to scientific journals in the near future. Research to better understand the laboratory culture of the grass shrimp (*Ceriodaphnia dubia*) is progressing well. This shrimp is a key food item for striped bass and sturgeon. Those culturing the sturgeon in the laboratory have indicated a need for food that is also under culture and therefore readily available to feed fish. Our research to determine the environmental needs of the shrimp has increased our capabilities to successfully culture this shrimp in the laboratory. Recently we have included the Asiatic

clam (*Corbicula*) in our culture operations. This clam exhibits potential as a filter feeder to remove undesirable particulate matter from aquaculture systems. In addition, the clam has demonstrated an ability to accumulate toxic materials such as heavy metals and organic materials. Clams, it is felt, will serve as excellent monitoring organisms in aquaculture systems. We are experimenting with methods of placing the clams in aquatic systems and their retrieval for tissue burden determination.

PUBLICATIONS: 80/01 TO 80/12

STEPHENSON, M.J. and KNIGHT, A.W. 1980. Growth, Respiration and Caloric Content of Larvae of the Prawn *Macrobrachium rosenbergii*. Comparative Biochemistry and Physiology 66A(3):385-391.
NAGAMINE, C., KNIGHT, A.W., NAGAMINE, C., KNIGHT, A.W., MAGGENTI, A. AND PAXMAN, G. 1980. Effects of Androgenic Gland Ablation on Male Primary and Secondary Sexual Characteristics in the Malaysian Prawn *Macrobrachium rosenbergii* with First Evident of Inocued

004.024 CRIS0069598
RESPONSE OF AQUATIC LIFE TO SALINITY, TEMPERATURE, DISSOLVED OXYGEN AND WATER FLOW

KNIGHT A W; LAND, AIR & WATER RESOURCES; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. \$5616.
Proj. No.: CA-D*-LAW-3075 Project Type: STATE
Agency ID: SAES Period: 01 JUL 74 To 31 DEC 75

OBJECTIVES: Study the effects of water temperature, flow, salinity and dissolved oxygen on the behavior, growth, and reproduction of aquatic test organisms, including opossum shrimp and striped bass.

APPROACH: Initial operations have been directed at techniques for maintaining and evaluating the effects of environmental factors on aquatic organisms. Artificial streams, static and continuous flow bioassay systems, oxygen consumption apparatus as well as experimental systems for obtaining growth information are being employed.

PROGRESS: 80/01 TO 80/12. Concentrated effort continues in the San Joaquin Delta area. The Asiatic clam (*Corbicula*) is being employed as a means of evaluating (monitoring) environmental factors as well as pollutants in the Delta. We have been placing clams in cages and on lines in areas of the Delta likely to be subjected to heavy metal, organic matter and other toxic substances. Other clams have been similarly placed in areas known to be free of contamination as controls. Information on clam growth, reproduction, survival and tissue burden is being collected for selected stations in the Delta. Some of the test sites are used as pre-discharge evaluation sites. For example, many of our stations are situated in locations that will likely be influenced by the proposed San Joaquin Agricultural Drain release into the Delta. With background information on clam growth, reproduction and tissue burden of organic and heavy metal materials, it will be possible to evaluate the impact of such a large discharge of agricultural wastewater on aquatic organisms. We are also conducting population evaluations of the clam at selected sites (same as for clam cages) to determine population changes in clam populations due to man's activities, such as agricultural wastewater return, domestic wastewater introduction, industrial waste discharge and out-of-basin water transfers.

PUBLICATIONS: 80/01 TO 80/12

KNIGHT, A.W. and FOE, C. 1980. Utilization of the Asiatic Clam, *Corbicula manilensis*, for the Direct Monitoring of the Effects of Receiving Waters on the Infauna of a Portion of the Sacramento-San Joaquin Delta.

004.025 CRIS0066677
THE EFFECTS OF IRRIGATION WASTE WATER ON AQUATIC PLANTS IN THE SACRAMENTO RIVER

KNIGHT A W; BAYER D E; LAND, AIR & WATER RESOURCES;
UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-LAW-3073-B Project Type: HATCH
Agency ID: CSRS Period: 10 OCT 74 To 30 DEC 80

OBJECTIVES: Determine what permutations in the aquatic vegetation growing in the Sacramento River (California) may occur as a result of the influence of irrigation return water and will relate these permutations to agricultural land management practices.

APPROACH: A survey of the aquatic vegetation growing in the river both upstream and down-stream of the Colusa Basin Drainage Canal outfall as well as in the canal itself is in progress. Variations through time and space will be noted and correlated with the quality of return water and also agricultural land management practices. Certain plant species will be grown under controlled conditions in the laboratory and the influence of irrigation return water determined using growth rates as a measure of plant performance.

PROGRESS: 80/01 TO 80/12. No progress report for this period.

PUBLICATIONS: 80/01 TO 80/12

FCRD, S.A., KNIGHT, A.W. and D.E. BAYER. 1980.
Irrigation return water impact on selected attached diatoms in the Sacramento River, Cal., U of Cal Water Resources Ctr Proj UCAL-WRC-W477.
Water Sci & Eng Paper No. 4511. 86 pp.

004.026 CRIS0075135
GROWTH AND MINERAL UPTAKE IN THE LEMNACEAE

SILK W K; LAND, AIR & WATER RESOURCES; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-LAW-3639-B Project Type: HATCH
Agency ID: CSRS Period: 01 APR 78 To 30 SEP 81

OBJECTIVES: Produce data on growth and nutrient uptake by selected aquatic plants (especially Lemna & Wolffia) under a variety of laboratory conditions. Growth of Lemna buds and increase in number of individual plants will be monitored simultaneously with nutrient removal rates in solutions of different concentrations of nitrates, potassium salts, phosphates and sulfates. The expansion pattern on a developing frond will be analyzed and compared to the pattern of nutrient removal.

APPROACH: Species of duckweed can be cultured vegetatively in defined nutrient medium (Billman, 1961). We have found modifications of published culturing techniques are satisfactory to maintain locally collected varieties of duckweed. Population growth will be monitored by planimeter measurement of total leaf area from microphotographs of small culture experiments and by fresh and dry weight analysis of larger scale experiments. Time lapse photomicrography of developing fronds marked with carbon particles will permit computerized analysis of the expansion pattern. The divergence of velocity will be plotted as a function of position on the frond. The expansion pattern can then be compared to the pattern of accumulation of mineral nutrients as determined by microprobe electron microscopy. Computer assisted analysis of the data could be used to develop a model to relate the mineral uptake rate to the growth rate and to define culturing conditions for nutrient removal by higher aquatic plants.

PROGRESS: 80/01 TO 80/12. Experiments were undertaken to evaluate the possibility of using duckweeds to remove nitrate from irrigation return water. Lemna protein per frond and per root increases with developmental stage until plants are at least two generations old. Protein per frond, per root, and per unit dry weight is greater in plants grown at 23.9C than at 18.3C. More protein is found in fronds than in roots, and more nitrate occurs in roots than in fronds. Nitrate per root increases with developmental stage and is higher (per root) in plants grown at 23.9C than at 18.3C. The distribution of generations within a growing population is constant for at least eight doubling times. Whether populations multiply

slowly at 15.6C or more rapidly at 23.9C, fronds which have not yet produced progeny form 62% of the population; fronds which are one generation old form 25% of the population; and fronds which are two generations old form 9% of the population. Results allow estimates of nitrate removal as a function of time after frond inoculation. To remove 10 mg l⁻¹ of nitrate-nitrogen would take 10.8 days at 23.9C after inoculation with 16 fronds per liter. The great difference between protein content of plants grown at 18.3C and at 23.9C implies that reliable models will require a large data base.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.027 CRIS0070366
ENVIRONMENTAL REQUIREMENTS OF POTENTIAL AQUACULTURE FISH SPECIES

CECH J J; WILDLIFE & FISHERIES BIOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-WFB-3455-B Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 76 To 30 SEP 81

OBJECTIVES: Determine the environmental requirements and limits of several California freshwater fishes with respect to temperature, dissolved oxygen, and other factors. These data would be used to indicate the adaptability of a species to aquaculture systems, including those receiving nutrient enrichment.

APPROACH: Environmental requirements will be determined by measurements of several respiratory, cardiovascular, and hematological variables under various environmental conditions. These measurements would indicate the physiological state of the fish regarding its overall energetic costs and oxygen uptake/transport functioning.

PROGRESS: 80/01 TO 80/12. Growth rates of juvenile (1-8 g) Sacramento blackfish, *Orthodon microlepidotus*, a native California cyprinid which grows to greater than 1.5 kg, were measured at three temperature ranges in laboratory aquaria where several diets were offered ad lib. and at four stocking densities in small ponds where natural food was available. Respiratory metabolic (oxygen consumption) rates of juvenile blackfish were also measured in flow-through or static respirometers. Transformations of both growth and respiration data to energy units showed that: growth rates increased with elevations in environmental temperature, growth in aquaria was possible with strictly plant-based diets and was faster with diets higher in protein, lipids, and total calories, growth rates in ponds with high stocking densities approximated those in laboratory aquaria fed pelleted diets, which exceeded the energy costs for respiratory metabolism, and growth rate in the pond with the lowest stocking density was the highest measured and exceeded respiration energy costs by as much as 2.5 fold. Extensive type of pond culture in warm water (optimal range: 24 degrees to 29 degrees C) with abundant natural food may be recommended for the hardy blackfish. Details of this investigation are forthcoming in published form.

PUBLICATIONS: 80/01 TO 80/12
CECH JR., J.J., MASSINGILL, M.J. and WURTSBAUGH, W.A. 1980. The Relationship of Food Conversion Efficiency and Growth Potential in Juvenile Mosquitofish, *Gambusia affinis*. Cal-Neva Wildlife Trans, pp. 1-5.

004.028 CRIS0066351
ECOLOGICAL STUDIES OF THE NAVARRO AND GARCIA ESTUARIES, WITH EMPHASIS ON THE FISHES

MOYLE P B; WILDLIFE & FISHERIES BIOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-WFB-3221-B Project Type: HATCH
Agency ID: CSRS Period: 04 FEB 75 To 30 DEC 80

OBJECTIVES: Define the physical, chemical and biological parameters of two estuaries (Navarro and Garcia) with special attention being paid to fish ecology.

APPROACH: The distribution, movements, and feeding habits of the fishes, transient and resident, will be studied in relation to daily and seasonal physical and chemical changes in the estuaries. Collections will be made over a 3-9 day period in each estuary once every two weeks in the summer and fall, once a month in the winter and spring.

PROGRESS: 80/01 TO 80/12. The data analysis is complete on this project and is being incorporated into the Ph.D. thesis of D. B. Varoujean. Essentially, this study had demonstrated that small north coast estuaries are important rearing and spawning areas for both marine and anadromous fishes. When the mouth of an estuary becomes closed during low-water years, the estuary may become anoxic in all but the surface of shallow waters, resulting in mortality of fish and crustaceans, and forcing species to compete with each other for limited space that normally would not come in contact with one another. These conditions may occur more frequently if the waters of coastal streams are diverted.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.029* CRIS0068125
INSTREAM FLOW REQUIREMENTS OF CALIFORNIA FISHES

MOYLE P B; WILDLIFE & FISHERIES BIOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-WFB-3206-B Project Type: HATCH
Agency ID: CSRS Period: 23 JUN 75 To 30 SEP 84

OBJECTIVES: Determine the requirements of the different life history stages of California fishes in relation to water velocity, substrate and depth. Show how these requirements vary in different stream types and in relation to temperature regimes and other fish species present. Determine if squawfish predation on salmon is increased by changed flow regimes and erection of diversionary structures.

APPROACH: Following the USFWS-IFG methodology, representative sections of streams are selected and subjected to intensive hydrological studies that allow the section to be simulated on a computer. Measurements of depth, velocity, substrate and other variables are then recorded for individual fish of all species present. When the two sets of data are combined, predictions can be made as to how such suitable habitat is available to each species, under different flow regimes. Samples of squawfish collected at different localities, times of the year and habitats are being examined for food habits. The results will be used in conjunction with data collected.

PROGRESS: 79/01 TO 79/12. This project has been terminated in favor of the more specific project WFB 3884-B. Much of what was learned in this project is summarized in Moyle and Li (1979) and Moyle (in press). Essentially, these studies document the distribution patterns of freshwater fishes in major portions of the Sacramento-San Joaquin drainage system in relation to the changing patterns of water use by man. Specific studies have also concentrated on the unique trout fishery of the McCloud River (Sturgess and Moyle 1978, Tippettts and Moyle 1978) and on the threatened fishes of the Pit River system (Daniels and Moyle 1978; Daniels 1979).

PUBLICATIONS: 79/01 TO 79/12
MOYLE, P.E., 1980 (Ed.). Studies on the distribution and ecology of fishes of the Sacramento-San Joaquin drainage system. I. Fishes of the Pit River system (Moyle and Daniels). II. Fishes of the Pajaro River system (Smith). III. Stream
DANIELS, R.A. 1979. Distribution and status of crayfishes in the Pit River drainage, California. Crustaceana. 20:1-8.

STURGESS, J. and MOYLE, P.E. 1978. Biology of rainbow trout, brown trout and interior Dolly Varden in the McCloud River, California, in relation to management. Cal-Neva Wildlife. pp. 232-250.

TIPPETS, W.E. and MOYLE, P.E. 1978. Epibenthic feeding by rainbow trout (*Salmo gairdneri*) in the McCloud River, California. J. Anim. Ecol. 97:549-559.

DANIELS, R.A. and MOYLE, P.E. 1978. Biology, distribution and status of rough sculpin, *Cottus asperimus*, in the Pit River drainage, Northeastern California. Copeia. p. 673-678.

004.030 CRIS0081224
ECOLOGICAL OF FISHES OF SACRAMENTO - SAN JOAQUIN ESTUARY, WITH EMPHASIS ON SUISUN MARSH

MOYLE P B; WILDLIFE & FISHERIES BIOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-WFB-3930-B Project Type: HATCH
Agency ID: CSRS Period: 28 MAR 80 To 30 SEP 82

OBJECTIVES: Determine the ecological requirements of major fish species of the more shallow, freshwater (12 ppt. salinity) portions of the estuary, especially Suisun Marsh, in relation to man-caused and natural changes in freshwater inflows. Species of special interest are chinook salmon juveniles, striped bass and native nongame fishes.

APPROACH: Selected areas are sampled every 2-4 weeks throughout the year using otter trawls, seines, traps and other appropriate methods. All fish are measured and samples aged, to determine use of area by size classes. Stomach contents are analyzed on a monthly basis, so a trophic web can be constructed. Selected species will be worked with in the laboratory to test salinity and temperature tolerances.

PROGRESS: 80/01 TO 80/12. In the past year we have sampled the sloughs of the Suisun Marsh twice a month to document changes in the fish fauna in relation to season, temperature, and salinity. We have also examined the stomachs of nearly 1000 fish to develop a food web for the marsh, and have conducted investigations of the life history of the splittail and tule perch, two native species potentially threatened by future developments in the marsh. We have found that the marsh is an important rearing area for juvenile salmon in the late winter and spring, at least during wet years. It is an important year-round habitat for juvenile striped bass and various native fishes. Catfish, once an important fishery in the marsh, appear to have declined since high-salinity waters invaded the marsh during the recent drought. However, we predict that the managed salinity regime proposed for the marsh by the Department of Water Resources, will bring back catfish and will probably improve conditions for striped bass and splittail as well.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.031* CRIS0015826
CONTROL OF WEEDS AND CERTAIN OTHER AQUATIC PLANTS IN THE PACIFIC SOUTHWEST

ANDERSON L W; YEO R R; USDA-ARS AQUATIC WEED CONTROL, DAVIS, CALIFORNIA. 95616.
Proj. No.: 5206-20280-001 Project Type: INHCUSE
Agency ID: ARS Period: 26 FEB 70 To 15 NOV 81

OBJECTIVES: Investigate individual and integrated approaches to control aquatic weeds, including herbicides, herbivorous fish and other aquatic fauna, insects, competitive plants, pathogens and other organisms. Investigate physiology, ecology, and biochemistry of aquatic plants in order to understand why and how the weed problems occur, and how effective control programs can be devised.

APPROACH: Find and test in laboratory, greenhouse, and field, biological agents that consume, destroy, or inhibit species of problem aquatic weeds. Discover new herbicides and growth regulators, and devise improved methods of using known phytotoxic chemicals for control of aquatic vegetation. Combine chemical and biological control methods to produce effective and acceptable integrated control programs. Study nutrition, growth, reproduction, and response of aquatic weeds to environmental factors, and utilize this information in programs designed to eliminate weed infestations and to prevent their recurrence.

PROGRESS: 80/01 TO 80/12. Several canals and Sheldon Reservoir in El Centro, Ca., were sampled to determine Hydrilla biomass and tuber density. Fresh biomass varied from 0 to 7.4 kg/m² and tuber density varied from 0 to 423/m² in canals. Biomass varied from 0.64 kg/m² to 2.03 kg/m² and tuber density from 12/m² to 65/m² in Sheldon Reservoir. When water was held in Sheldon Reservoir, concentrations of greater than 1 ppm copper resulted in good control of Hydrilla. Draw-down application of fluridone (without soil incorporation) at 1 or 2 lb/acre did not control Hydrilla. Application of endothal (Aquathol -K R) to a small pond in El Centro resulted in ca. 75% control of Hydrilla. Although continuous contact bioassays of PH 4062 at .25 to 1.0 ppm controlled both algal species, Cladophora appeared to be slightly more resistant than Rhizoclonium. In limited contact tests, Rhizoclonium was controlled one week after exposure to 1.0 ppm concentration of PH4062 for 2 h. while exposure to a 2.0 ppm of PH4062 for 2 h. was necessary for good Cladophora control. A dense infestation of M. brasilienses in a drainage canal was controlled by a foliar application of fenac at 15 lb/acre in 200 gal/A spray volume. The degree of control in the canal site was not expected and additional studies on foliar application of fenac will follow. A detailed study of the morphology of Hydrilla was made using a scanning electron microscope and normal and polarized light microscopy, and macrophotography.

PUBLICATIONS: 80/01 TO 80/12

ANDERSON, I. and RAINES, R.W. 1980. Response of Hydrilla verticillata, elodea canadensis, and Myriophyllum spicatum to combinations of Komeen and Endothal in Moving Water. Abstract, WWS Research Progress Report, p. 335.
DECHORETZ, N. and PINE, E.T. 1980. Evaluation of Komeen for Aquatic Weed Control in Ponds. Abstract, WWS Research Progress Report, p. 335.
DECHORETZ, N. and PINE, E.T. 1980. Control of Submersed Aquatic Weeds in Irrigation Canals with Fluridone. WWS Research Progress Report, p. 340.

004.032* CRIS0077533
ANALYSIS AND MODELING LAKE MICHIGAN FISH POPULATION

VANDYNE G; FISHERY & WILDLIFE BIOLOGY; COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO. 80523.
Agency ID: CSVM05500 Period: 01 JAN 76 To 31 DEC 78

OBJECTIVES: Assessment of power plant effects such as enterment, impingement and relatively small thermal increments on Lake Michigan implies a need for a systems analysis approach. Proposed is a modelling effort to examine and interrelate the data from the fishery and related investigations in the vicinity of the Donald C. Cook Nuclear Power Plant to determine power plant effluent pollution effects on commercial and sports fish in Lake Michigan.

APPROACH: The model will examine changes over time on a multispecies population sector. Climatic variables, plant operations and seasonal effects will be used as driving variables in the model to change the values of elements in the transition matrices. The model, after development and revisions, will be used to make predictions of impacts of alternative power plant operational stages on the population vector of the lake ecosystem.

004.033
WATER QUALITY STUDY

CRIS0076057

MORRISON S W; MICROBIOLOGY; COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO. 80523.
Agency ID: CSVM06349 Period: 30 JUN 78 To 29 JUN 83

OBJECTIVES: Carry out a continuing study of the Cache la Poudre River as it has been effected by the establishment of an industrial complex at Windsor, CO.

APPROACH: Sampling stations above and below the city of Fort Collins and the town and manufacturing complex at Windsor, CO, 12 miles downstream from Fort Collins have been established. Continuous monitoring for a number of indicators of water quality are to be carried out to determine and the effects of population and industrialization pressures on the river. The indicators include physical, chemical (inorganic, organic, heavy metal), and biological (bacteria, benthic and planktonic organisms, fish), parameters.

PROGRESS: 79/10 TO 80/12. This study is a continuing Cache la Poudre River surveillance project for the river segment from above Fort Collins to a point near the confluence with the South Platte River. A data base is being established for chemical, physical and biological parameters of the stream. Fish population studies and benthic surveys are included. The data is being used by state, local and industrial agencies in establishing a wastewater pollution control and management for the Poudre and discharges to the stream. Graduate students are receiving partial support for their participation in the study.

PUBLICATIONS: 79/10 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.034 CRIS0077525
TOXIC EFFECTS ON THE AQUATIC BIOTA FROM COAL AND OIL SHALE DEVELOPMENT

SKOGERBOE R K; NATURAL & ENVIRONMENTAL RES; COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO. 80523.
Agency ID: CSVM01188 Period: 01 JUL 75 To 31 DEC 78

OBJECTIVES: Study the effects of coal combustion and the aquatic biota. Study of ammonia toxicity to fishes and aquatic macroinvertebrates. Study of effects of coal and oil shale mining on receiving streams in increased inloads of dissolved solids.

APPROACH: Western Colorado is coming under heavy pressure for energy development, particularly coal and oil shale development. At the same time, Western Colorado is renowned for its wildlife including fishing. The relationship and impact of energy development on aquatic biota will be determined using ecosystem sampling techniques and quantifying ammonia concentrations by gas chromatography.

004.035* CRIS0044200
EVALUATION OF EFFICACY, CROP RESPONSES AND CROP AND WATER RETENTION OF POTENTIAL AQUATIC HERBICIDES

ANDERSON L W; USDA-ARS AQUATIC WEED CONTROL LAB, DENVER, COLORADO. 80225.
Proj. No.: 5604-20280-005 Project Type: INHOUSE
Agency ID: ARS Period: 02 DEC 77 To 30 SEP 80

OBJECTIVES: Identify effective, new aquatic herbicides and algicides. Determine the phototoxicity of irrigation water containing aquatic herbicides on crops and the extent of herbicide residue retention in the exposed crops. Determine the level of herbicide residue in water resulting from the application of herbicide to irrigation canals, or impoundments.

APPROACH: Use a greenhouse, static water screening bioassay for observing the phytotoxic effects of new chemical compounds on American pondweed sago pondweed and Elodea. Use a unialgal culture bioassay to evaluate new chemicals for algicidal properties. Make applications of candidate aquatic herbicides (which show sufficient efficacy and environmental safety) to irrigation canals or canal banks and subsequently sample exposed water and analyze for herbicide residues. Develop bioassay for evaluating controlled-release aquatic herbicides. Grow representative crops in small, replicated plots and irrigate with water containing appropriate levels of aquatic herbicide and subsequently determine the herbicide residue levels in the harvested crops.

PROGRESS: 77/02 TO 80/09. Rates of 2.25 to 7.43 kg/ha simazine applied to ditchbanks of flowing canals produced a maximum of 60 ug/l. First water flow samples from dry-canal treatments at similar rates produced a maximum of 250 ug/l with rapid subsequent dissipation. In six crops (corn, pinto beans, alfalfa, sugarbeets, tomatoes, cucumbers) irrigated with water containing 0.01 or 0.1 mg/l simazine, only trace amounts (0.5 to 2.9 ppb) were found. Similar studies showed little or no arsenic accumulation in crops exposed to 1.0-2.0 ppm MSMA. Small pond tests showed that granular fluoridone controls elodea, pondweeds, and stunts cattails within three months when applied at 2-3 lbs/acre. The levels of dicamba were determined in 6 crops that had been irrigated with .05 or 0.5 ppmw dicamba by furrow or sprinkler. Residues were less than .01 ppmw with the .05 ppm. Velpar was tested 1.0 ppm in a small (0.08 ha) pond. Fluoridone is effective in stopping growth of American and sago pondweed when vegetative tubers were exposed to 1 ppm in the light.

PUBLICATIONS: 77/02 TO 80/09

ANDERSON, L.W.J. and RAINES, R.W. 1980. Response of *Hydrilla verticillata*, *Elodea canadensis*, and *Myriophyllum spicatum* to combinations of Komeen and Endothall in moving water. West. Soc. Weed Sci. Prog. p.334-335.

ANDERSON, L.W.J. 1980. Dicamba residues in crops irrigated with water containing low levels of Benvel 4SR herbicide. West. Soc. Weed Sci. Progr. Rept. p. 346.

004.036

CRIS0076966

THE EFFECTS OF AGRICULTURAL DRAINAGE OF NATURAL SYSTEMS - PHASE III

DILL N H; FEBRIER J J; AGRI & NATURAL RESOURCES; DELAWARE STATE COLL, DOVER, DELAWARE. 19901.
Proj. No.: DELX-0007-79-2 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 78 To 30 SEP 83

OBJECTIVES: Determine and measure the operationally significant effects of agricultural drainage on natural systems of the Del-Mar-Va Peninsula with particular reference to changes and trends in water relationship, microclimate population and community dynamics community productivities, viability of wetlands. Provide practical recommendations/guidelines for maintaining natural ecosystem where possible or maximizing desirable ecological changes and minimizing undesirable changes where changes are necessary.

APPROACH: See item No. 24.

PROGRESS: 79/10 TO 80/12. A water quality monitoring network was established in June 1977 on the Upper Choptank River Watershed (Delmarva Peninsula) to compare reconstructed and unreconstructed agricultural drainage ditches. Water quality variables and benthic macroinvertebrates are sampled bimonthly. Water-table levels and soil moisture are also monitored. Statistical analysis of water quality data for the calendar years of 1978-1979-1980 is in progress. Significant differences between reconstructed and unreconstructed ditches include; increased water temperature and air temperature variations (2.5 degrees - 3.0 degrees C. water, 4 degrees - 6 degrees air); increases in pH, alkalinity (6-10 mg/l. CaCO₃), hardness (0-15 mg/l.), sulfate (70-100 mg/l.), dissolved oxygen (2-4 mg/l.) and

calcium (2-6mg/l.); decreased acidity (10-15 mg/l. CaCO₃), hardness (9-15 mg/l.) sulfate (70-100 mg/l.), dissolve oxygen (2-4 mg/l.) and calcium (2-6 mg/l.); decreased acidity (10-15 mg/l. CaCO₃), color (20-40 Pt Co Units) and turbidity (10 to 20 NTU). Analysis indicates that the relationships among variables, as well as the variables themselves are affected. Other water quality variables being monitored include residue, chloride, copper, lead, iron, nitrate, phosphate, fecal coliform, and biochemical oxygen demand. Three-year baseline data now exists on a ditch in which reconstruction activities commenced in April 1980. Post-reconstruction data will allow validation of present hypotheses.

PUBLICATIONS: 79/10 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

004.037

CRIS000920

INSECTICIDE AND NON-CHEMICAL CONTROL OF MOSQUITOES

LAKE R W; MURPHY F; ENTOMOLOGY & APPLIED ECOLOGY; UNIVERSITY OF DELAWARE, NEWARK, DELAWARE. 19711.
Proj. No.: DEI00728-A Project Type: STATE
Agency ID: SAES Period: To 01 JAN 99

OBJECTIVES: Study the effectiveness of control methods by trapping adult mosquitoes; the toxicity of insecticides to possible resistant and non-resistant mosquitoes, and to muskrats; and ditching of salt marshes as a control method.

APPROACH: Light trapping of adult mosquitoes with New Jersey light traps. Field and laboratory tests of promising insecticides. Determine resistance of pest species to insecticides with WHO test-kits. Ditching studies of standard and large (up to 15 feet wide) ditches.

PROGRESS: 80/01 TO 80/12. The following pest mosquitoes accounted for greater than 94% of the total females trapped: *Culex* spp. 48.5%, *Coquillettidia perturbans* 32.7%, *Aedes vexans* 8.3% and *A. sollicitans* 5.7%. *Anopheles crucians* complex, *A. cantator* and *Psorophora ferox* made up little more than 3% of the total. Field tests with *Bacillus thuringiensis* var *israelensis* in micro marsh pools demonstrated the efficacy of this bacterial insecticide in controlling *Culex* spp. and *A. sollicitans* larvae. Dosage rates ranged from 0.25 to 1.25 kg/ha. In most tests mortality was 98.6-100% within 48 hours at the 1.0 and 1.5 kg/ha rate. In one test only 80 and 86.7% mortality was recorded for the .25 and .50 kg/ha rate. This material appears to be effective in both fresh and saline waters. Two tests were conducted with *A. sollicitans* in water of up to 15 ppt salinity. Oviposition containers in which separate infusions of alfalfa, straw and timothy grasses were tested remained attractive to *Culex* species for approximately 10-14 days. In five separate tests straw accounted for 69.4%, alfalfa 19.0%, and timothy 11% of 3,292 egg rafts collected. Eggs reared to 4th instar were identified as a mixture of *Culex restuans* and *Culex pipiens*. Initial tests at Bombay Hook indicate that under dry or near drought conditions oviposition containers can be used as preferential sites for obtaining *Culex* sp eggs (*C. salinarius*, *C. pipiens* and *C. restuans*) when collecting in natural sites yields low populations of larvae.

PUBLICATIONS: 80/01 TO 80/12

MATHER, T.N. 1980. Small Plot Evaluations of the Toxicity of Selected Chemicals for Mosquito Control to Salt Marsh Wildlife. Master of Science Thesis. Univ. of Delaware.

004.038

CRIS0068332

PRODUCTIVITY OF THE SALINE MARSHES ON FLORIDA'S NORTH AND WEST COASTS, PHASE II

COULTAS C L; SUHRAHMANYAM C B; FLORIDA AGRIC & MECH UNIVERSITY, TALLAHASSEE, FLORIDA. 32307.

Proj. No.: FLAX-PR-0002-4232 Project Type: GRANT
Agency ID: CSFS Period: 14 JAN 75 To 13 JAN 80

OBJECTIVES: The objectives are identical to those in the 1973 project entitled "Productivity of the saline marshes on Florida's North and West Coasts," with the following additions: Measure productivity of marsh plants. Determine calorific values of marsh plants and animals.

APPROACH: In addition to the approach described in the previously cited project (1973) we will use the following: Monthly growth measurements will be made of marsh plants on different soils. The ¹⁴C technique will be used to measure production of Juncus. Plants will be harvested in 1 m² plots. An oxygen bomb calorimeter will be employed.

PROGRESS: 79/01 TO 79/12. Juncus roemerianus is the dominant salt marsh angiosperm in Northwestern Florida, and its growth and production was determined in three soil zones. Productivity of Spartina and Distichlis was also measured. Total net aerial production of Juncus decreased landward from 949 g/m²/yr in low marsh to 595 g in upper marsh and 243 g in high marsh. Production of Spartina also decreased landward from 700 g/m²/yr to 335 g to 130 g in the three zones. Height and diameter of Juncus shoots and rhizomes decreased landward. Annual mean below ground biomass was 3 to 8 times that of annual mean above ground biomass in the three zones. Decomposition of Juncus and Spartina was faster in low marsh zones, and Spartina decomposed faster. Several methods were used to estimate the primary production of these plants. Nutritive values of shoots and rhizomes of Juncus and shoots of Spartina and Distichlis, were measured for live, dead and decomposing plant parts. Carbohydrates, proteins, lipids, ash, phosphates and nitrates showed seasonal fluctuations. Calorific values were comparable for live and decomposing shoots. Zonal differences were significant in ash, crude fiber, protein, lipid and phosphorus of rhizomes, and only of ash of shoots of Juncus. Protein enrichment of detritus during decomposition was observed. The detritus appears to be totally produced within the marshes by these plants. Several soil factors were examined, such as electrical conductivity, moist pH, and cation exchange capacities.

PUBLICATIONS: 79/01 TO 79/12

KRUCZYNSKI, W.L., SUBRAHMANYAM, C.B. and DRAKE, S.H. 1978. Studies on the plant community of a North Florida salt marsh. Part I. Primary production. Bull. Mar. Sci. 28:316-334.

KRUCZYNSKI, W.L., SUBRAHMANYAM, C.B. and DRAKE, S.H. 1978. Studies on the plant community of a North Florida salt marsh. Part II. Nutritive values and decomposition. Bull. Mar. Sci. 28:707-715.

COULTAS, C.L. and GRASS, E.R. 1975. Distribution and properties of some tidal marsh soils of Apalachee Bay, Florida. Proc. Soil Sci. Amer. 39:914-918.

004.039 CRIS0070145
COMPARATIVE ECOLOGY OF SELECTED SPECIES OF AQUATIC INSECTS, PHASE IV

PETERS W L; FLORIDA AGRIC & MECH UNIVERSITY, TALLAHASSEE, FLORIDA. 32307.
Proj. No.: FLAX-PR-0001-4231 Project Type: GRANT
Agency ID: CSRS Period: 22 SEP 75 To 01 JUL 80

OBJECTIVES: Study the ecology of selected species of aquatic insects that are important in understanding the mechanisms of a natural aquatic environment, study the comparative ecology of selected aquatic insects across major climatic areas in order to characterize critical factors, conditions, and indices of the unique relationships with a natural aquatic environment, and develop biological methods based on aquatic insects to indicate, and prevent pollution in natural aquatic environments, by agriculture, industry and the general public.

APPROACH: Various species of aquatic insects will be selected for studies of ecology, life history, habits, behavior, and seasonal distribution. The Ephemeroptera (Mayflies), Chironomidae (midges) and Coleoptera (beetles) will receive initial emphasis. Relationships of the several species with their aquatic environments including pollutants will be established.

PROGRESS: 75/09 IC 80/09. During the period of this grant, research was completed on the Adult life and emergence of Dolania Americana in the Blackwater River, Florida. This research is an accumulation of 5 years' data. The environmental requirements of pollution tolerance of common freshwater chironomidae in the United States was completed and published. A total of 16 papers on Ephemeroptera, Chironomidae and Aquatic were published.

PUBLICATIONS: 75/09 TO 80/09

BECK, W. M., JR. 1977. Environmental requirements and pollution tolerance of common freshwater Chironomidae. U. S. Environmental Protection Agency, Environmental Monitoring Series, 260p.

HUBBARD, M. D. 1977. The validity of the generic name Parameletus Bengtsson (Ephemeroptera: Siphonuridae). Proc. Entomol. Soc. Wash. 79(3) : 409-410.

HUBBARD, M. D. AND CUNNINGHAM, W. G. 1977. Orientation of mounds in the ant Solenopsis invicta (Hymenoptera, Formicidae, Myrmecinae). Insectes Sociaux 24(1) : 3-7.

HUBBARD, M. D. and PETERS, W. L. 1977. Ephemeroptera. In S. B. HURLBERT, ed. Biota Acumatica de Sudamerica Austral. San Diego State University. pp. 165-169.

HUBBARD, M. D. and EDMUNDS, G. 1977. A homonymic synonym in Callibaetis (Ephemeroptera: Baetidae). J. New York Entomol. Soc. 85(2) : 55.

004.040 CRIS0075815
RELATIONSHIPS BETWEEN SALT MARSH AND ESTUARINE ANIMAL COMMUNITIES AND ENERGY EXCHANGE

SUBRAHMANYAM C B; BIOLOGY; FLORIDA AGRIC & MECH UNIVERSITY, TALLAHASSEE, FLORIDA. 32307.
Proj. No.: FLAX-PR-0002-4232-1 Project Type: GRANT
Agency ID: CSRS Period: 21 APR 78 To 20 APR 88

OBJECTIVES: Conclude the study of benthic and pelagic animals in St. Marks estuary. Assess metabolic requirements of estuarine and marsh animals. Determine caloric values of marsh and estuarine animals and plants. Initiate study of seasonal composition of estuarine and inshore plankton.

APPROACH: A benthic dredge will be used to sample a known volume of sediments, and a 14-ft balloon trawl for collecting nektonic and benthic species. The rate of oxygen uptake of young and mature specimens of invertebrates and fish will be determined in a static system in 2-hr experiments. Caloric values of dried specimens of plants, invertebrates and fish will be determined in a Parr Oxygen Bomb Calorimeter using standard procedure. A No. 3 net and a No. 20 net will be used to sample phyto- and zooplankton in the estuary and in inshore waters. After taking the settling volumes qualitative analysis of the species will be carried out in the laboratory.

PROGRESS: 77/10 TO 79/09. The study of the infaunal invertebrates and fish of St. Marks River estuary and shallow inshore was continued and completed. The soils of the same localities contained 80 to 92% sand, 2 to 13% clay, and 0.2 to 2% organic matter. The density of invertebrates was higher than in marsh, and amphipods were more abundant. Fish numbers declined from about 80-2000/catch at inshore station to 5-10/catch at river station. Black bass and spinbox fish were common in trawl samples. Estuarine fish, such as Leiostomus xanthurus, Anchoa, flounders and blue crabs and shrimps enter marshes as juveniles. The fish production was estimated at 1.68 g/m²/yr at St. Marks and 3.13 g/m²/yr at Wakulla. Fish catch in Florida amounts to 18 million dollars per hours. A Master's Thesis was developed on the economic value of salt marshes, and an estimate of 56 to 69 dollars per acre was arrived at based upon blue

crab fishery. The distribution patterns of invertebrates show that *Cyathura* is ubiquitous, certain polychaetes are restricted to either marsh zones or tidal creeks, and molluscs such as *Polymesoda* are restricted to marsh zones. Among fishes killifishes occur more abundantly in marsh creeks than in estuaries. Energy exchange between estuaries and marshes in via tidal creeks. Preliminary experiments on metabolic needs of fish species indicate that migratory fish species need basically more oxygen per gm of body weight than resident fish, and both types are metabolically dependent on external oxygen.

PUBLICATIONS: 77/10 TO 79/08

SUBRAMANYAM, C.E. 1980. The role of salt marshes in the production of fish. Florida A and M University Research Bulletin. In Press.
SUBRAMANYAM, C.E. 1980. Oxygen consumption of estuarine fish in relation to external oxygen tension. Comparative Biochemistry and Physiology. In Press.

004.041* CFIS0076759
ECOLOGICAL STUDIES IN RELATION TO ESTUARIES AND ENERGY FLOW

SUBRAMANYAM C E; BIOLOGY; FLORIDA AGRIC & MECH UNIVERSITY, TALLAHASSEE, FLORIDA. 32307.
Proj. No.: FLAX79004 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 78 To 30 SEP 83

OBJECTIVES: Study community structure and seasonal variations in marsh and estuaries; study breeding cycles of individual species; study nutritional needs of species in terms caloric intake study energy utilization of species in terms of oxygen consumption; determine the energy content of species in terms of caloric values and study activity patterns in field and laboratory to understand movements of species.

APPROACH: Collect animals with trawl, plankton nets, corer and grabs. Sort and identify species. Follow the seasonal distribution of larvae in plankton to assess breeding patterns. Conduct feeding experiments in laboratory, and evaluate food intake and assimilation. Study the oxygen consumption rates by continuous flow techniques, and determine diurnal and tidal rhythms of metabolism by 24-hr experiments. Burn the organisms in Oxygen bomb calorimeter and determine caloric values. Tag fish species in field and follow movements by recapture. Release tagged fish in enclosures and follow activity. Perform laboratory experiments.

PROGRESS: 79/08 TO 80/08. The abundance patterns of fish and invertebrates in St. Marks coastal estuarine-marsh system were summarized in a published paper. Preliminary experiments on the metabolism of estuarine fish showed that the two resident species, *Fundulus grandis* and *F. similis* consumed 0.036 - 0.047 ml(2)/gm/hr, which was lower than 0.071 - 0.112 ml(2)/gm/hr consumed by the migratory species *Leiostomus xanthurus* and *Lagodon rhomboides*. All the four species showed metabolism dependent on ambient oxygen tension in the range of 20 - 90 mmHg. Plankton collections and water quality study in St. Marks estuary and Apalachee Bay were started in April 1979 and will be completed in May 1981. Differences between surface and bottom salinity in one tidal cycle were as high as 5-8 p.p.t., but between surface and bottom oxygen (0.5-1.0 ml/l) and temperature (1-2 degrees C) were negligible. Summer temperatures were higher in contrast to salinities because of rainfall. Plankton volume varied from 5ml/tow (3 minutes) to 300 ml/tow between cool and warm months. Phytoplankton maxima were observed in fall and early winter, and zooplankton peaks in late spring and late summer. When stations are compared, Apalachee Bay stations generally showed larger volume of plankton, and mesohaline estuarine stations showed less. Crustacean larvae such as crab zoea and megalopa, penaeid postlarvae, and fish larvae were abundant from spring through fall.

PUBLICATIONS: 79/09 TO 80/08

SUBRAMANYAM, C.E. Oxygen Consumption of Estuarine Fish in Relation to External Tension. Comparative Biochemistry and Physiology 67A:129-133.
SUBRAMANYAM, C.E. Studies on the Animal Communities in Two North Florida Salt Marshes. Pt. III. Seasonal Fluctuations of Fish and Macroinvertebrates. Bulletin of Marine Science 30:790-818.

004.042 CFIS0075816
COMPARATIVE ECOLOGY OF SELECTED SPECIES OF AQUATIC INSECTS, PHASE IV

PETERS W L; ENTOMOLOGY; FLORIDA AGRIC & MECH UNIVERSITY, TALLAHASSEE, FLORIDA. 32307.
Proj. No.: FLAX-PE-0001-4231 Project Type: GRANT
Agency ID: CSFS Period: 21 APR 78 To 01 JUL 80

OBJECTIVES: Study the ecology of selected species of aquatic insects that are important in understanding the mechanisms of a natural aquatic environment, study the comparative ecology of selected aquatic insects across major climatic areas in order to characterize critical factors, conditions, and indices of the unique relationships within a natural aquatic environment, and develop biological methods based on aquatic insects to evaluate and prevent pollution in natural aquatic environments.

APPROACH: Various species of aquatic insects will be selected for studies of ecology, life history, habits, behavior, and seasonal distribution. The Ephemeroptera (Mayflies), Chironomidae (midges) and Coleoptera (beetles) will receive initial emphasis. Relationships of the several species with their aquatic environments including pollutants will be established.

PROGRESS: 80/01 TO 80/12. During this grant, the environmental requirements on pollutions tolerance and Ephemeroptera in the United States were completed and published. Ecology and taxonomy of various species were completed from Wisconsin, New Zealand, and New Caledonia. A total of 13 papers on Ephemeroptera, Chironomidae and aquatic weevils were published.

PUBLICATIONS: 80/01 TO 80/12

FLOWERS, R. W. 1978. Occurrence of *Cloeon cognatum* Stephens in the United States (Ephemeroptera, Baetidae). Entomological News 89 (2 & 3) : 79-80.
FLOWER, R. W. and HILSENBOFF, W. L. 1978. Life cycles and habitats of Wisconsin Ephemeroptera (Ephemeroptera). Hydrobiologia 60 (2) : 155-171.
HUBBARD, M. D. and PETERS, W. L. 1978. A catalogue of the Ephemeroptera of the Indian Subregion. Oriental Insects Supplement 9. 43pp.
HUBBARD, M. D. and RIEK, E. F. 1978. New name for a Triassic mayfly from South Africa (Ephemeroptera). Psyche 83(3-49) : 260-261.
HUBBARD, M. D. and PETERS, W. L. 1978. Environmental requirements and pollution tolerance of Ephemeroptera. U. S. Environmental Protection Agency (EPA-600/4-78-061), Cincinnati. vi + 461pp.

004.043 CRIS0076796
WATER QUALITY STUDIES: COMPARATIVE ECOLOGY AND SYSTEMATICS OF SELECTED AQUATIC INSECTS

PETERS W L; ENTOMOLOGY; FLORIDA AGRIC & MECH UNIVERSITY, TALLAHASSEE, FLORIDA. 32307.
Proj. No.: FLAX79009 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 78 To 30 SEP 83

OBJECTIVES: Study the systematics of mayflies, midges, and aquatic weevils when needed to use as a tool in water quality studies in the U.S., study the ecology of selected species of mayflies, midges, and aquatic weevils that are important in understanding the mechanisms of a natural aquatic environment, study the comparative ecology of selected species of mayflies, midges, and aquatic weevils across major climatic areas in order to characterize critical factors, conditions, and indices of the unique

relationships with a natural aquatic environment, and develop biological methods based on aquatic insects to indicate and prevent pollution in natural aquatic environments by agriculture, industry and the general public.

APPROACH: Various species of aquatic insects will be selected for studies of ecology, life history, habits, behavior, and seasonal distribution. The Ephemeroptera (Mayflies), Chironomidae (midges) and Coleoptera (beetles) will receive initial emphasis. Relationships of the several species with their aquatic environments including pollutants will be established.

PROGRESS: 79/10 TO 80/12. Various taxonomic and ecological studies on aquatic insects have been completed and published. These include among others: (1) a revision of the family Baetiscidae, (2) a review of the nearctic Heptagenia, (3) a comparison of mayfly instar determination methods, (4) comparative internal anatomy of larval mayflies, (5) several works on Southern Hemisphere Leptophlebiidae, (6) a revision of Homoeoneuria, (7) new chironomid records for southern U.S., (8) taxonomic composition of Chironomidae in sand bottom streams in Florida, and (9) a checklist of Hyperodes. Studies continue on: (1) limnology and species ecology of Blackwater River, (2) ecology of aquatic insects of Burnt Mill Creek, (3) ecology of Chironomidae in Turkey Creek, (4) the Chironomidae of Florida, and (5) ethology of aquatic weevils.

PUBLICATIONS: 79/10 TO 80/12

BECK JR., W.M. 1980. Interesting New Chironomid Records for the Southern United States (Diptera: Chironomidae). Journal of the Georgia Entomological Society 14(1):69-73.

BERNER, L. and PESCADOR, M.L. 1980. The Mayfly Family Baetiscidae (Ephemeroptera). Part I. In: Flannagan, J.F. and Marshall, K.E., Eds., Advances in Ephemeroptera Biology, pp. 511-524. Plenum Press, New York.

FINK, T.J. 1980. A Comparison of Mayfly (Ephemeroptera) Instar Determination Methods. In: Flannagan, J.F. and Marshall, K.E., eds., Advances in Ephemeroptera Biology, pp. 367-380. Plenum Press, New York.

FLOWERS, R.W. 1979. A New Species of Baetis from Panama (Ephemeroptera:Baetidae) Pan-Pacific Entomol. 55(3):187-191.

FLOWERS, R.W. 1980. A Review of the Nearctic Heptagenia (Heptageniidae, Ephemeroptera). In: Flannagan, J.F. and Marshall, K.E., Eds., Advances in Ephemeroptera Biology, pp. 93-102. Plenum Press, New York.

004.044 CRIS0071130
VALUE OF TIDAL MARSHES IN RELATION TO ESTUARINE ECOSYSTEM, AND EVALUATION OF FRESHWATER WETLANDS

COULTAS C L; SUBRABMANYAM C B; RURAL DEVELOPMENT CENTER; FLORIDA AGRIC & MECH UNIVERSITY, TALLAHASSEE, FLORIDA. 32307.

Proj. No.: FLAX-PR-0002-222 Project Type: GRANT
Agency ID: CSRS Period: 16 JAN 76 To 04 NOV 80

OBJECTIVES: Stabilize dredge spoil & study animal & plant colonization. Study animal communities of St. Marks River estuary. Estimate value of tidal marshes in Wakulla Co. Investigate parameters important for growth of Juncus. Characterize merits of selected freshwater wetland. Compare soil properties of marshes & upland.

APPROACH: (The methods related to objectives in the same order). Quantitative bimonthly collection of plants & animals in dredge spoil. Quantitative monthly collection of plankton, nekton & benthos from estuary. Estimation of standing crop biomass. Estimation of standing crop, collection of fish catch data. Application of fertilizers and monthly estimations of productivity of Juncus. Laboratory determination of soil characteristics. Survey of freshwater soils using standard methods and determination of soil properties. Examination of soils along transects, and estimation of soil properties.

PROGRESS: 79/01 TO 79/12. A study of the fish and invertebrate communities in St. Marks River estuary and shallow waters of Gulf of Mexico is being conducted, with a two year sampling program. An investigation of the infaunal communities of tidal creeks has been completed, and the results are being processed for a scientific paper. The colonization process in the intertidal zone of a man made dredge spoil island was completed. Cyathura polita, an isopod, has been recorded in Juncus marshes for the first time. Its density in the sediments varied between 58 and 75/m². Reproduction occurred in April, young were common in May and these produced young in following April. Males matured first, and possible protogynous hermaphroditism may exist. This is a very important forage species for young fish. A total of 29 species of polychaetes colonized the intertidal zone of the island. Densities varied from 16 to 1152/m². No correlation between substrate type and feeding preferences was noticed. Among the four stations studied, species appeared to expand their habitat from low to high tide regions over a year's time. Scoloplos and Aricidea were pioneering species. An equilibrium of number of species was not detected, and more species moved in from estuaries. This study showed that disturbed marshes may be colonized by estuarine species. A comparison with the estuarine fish species of the marsh species revealed that several commercially important species use marshes as nursery.

PUBLICATIONS: 79/01 TO 79/12

SUBRABMANYAM, C.B. and KRUCZYNSKI, W.L. 1978. Colonization of polychaetous annelids in the intertidal zone of a dredged material island in North Florida. Proc. Second Internatl. Ecol. Congr. Statistic. Ecol., Jerusalem. In Press.
COULTAS, C.L., BREITENBECK, G.A., KRUCZYNSKI, W.L. and SUBRABMANYAM, C.B. 1978. Vegetative stabilization of dredge spoil in North Florida. J. Soil and Water Conser. Jul-Aug:183-185.
COULTAS, C.L. 1976. Soils of Apalachicola National Forest wetlands. Part I. Titi swamps and savannahs. Proc. Soil and Crop Sci. Soc. Fla. 36:72-77.

004.045* CRIS0079913
THE ECOLOGICAL IMPACT OF INTEGRATED CHEMICAL AND BIOLOGICAL AQUATIC WEED CONTROL

HALLER W T; AGRONOMY; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FIA-AY-01987 Project Type: STATE
Agency ID: SAES Period: 01 AUG 79 To 31 DEC 82

OBJECTIVES: Determine the impact of chemical/biological control on the fishery environment, and ascertain the most desirable balance of vegetation versus open water that will maintain desirable water quality, fish growth and reproduction; evaluate the feasibility of combining chemical and biological weed control in a natural lake and determine costs benefit ratios.

APPROACH: Two lakes and 24 ponds will be utilized to test the above objectives, water quality, fish population, benthos, zooplankton, and phytoplankton will be analyzed in each habitat.

PROGRESS: 80/01 TO 80/12. Collection of background information was conducted on aquatic macrophytes, phytoplankton, benthos, algae and fish populations from Orange Lake (4,921 ha), Lake Pearl (23.5 ha), and in 24 0.2 ha ponds before initiation of treatment. The 24 ponds were separated into chemical, grass carp, fertilization, and control. Grass carp were stocked at a rate of 4, 8 and 16/pond and chemical treatments were applied to evaluate effectiveness for 30, 60 and 100% vegetation control. Treatment ponds supported plankton populations consisting primarily of the green algae genera Cosmarium, Scenedesmus and Tetraedron. The cladoceran genera Macrobrachium and Alona and the rotifer Keratella numerically dominated all samples. Lake Pearl was chemically treated three times during the spring and summer to reduce biomass and stocked with grass carp to study integrated control. Radio transmitters were implanted in ten grass carp and nine largemouth bass.

Although individual bass moved as an immediate response to herbicide application, percent occurrence of sightings remained evenly distributed in respect to herbicide treatment. Eighty-one percent of the grass carp were found in the treatment area prior to treatment, decreasing to 56% post-treatment. Dominant genera were the flagellated Ceratium and Chlamydomonas and the nonflagellated chlorophytes Ankistrodesmus, Staurastrum and Cosmarium. Infestation of hydrilla in Orange Lake has increased from 66 ha in 1978 to 1,240 ha in 1980.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.046* CRIS0068632
BASELINE STUDIES FOR EVALUATING THE RESPONSE OF AN ECOSYSTEM TO THE INTRODUCTION OF WHITE AMUR

EWEL K C; FOR RES & CONSERV; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-FY-01765 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 DEC 80

OBJECTIVES: Determine the forcing functions, main energy flows, and variations in the important components in an aquatic ecosystem; construct and simulate a model which will incorporate these variables and which will include the possible effects of the introduction of white amur to the ecosystem; monitor the changes that actually do take place in an ecosystem when the fish is introduced, revising the model until it is a reasonable generalization of the ecosystem.

APPROACH: Baseline ecological data will be collected by state agencies on a lake into which the white amur will be introduced in the second year of the study. Models incorporating these data will predict the effects of the fish, and these models will be verified by continued data collection.

PROGRESS: 80/01 TO 80/12. A model of Lake Conway, FL, was simulated with and without white amur present. If rates used in the model are accurate, the grazing food chain in this lake is slightly more important than the detritus food chain, and 10% of the gross primary productivity is grazed. One-quarter of the annual phosphorus input to the epilimnion comes from leaching and decay of submersed macrophytes. Simulated ranges of state variables were close to values measured in most cases. The model was stable during a simulation representing ten years. After two years, simulated addition of white amur (7000 fish, each weighting 458g) decreased submersed macrophyte biomass to 60% of its normal peak biomass. Water quality improved, gross primary productivity and community respiration decreased, and the relative importance of the grazing food chain increased. Biomass of benthic invertebrates and secondary predator fish increased. Addition of half as many fish five years after the first introduction brought about the same degree of macrophyte control, but recovery was more rapid.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.047 CRIS0067422
ECOLOGICAL STUDY OF LAKE WALES, FLORIDA AFTER INTRODUCTION OF WHITE AMUR (CIENOPHARYNGODON IDELLA)

SHIREMAN J V; FOR RES & CONSERV; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-FY-01748 Project Type: STATE
Agency ID: SAES Period: 01 JAN 75 To 31 DEC 80

OBJECTIVES: Monitor the influence of stocked white amur on water chemistry and biological organisms in Lake Wales. Establish the rate of change in these parameters.

APPROACH: Limnological survey of the lake will be conducted. This will include sampling water, benthos, zooplankton, phytoplankton, and sediment. Samples will be collected monthly.

PROGRESS: 80/01 TO 80/12. During the study period, 1977-1979, hydrilla cover increased from 48.9% during May, 1978 to 80.9% by September, 1979. Water quality determinations (chloride, sulfate, conductivity, chlorophyll a and turbidity) did not display seasonal differences. Calcium, magnesium, total iron, potassium, nitrate, nitrogen and ammonia levels fluctuated seasonally exhibiting negative correlations with the amount of hydrilla. Sodium, orthophosphate and total phosphate levels did not exhibit seasonal and chronological changes. Phytoplankton populations can be described by the following generalizations: seasonal periodicity was constant from year to year; seasonal changes were repetitive from year to year on a short-term basis; and seasonal changes in frequency and concentrations were minimal. Zooplankton populations exhibited seasonal differences and as hydrilla abundance increased greater numbers of littoral species were encountered. Benthic organisms exhibited significant seasonal changes, however, these changes were minimal. Generally, benthic numbers decreased as hydrilla increased. Previous studies have shown that hydrilla supports organisms that are normally found in the benthic community. Bluegill, redear sunfish and largemouth bass condition factors changed little during the study. It is doubtful that the hydrilla infestation during this study was sufficient to cause severe changes in conditions. Grass carp growth rates were good from 1974-1978.

PUBLICATIONS: 80/01 TO 80/12
MARTIN, R.G. and SHIREMAN, J.V. 1976. A Quantitative Sampling Method for Hydrilla-inhabiting Macroinvertebrates. J. Aquatic Plant Manage 14:16-19.
SHIREMAN, J.V. and MARTIN, R.G. 1978. Seasonal and Diurnal Zooplankton Investigations of a South Central Florida Lake. Florida Scientist 41:193-201.
DURANT, D.R., SHIREMAN, J.V. and GASAWAY, R.D. Reproduction, Growth and Food Habits of Seminole Killifish, Fundulus seminolis, from Two Central Florida Lakes. Amer. Midland Nat. pp. 127-133.
SHIREMAN, J.V., COLLE, D.E. and MACEINA, M.J. 1980. Grass Carp Growth Rates in Lake Wales, Florida. Aquaculture 19:379-382.
COLLE, D.E. and SHIREMAN, J.V. 1980. Coefficients of Condition for Largemouth Bass, Bluegill, and Redear Sunfish in Hydrilla Infested Lakes. Trans. Amer. Fish. Soc. 109:521-531.

004.048 CRIS0079914
THE ECOLOGICAL IMPACT OF INTEGRATED CHEMICAL AND BIOLOGICAL AQUATIC WEED CONTROL

SHIREMAN J V; SCHOOL OF FOREST RESOURCES; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-FY-01987 Project Type: STATE
Agency ID: SAES Period: 01 AUG 78 To 31 DEC 82

OBJECTIVES: Determine the impact of chemical/biological control on the fishery environment, and to ascertain the most desirable balance of vegetation versus open water that will maintain desirable water quality, fish growth and reproduction. Evaluate the feasibility of combining chemical and biological weed control in a natural lake and determine cost benefit ratios. Determine the effects of dense submersed aquatic weed growth on the recreational utilization, fish production and water quality of shallow inland Florida lakes.

APPROACH: Two lakes and 24 ponds will be utilized to test the above objectives, water quality, fish population, benthos, zooplankton, and phytoplankton will be analyzed in each habitat.

004.049* CRIS0080007
ENVIRONMENTAL IMPACT AND WEED MANAGEMENT STRATEGIES UTILIZING GRASS CARP (CIENOPHARYNGODON IDELLA)

SHIFEMAN J V; SCHOOL OF FOREST RESOURCES; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-FY-01986 Project Type: STATE
Agency ID: SAES Period: 24 JUL 79 To 31 OCT 81

OBJECTIVES: Impact assessment of grass carp on the Lake Wales ecosystem. Determine management strategies for vegetation control utilizing grass carp. Develop methods for selective removal of grass carp from Lake Wales.

APPROACH: Standard field and laboratory methods will be utilized. See attached proposal.

004.050 CRIS0012468
RELATIONSHIPS BETWEEN PESTICIDES AND GEORGIA FARM POND ECOSYSTEMS

REINERT R E; FOREST RESOURCES; UNIVERSITY OF GEORGIA, ATHENS, GEORGIA. 30602.
Proj. No.: GE000392 Project Type: HATCH
Agency ID: CSRS Period: 04 FEB 66 To 30 SEP 81

OBJECTIVES: Design and construct an automatic intermittent flow proportional diluter system capable of simultaneously delivering to test aquaria three different concentrations of each of two contaminants and all possible cross combinations. Determine the rates and sites of accumulation and the physiological effects of different combination and concentrations of methyl parathion and toxaphene on the bluegill.

APPROACH: With the use of the diluter system different groups of bluegill will be exposed to various combinations and concentrations of methyl parathion and toxaphene. Some groups of bluegill will be exposed to the insecticides for short term (56 hr) acute toxicity tests; others will be exposed for periods of 6 weeks to determine uptake rates, principal sites of storage, and long term effects on such parameters as growth, behavior, and mixed function oxidase activity.

PROGRESS: 76/06 TO 81/09. During the past 5 years the following studies have been done under this research project. A study which concerned the design of a proportional diluter to deliver combinations of contaminants to fish, and the use of this diluter to assess the effects of various combinations of concentrations of toxaphene and methyl parathion on bluegill. Two studies concerning the applicability of using gill histology as an "early warning" technique for assessing the effects of contaminants of farm pond fishes; a study that concerned the design and use of a small heart rate transmitter to measure heart rate as a physiological indicator of stress; a study of the capacity of farm pond fishes to acclimate to changes in pH in the laboratory and the field; a study concerning the use of adenylate energy charge as a measure of stress in farm pond fishes; a study of the odd-even food chain concept using algae, Daphnia, and fathead minnows. Because of the replacement of most of the insecticides that have been demonstrated to be harmful to fishes with less harmful materials we are terminating this project as of 9/30/81. However, because of the increasing threat of contaminants other than insecticides to farm pond fishes, we have initiated a new Hatch project entitled "Effects of Environmental Contaminants on Georgia Farm Pond Fishes".

PUBLICATIONS: 76/06 TO 81/09

- HOHREITER, D.W. and R.E. REINERT. 1980. Adenylate Energy Charge as an Indicator of Stress in Fish. (Abstract) American Fisheries Society 110th Annual Meeting, Louisville, KY.
STRINGER, G.I. 1979. The effects of an anionic detergent on the gill tissue morphology of sheepshead minnows, *Cyprinodon variegatus*. (Abstract) Annual Meeting of the Southeastern Electron Microscope Society, Athens, GA. 1979.
CULBERTSON, J.C. 1979. Electron microscope observations of the gills of weakfish, *Cynoscion regalis* and spot, *Leiostomus xanthurus*. (Abstract) Annual Meeting of the Southeastern Electron Microscope Society, Athens, GA. 1979.

MUDRE, J.W. 1979. Some effects of surgical implantation of transmitters on the physiology and behavior of channel catfish.

004.051 CRIS0083648
EFFECTS OF ENVIRONMENTAL CONTAMINANTS ON GEORGIA FARM POND FISHES

REINERT R E; SRODE J; FOREST RESOURCES; UNIVERSITY OF GEORGIA, ATHENS, GEORGIA. 30602.
Proj. No.: GEC00738 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 81 To 31 JAN 84

OBJECTIVES: Refine an adenylate (ATP, ADP, AMP) assay procedure for determining energy charge (ATP + 1/2 ADP divided by ATP + ADP + AMP) in farm pond fishes; Test the applicability of energy charge as a sensitive indicator of stress caused by various contaminants and water quality parameters associated with agricultural and forestry practices; Determine the capacity of farm pond fishes to acclimate to changes in pH.

APPROACH: In our Whitehall Laboratory energy charge values will be determined for fishes that are stressed by handling, by changes in temperature and dissolved oxygen, and by exposure to sublethal concentrations of insecticides and herbicides. Fishes will be tested using static and flow-through bioassay tests; Fish from low and neutral pH environments will be tested by first exposing them to a series of pHs and then transferring them directly to aquaria adjusted to low pH levels. For each acclimation group, median resistance time determined by probit transformation will be plotted against pH.

004.052 CRIS0077715
OYSTER PRODUCTION EQUIPMENT DEVELOPMENT

WANG J K; AGRI ENGINEERING; UNIVERSITY OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW00528-S Project Type: STATE
Agency ID: SAES Period: 01 JAN 79 To 30 SEP 81

OBJECTIVES: Develop a system for flushing and cleaning stacked oyster trays of pseudofeces; ideally without breaking open the stacks.

APPROACH: In depth review of literature covering applicable methods and technology. Determine physical and hydraulic properties of oyster at different stages of growth. Design and testing of prototype equipment.

PROGRESS: 80/01 TO 80/12. A prototype oyster cleaning and sorting equipment was designed and constructed. Preliminary tests were conducted on the mechanical oyster cleaner by varying the oyster feed rate, water flow rate, and water pressure. It was found that the oyster cleaner provides satisfactory cleaning for oysters of length greater than 2.5 cm (1 inch). It can clean 250 marketable oysters per minute (about 30 bushels per hour or 680 kg per hour). A water flow rate of greater than 1.58 L/s (25 GPM) and a water pressure of 103 kPa (15 psi) are required. It was found that a 6-inch diameter by 50-foot long parallel rollers can effectively size artificially grown oysters. The prototype sizer can size oysters satisfactorily at a feed rate of 200 marketable oysters per minute (about 24 bushels per hour or 540 kg per hour) at a roller inclination of 175 rad (10 degrees).

PUBLICATIONS: 80/01 TO 80/12

- WANG, J.K. and YCW, K.W. 1980. Analysis of Oyster Production in Hawaii. Paper Presented at the ASAE Summer Meeting, San Antonio, TX. ASAE Paper 80-5047.
YOW, K.V. and WANG, K.J. 1980. Mechanical Cleaning and Sorting of Hawaiian Cultured Oysters. Paper Presented at the ASAE Winter Meeting, Chicago, IL. ASAE Paper 80-6502.

004.053 CRIS0081904
AQUACULTURAL WASTEWATER MANAGEMENT AND UTILIZATION IN
HAWAII

YANG P Y; AGRI ENGINEERING; UNIVERSITY OF HAWAII,
HONOLULU, HAWAII. 96822.
Proj. No.: BAW00531-S Project Type: STATE
Agency ID: SAES Period: 01 MAR 80 To 30 SEP 82

OBJECTIVES: Characterize effluent quality (organics and inorganics) of aquacultural pond; determine the role of oxygen demand in the water column of the pond; explore the appropriate control of oxygen concentration in the pond; explore the appropriate treatment alternatives in order to control water quality and water reuse of pond effluent.

APPROACH: Establishment of data collection plan, sample collection and analysis of wastewater characterization. Conduct oxygen demand study in the field and laboratory and establishment of the relationship between oxygen consumption rate and available oxygen demand material in the pond. Search available techniques and develop new ways to control oxygen level in the pond. Conduct laboratory and pilot plant study on the treatment alternative for water quality control and water reuse of pond effluent.

PROGRESS: 80/03 TO 80/12. Investigations were conducted into the qualitative and quantitative nature of the water column oxygen demand of prawn (*Macrobrachium rosenbergii*) grow-out ponds. It was found that the water column oxygen demand represented between 48 to 87% of the total pond oxygen loss at night. A good correlation existed between the oxygen uptake rate and the total COD, particulate COD, suspended solids, volatile suspended solids and secchi disk depth measurements of the water column. Water quality management guidelines and procedures regarding oxygen demand in the pond were developed. This will provide a more positive control of the causes of oxygen depletion in the prawn production ponds and reduce the damage of cost of prawn production. Characterization of effluent quality (organics and inorganics) of aquacultural pond and the appropriate treatment alternatives for controlling water quality and water reuse of pond effluent are under investigation.

PUBLICATIONS: 80/03 TO 80/12

LCSC&DC, T.M. 1980. An Investigation of the oxygen Demand Materials of the Water Column in Prawn Grow-out Ponds. M.S. Thesis, Univ. of Hawaii, Honolulu, 100 pp.

004.054 CRIS0082666
EXAMINATION OF THE SPAWNING ECOLOGY AND EARLY LIFE
HISTORY OF KOKANEE SALMON IN COEUR D'ALENE LAKE

BENNETT D; FOREST WILDLIFE & RANGE EXP ST; UNIVERSITY
OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0073 Project Type: STATE
Agency ID: OCI Period: 01 JUN 79 To 30 MAY 81

OBJECTIVES: Examine the ecology of shoreline spawning kokanee in Coeur d'Alene Lake and where needed, supplement this work with observations in Priest and Pend Oreille Lakes; examine spawning success, fry growth and mortality of shoreline spawning kokanee; evaluate behavior and recruitment of young-of-the-year shoreline spawning kokanee.

APPROACH: Underwater diving and surface examination of suspected spawning areas will be conducted during the spawning period to obtain data on timing and physical characteristics of the habitat. Fertilized embryos will be placed in hatching boxes to assess spawning success. Fry traps will be positioned over known embryo concentrations to quantify fry emergence. Trawling will be conducted to evaluate concentrations of fry and timing and period of recruitment of pelagic waters.

PROGRESS: 80/01 TO 80/12. Trawling for juvenile kokanee in Coeur d'Alene Lake suggested that the majority of spawning activity was occurring in the northeast part of the lake. Preliminary data

indicated that recruitment to pelagic waters occurred shortly after emergence; emergence occurred over a prolonged period of time from late spring to early summer. Data also suggested significant higher growth rates in juvenile fish from Coeur d'Alene Lake as compared to Pend Oreille Lake. Observations of spawning ecology revealed that kokanee were spawning at significant depths (15 m) along rip-rapped shorelines in Coeur d'Alene Lake. Natural spawning occurred over a large, irregular gravel substrate and that some fish were not constructing well defined redds as reported previously for this species. Embryos planted in Whitlock-Vihert boxes demonstrated that hatching and emergence success was highest over man-altered fill areas. Emergence success in "natural" areas was considered low. Daily growth estimates are being made by examination of otoliths which should provide additional information on abundance and survival of juvenile kokanee.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.055 CRIS0082655
JUVENILE EMIGRATION OF LAHONTAN CUTTHROAT TROUT IN
THE TRUCKEE-PYRAMID LAKE SYSTEM

BENNETT D; BJCENN I C; FOREST WILDLIFE & RANGE EXP
ST; UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0062 Project Type: STATE
Agency ID: OCI Period: 01 CCT 78 To 30 SEP 80

OBJECTIVES: Develop a comprehensive bibliography on timing and factors affecting salmonid fish emigration with particular reference to cutthroat trout; determine the timing and factors related to juvenile Lahontan cutthroat trout (*Salmo clarki henshawi*) emigration in the Truckee River basin and determine the impact of predators on plants of juvenile Lahontan cutthroat trout.

APPROACH: Juvenile cutthroat trout have been introduced in natural and artificial stream channels at different densities under normal levels of predation and no predation and their movements monitored daily through the use of traps. Observations are being made on fish distribution, critical habitat and response to varying environmental conditions.

PROGRESS: 80/01 TO 80/12. Lahontan cutthroat trout fry were planted in artificial and natural stream channels at 1, 5 and 10 fish/m² to evaluate factors affecting the timing of migration and population responses to high densities. Fish were planted in early July 1978 and 1980 and traps were maintained into November when freezing temperatures precluded further trapping. Emigration of fry were correlated with increased discharges. Cutthroat trout were found to emigrate from the natural stream channel nearly every month of the year with greatest movement in the spring. Predation by resident brown, brook and rainbow trout was found to significantly affect the density of cutthroat juveniles in the stream channels. Densities of less than 1 fish/2 m² were common in predator free channels and about half this number in channels with predators.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.056 CRIS0082656
EFFECT OF PEAKING POWER GENERATION ON FISH

BENNETT D; WHITE R G; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0063 Project Type: STATE
Agency ID: OCI Period: 23 FEB 79 To 28 FEB 81

OBJECTIVES: Assess the status of the warmwater fishery and determine the potential of improving warmwater fish habitat in lower Snake River reservoirs for the Snake River compensation plan. Subobjective: Assess angler use and fishery characteristics in the lower Snake reservoirs aerial and ground surveys will be employed. anglers will be

interviewed to assess their attitudes and preferences.

APPROACH: Resident fishes will be collected by various appropriate techniques to assess species composition, relative abundance and habitat associations. Some of the collected fish are dissected to obtain information on the ecology of selected species while other fish are released with individually numbered tags for later identification if recaptured by sports fishermen or by researchers. Data interpretation and recommendations will be made regarding the potential of improving warmwater fish habitat in lower Snake reservoirs.

PROGRESS: 80/01 TO 80/12. Preliminary results of fish collections and assessing angler use in lower Snake reservoirs has revealed a significantly sports fishery for several species of introduced warmwater fish. The period from March-May received the most intense fishing pressure. Angling success was highly variable but averaged 0.5 fish/hour. Twenty-five species of fish representing 9 families were collected in lower Snake reservoirs. Largescale suckers were the most abundant species followed by northern squawfish, bridgelip sucker, white crappie, yellow perch and carp. A few differences in species composition were found among five representative habitat types in Little Goose Reservoir. Water level fluctuations of 1.5 m were found to expose spawning nests and expose embryos to desiccation of shoreline spawning fishes. Data analysis is continuing to further assess the status of the warmwater fishery in the lower Snake reservoirs. Crayfish was the dominant forage species for predator species while crappies fed primarily upon zooplankton. Channel catfish and smallmouth bass were the two predatory resident species which consumed anadromous salmonid smolts during the spring emigration of smolts from the Snake River.

PUBLICATIONS: 80/01 TO 80/12

BENNETT, D.H., BRATOVICH, P.M., HANSEL, H., KNOX, W. and PALMER, D. 1980. Status of the Warmwater Fishery and the Potential of Improving Warmwater Fish Habitat in the Lower Snake Reservoirs. Annual Rept. U.S. Army Corps of

004.057* CFIS0069627
CARRYING CAPACITY OF STREAMS FOR BEARING SALMONIDS AS AFFECTED BY SEDIMENT & OTHER COMPONENTS

BJORNEN T C; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0031 Project Type: STATE
Agency ID: OCI Period: 01 JUN 74 TO 30 SEP 78

OBJECTIVES: Assess the density (#/m²) of juvenile anadromous salmonids in selected forest streams of central Idaho; relate stream morphometry, cover, temperature, insect drift, numbers of cohabiting fish species, seeding rate (stock recruitment), and fish growth to numbers of juvenile anadromous salmonids; determine effects of a point influx of sediment on fish density; evaluate the usefulness of fall weir counts in determination of fish abundance.

APPROACH: Artificial channels will be employed in assessing the effect of seeding rate on salmonid abundance. Estimation of stream variables and fish abundance and growth will be made on Marsh Creek, Cape Horn Creek, Knapp Creek and Middle Fork on the Salmon River. Models for explaining fish abundance will be formulated and tested.

PROGRESS: 80/01 TO 80/12. During 1974, 1975, and 1976, we sampled Beaver, Cape Horn, Elk, Knapp and Marsh Creeks in the Central Idaho batholith and conducted experiments in artificial stream channels at Hayden Creek Research Station, Idaho, to determine their carrying capacity for rearing juvenile spring chinook salmon (*Oncorhynchus tshawytscha*) and related factors. We utilized a transect method to measure stream physical parameters, snorkeling gear to facilitate counting of fish, fish weirs to enumerate pre-smolt chinook migrating downstream, and 30 m³ of granitic sand dumped into Knapp Creek to assess sediment effects on fish abundance. We released

Juvenile chinook from Rapid River Hatchery into Cape Horn, Knapp, and Marsh creeks after various treatments of predator and resident chinook population removal to help define carrying capacity. We also placed chinook population removal to help define carrying capacity. We also placed chinook fry into artificial stream channels to help assess the effects of weeding rate (egg deposition or juvenile plants) and water temperature on fish abundance. Numerical and biomass densities of age 0 chinook salmon in stream sites averaged 0.42 fish/m² and 1.51 g/m². The maximum average densities observed in naturally seeded streams were 0.48 fish/m² and 2.29 g/m², compared to 1.38 fish/m² and 5.42 g/m² in sites of Cape Horn Creek, where I stocked juvenile chinook salmon.

PUBLICATIONS: 80/01 TO 80/12

SEKULICH, P.T. 1980. The Carrying Capacity of Infertile Forest Streams for Rearing Juvenile Chinook Salmon. University of Idaho. Ph.D. Dissertation, 156 pp.

SEKULICH, P.T. and BJORNEN, T.C. 1977. The Carrying Capacity of Streams for Rearing Salmonids as Affected by Components of the Habitat. Completion Report to Memo of Understanding No. 12-11-204-11 to U.S. Forest Service, 79 pp.

004.058* CRIS0082659
WILD VERSUS HATCHERY TROUT

BJORNEN T C; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0066 Project Type: STATE
Agency ID: OCI Period: 01 JAN 79 TO 30 JUN 81

OBJECTIVES: Determine effect of stocking catchable-size trout on the abundance of wild trout. Investigate competition and survival under predation of wild and hatchery fry, over-winter survival and behavior and length of hatchery experience required to alter fry behavior.

APPROACH: Plants of rainbow trout will be made for 2 years into several sections of a stream and wild trout abundance and movement will be assessed. Short-term abundance and behavior of wild and hatchery trout will be observed in a second stream. Experiments with fry will be conducted in artificial stream channels.

PROGRESS: 80/01 TO 80/12. For the past two years we have been studying interactions of wild and hatchery trout in two Idaho streams; the infertile St. Joe River and the productive Big Springs Creek, tributary to the Lemhi River. To date, we have found no evidence that single plants of hatchery-reared, catchable-size rainbow trout displace wild resident trout. Study of effects of repeated plants is in progress. Behavioral differences of wild and hatchery rainbow trout are being studied in experimental stream channels.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.059 CRIS0082660
EFFECTS OF CHRONIC TURBIDITY ON SOCIAL COMBUST IN JUVENILE STEELHEAD TROUT AND COHO SALMON

BJORNEN T C; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0067 Project Type: STATE
Agency ID: OCI Period: 08 FEB 78 TO 30 MAY 80

OBJECTIVES: Determine if chronic turbidity interferes with feeding of age 0 steelhead and coho salmon, if turbidity does interfere with feeding, then determine if interference with feeding reduces growth of age 0 steelhead trout and coho salmon, if growth is reduced, determine if age 0 fish from turbid water streams are less able to secure and defend territories and otherwise compete in downstream rearing areas.

APPROACH: We conducted tests at two facilities using fireclay and bentonite clay to generate turbidities in the 22-200 NTU range. We subjected steelhead trout and coho salmon alevins to varying levels of turbidity (contrasted with clear water control) and monitored growth differences based on total length and weight changes. We also calculated daily weight and length changes. After a period of growth, we marked one of the two groups of fish and combined all survivors in a single clear water test unit to determine the effect of rearing in turbid water on social contest ability. Numbers of out migrants of both turbid and clear water reared fish were recorded in both test phases.

PROGRESS: 80/01 TO 80/12. Many small, intermittent West Coast streams are important spawning grounds for species of anadromous salmonids. Chronic turbidity in these streams during fry emergence and rearing period could affect the numbers and quality of fry emigrating from these streams. Laboratory tests were conducted in three facilities over a two-year period to determine the effect of chronic turbidity on feeding, growth and social interactions of steelhead trout (*Salmo gairdneri* Richardson) and coho salmon (*Oncorhynchus kisutch* Walbaum). Differences in feeding capability and growth between fish reared in clear water (zero turbidity) and fish reared in varying levels of clay generated turbidity were indirectly assessed by measuring differences in the size related variables of condition factor, ending weight and length and mean daily weight and length increases. The two groups of fish were compared for each series of tests. Differences in the effects of the two types of rearing environment were also assessed by counting the numbers of emigrants from the clear and turbid water test units. Differences between the two groups of fish with respect to competitive ability were assessed by combining survivors of the growth phase from both clear and turbid water channels and counting the percentages of clear and turbid water reared fish that emigrated after agonistic encounters had occurred. Fish reared in clear water were notably larger and increased more rapidly in both weight and length than fish reared in turbid water.

PUBLICATIONS: 80/01 TO 80/12

SIGLER, J.W. 1980. Effects of Chronic Turbidity on Feeding, Growth and Social Behavior of Steelhead Trout and Coho Salmon. Ph.D. Dissertation. University of Idaho. 158 pp.

SIGLER, J.W. and BJORNEN, T.C. 1980. Effects of Chronic Turbidity on Feeding, Growth and Social Behavior of Steelhead Trout and Coho Salmon. Final Report for Memorandum of Agreement 12-11-204-11, Supplement No. 75. College of

004.060 CRIS0082661
A STUDY OF FISH RESOURCES OF THE GOSPEL HUMP AREA

BJORNEN T C; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0068 Project Type: STATE
Agency ID: OCI Period: 05 APR 79 To 30 SEP 82

OBJECTIVES: What quantity and quality of habitat is available to resident and anadromous fish in Gospel-Hump area study streams? What species of resident and anadromous fish are present, what types of habitat are they using and what are their present and potential densities in various habitat types in Gospel-Hump area streams? What is the potential yield of resident and anadromous fish from Gospel-Hump area streams? What differences are there in fish abundance and habitat quality between undisturbed Gospel-Hump drainages compared to nearby drainages compared to nearby drainages with logging and roading activities similar to those proposed.

APPROACH: Streams will be stratified into five habitat types (pool, riffle, run, pocketwater, backwater) and fish densities will be observed via snorkeling in each habitat type. Ten sites per km of stream length will be selected randomly. Habitat typing and relative habitat quality will be based on measurements (depth, width, surface velocity, substrate composition, instream and riparian cover)

taken across a habitat transect (stream profile) at each site. An entire stream section will be photographed with large-scale (1:3000) color aerial photography to aid in measuring total surface area. Estimates of total fish numbers will be calculated from observed fish densities and total areas for each habitat type.

PROGRESS: 80/01 TO 80/12. During the past year we initiated research to quantify the present and potential fish populations (both resident and anadromous species) in three undeveloped and three developed watersheds. This research will provide information for a model which will predict the effects of forest management activities on the fishery resource. We have identified five habitat types (pool, riffle, run, pocketwater, and backwater), observed fish densities (fish/m²) via snorkeling in each habitat type to quantify and qualify available habitat, and will estimate total numbers of fish for each stream section. One of our study streams was photographed using large-scale (1:3000) color aerial photography techniques to measure total surface area. Fish migrations, movements, and habitat use will be monitored for 3 years. We will quantify changes in aquatic habitat, and utilize a sediment routing model to predict changes in fish populations resulting from various forest management activities.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.061 CRIS0084234
COEUR D'ALENE RIVER FISHERIES INVESTIGATIONS

BJORNEN T C; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0074 Project Type: STATE
Agency ID: OCI Period: 01 JUL 80 To 30 JUN 82

OBJECTIVES: Evaluate the status and stability of the fish populations in the Coeur d'Alene River. Identify factors which may limit the successful use of special regulations to maintain or restore west slope cutthroat trout populations. Make management recommendations based upon prior knowledge and data gathered from this study.

APPROACH: Conduct creel census to obtain estimates of harvest, effort, angling trends, angler satisfaction, regulation compliance, etc. Use direct underwater census on a continuous basis to monitor relative changes in abundance and gross movement patterns. Use weirs, tags and specific observation to monitor movements and other behavior.

PROGRESS: 80/01 TO 80/12. The increasing interest to maintain native wild trout populations has created new challenges in sport fishery management. The immediate and most popular solution has been to restrict the methods of angling. Most initial studies reveal that such special regulations successfully reduce total mortality due to reduction in angling mortality. Consequently, restrictive angling regulations are becoming widespread as a management tool to maintain or salvage depleted stocks. More recent evidence, however, suggests that special restrictive regulations may not have the universal effect anticipated. Preliminary investigation of the Coeur d'Alene River stocks suggests a failure in the use of special regulations to restore the depleted cutthroat trout population. Major emphasis of this study is to identify factors which may be limiting the success of special regulations as an effective management tool. Possible sociological in addition to biological constraints are being investigated.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.062 CRIS0084235
EFFECTS OF ADDITIONAL PEAKING FROM A FOURTH GENERATOR AT DWORSHAK DAM IN CATCHABILITY, ETC.

EJORN T C; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0075 Project Type: STATE
Agency ID: OCI Period: 01 JUL 80 To 30 JUN 81

OBJECTIVES: To assess the effects of peaking flows and ramp rate on fish movements and distribution, suitability of the river for fishing, and catchability of steelhead in the Clearwater River.

APPROACH: Flows and flow changes simulating those from an additional generator at Dworshak Dam were scheduled during the fall and winter of 1980-81. Fish movements were traced with radio tags and census was used to monitor angler use and success rates.

PROGRESS: 80/01 TO 80/12. The Corps of Engineers is proposing an additional generator to be used for power peaking at Dworshak Dam. The addition of a fourth generator would increase daily discharges during peaking operations from the present 10-11,000 cfs to 16-17,000 cfs. The objective of this study is to evaluate the effect of daily peaking on steelhead trout behavior and steelhead trout fishermen. Radio transmitters were implanted in 17 steelhead during September, 1980 with additional transmitters implanted during the fall and winter. These fish will be monitored to evaluate their behavior during different peaking regimes. A special creel census (with hired anglers) will be conducted to evaluate fish catchability during both peaking flows. We will also determine the effects of the daily timing of the peak flows and daily rate of change in flows to see what conditions might provide the best fishing. Active research in progress.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.063 CRIS0084236
SPAWNING, EARLY LIFE HISTORY, HABITAT SELECTION OF
NORTHERN SQUAWFISH: INFER. TO COLORADO SQUAWFISH

EJORN T C; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0076 Project Type: STATE
Agency ID: OCI Period: 15 APR 80 To 30 SEP 81

OBJECTIVES: To describe for northern squawfish (*Ptychocheilus oregonensis*): spawning biology including seasonal and daily timing, characteristics of preferred spawning sites, spawning behavior, age structure and gonadal development patterns; early life history including food habits, daily activity patterns and monthly growth rates; habitat selection, daily activity and seasonal movement patterns.

APPROACH: Most of the project involves faceplate observations and river mapping. In addition, adults are gill netted to ascertain movements and spawning population characteristics and young are seined for food habit examination. Results are compared between fish from the St. Joe River between St. Joe City and Avery and the Clearwater River below Lenore. Other river sections are sometimes included.

PROGRESS: 80/01 TO 80/12. Selected aspects of the life history and behavior of northern squawfish (*Ptychocheilus oregonensis*) were studied in populations in the St. Maries, St. Joe and Clearwater Rivers of north Idaho during 1980 in the first half of a two-year study. Large schools of spawning fish were located and spawning behavior was described in detail. Spawning sites were described and compared and size, age and gonadal development patterns in the spawning populations were also examined. Development of young-of-the-year squawfish was monitored for one year and growth rates were determined. Food habits were examined in detail at intervals until one year of age. Habitats selected by all sizes of northern squawfish in the lower fastwater area of the St. Joe River during summer low flows were described and compared.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

004.064* CRIS0084239
HABITAT SELECTION AND SPECIES INTERACTIONS OF
JUVENILE TROUT IN FLATHEAD RIVER TRIBUTARIES

EJORN T C; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0079 Project Type: STATE
Agency ID: OCI Period: 01 MAY 80 To 30 JUN 82

OBJECTIVES: Determine habitat utilized by juvenile bull trout and cutthroat trout. Evaluate species interactions between juvenile bull trout and cutthroat trout.

APPROACH: Utilized habitat will be quantified at 2 levels, macro and micro. Macro refers to the habitat unit, pool riffle or run, that juvenile fish are using. Micro refers to the exact location within the habitat unit an individual fish has chosen. Habitat units will be examined in large and small streams. Allopatric and sympatric situations will be sought.

PROGRESS: 80/01 TO 80/12. Migratory populations of cutthroat and bull trout utilize the upper portion of the Flathead River drainage for spawning and rearing. Many of the major tributaries to the upper forks of the river drain National Forest or British Columbia forest lands. These public lands are being investigated for coal, oil, and gas development. The potential impacts of these developments on the adjacent waters and ensuing effects on the Flathead fishery is of concern to the Montana Dept. of Fish, Wildlife and Parks. Although habitat assessments, fish distribution and fish abundance data is available, the question of habitat selection remains unclear. The study is being conducted to better define the habitat selection of cutthroat and bull trout. Study has not been completed nor has data been compiled and processed.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.065 CRIS0084241
DEVELOPMENT AND VALIDATION OF HABITAT-STANDING CROP
FUNCTIONS FOR STREAM FISH AND THEIR FOODS

EJORN T C; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0081 Project Type: STATE
Agency ID: OCI Period: 01 OCT 79 To 30 MAR 83

OBJECTIVES: The current objective of the fisheries portion of the study is to incorporate instream cover density into our emerging habitat-standing crop function in an effort to quantify the way it modifies the carrying capacity of streams undergoing progressive dewatering. Determine impact of reduced flow on aquatic insects, especially the dewatered zone.

APPROACH: Our approach is the stocking/emigration technique, with experimental (progressively dewatered) and control channels (constant flow) each containing subsections with varying densities of instream cover. Following pre-planned series of flow reductions, subsections are isolated with block nets and electrofished to determine fish distribution. Sample before and after flow reduction.

PROGRESS: 80/01 TO 80/12. Three reduced stream discharge experiments were completed during 1980. These experiments were carried out at the Troy Instream Flow Research Facilities in Wallowa County, Oregon. The experiments were conducted to supplement information on the base line response of fish and aquatic macroinvertebrates to reduced stream discharge. This information will be used to develop habitat-standing crop functions, which will enable prediction of the reduced stream discharge response of fish and macroinvertebrates in reconstructed experimental channels at the Troy facilities. The reconstruction of the channels was completed by December 1980, and consisted of a change in the

channel configuration that was predicted to result in maximal change in those habitat parameters most closely associated with the aquatic organisms response to reduced stream discharge.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.066 CRIS0077917
LIMNOLOGICAL PARAMETERS

FALTER C M; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0059 Project Type: STATE
Agency ID: OCI Period: 01 MAY 77 TO 01 MAY 80

OBJECTIVES: Assess the effect of low pool levels on selected limnological parameters. Temperature, dissolved oxygen, hydrogen sulfide, transparency, algal nutrients, algae and primary production in Dworshak Reservoir during the drought summer of 1977.

APPROACH: Compare limnological data from low runoff, drought year to limnological conditions from 1972-75. The draw-down reservoir was sampled monthly from May through November 1977 at both inshore and mid-channel sites.

PROGRESS: 80/01 TO 80/12. Prominent limnological features of Dworshak Reservoir, a 200 meter deep oligotrophic impoundment in North Idaho were investigated in 1977, an extreme low flow year. Average reservoir retention time of 304 days increased to 634 days in water year 1977. Despite the high retention time, water quality and production characteristics of the reservoir were still determined primarily by influent quality and ambient temperatures. Minimum oxygen levels were 35% saturation at 200 m. Epilimnial temperatures through the Summer of 1977 were 22-24 C but low nutrient loading limited algal and zooplankton production to oligo-mesotrophic levels.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.067 CRIS0084244
SPOKANE RIVER LIMNOLOGY

FALTER C M; MITCHELL B D; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0084 Project Type: STATE
Agency ID: OCI Period: 01 FEB 80 TO 31 JUL 81

OBJECTIVES: To determine the composition of the aquatic communities of the Spokane River (the 12-mile long outlet arm of Coeur d'Alene Lake) in north Idaho in response to upstream metals loading and sewage discharges to the study reach.

APPROACH: Parameters studied include phytoplankton growth in relation to nutrient addition and metals chelation, sediment composition and macrophyte distribution. Phytoplankton abundance was severely limited in Lake Coeur d'Alene outlet waters by high ambient concentrations of zinc and other heavy metals in the water column. Such inhibition has apparently been in effect since the initiation of sulfide ore mining in the watershed nearly 100 years ago. Experimental algal yields were 48% to 88% below predicted yields based on nutrient concentrations alone. Treatment with sodium salt of EDTA permitted higher algal response and showed the waters to be mesotrophic and primarily phosphorus-limited. Zooplankton and benthos communities in the Spokane River were also depressed below normal mesotrophic levels with both diversity and biomass quite low.

PROGRESS: 80/01 TO 80/12. The biotic communities of a 12-mile reach of the Spokane River were described in relation to upstream metals loading and municipal sewage discharges to the study reach. Phytoplankton and attached benthic algae production is severely depressed by upstream zinc loading. Benthic invertebrate composition diversity was low, as was total number. Despite a well-washed river bottom of

sand, cobble, and coarse logging debris (bark), benthic communities were dominated by forms apparently relying on heterotrophic organic inputs.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.068 CRIS0084243
STEELHEAD HATCHERY AS AFFECTED BY RELATIVELY HIGH TEMPERATURE WATER

KLCNTZ G W; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0083 Project Type: STATE
Agency ID: OCI Period: 05 JUN 80 TO 14 JUN 81

OBJECTIVES: To demonstrate that steelhead trout from Wallawa can be raised in 15 C water from the first feeding fry stage through smoltification.

APPROACH: Three raceways - two in series and one single-pass - will be stocked with several thousand steelhead first-feeding fry. The growth of the fish will be monitored and forecasting using computerized models. In addition, water chemistry parameters will be monitored and evaluated for their effect on growth and growth rates.

PROGRESS: 80/01 TO 80/12. During the first six months of this study, three groups of steelhead trout were monitored for growth rates and length frequency distribution within groups. The groups were designated: A (large fish), B (medium fish), and C (small fish). Each group was set on a feeding schedule designed to permit it to have an average 5.5/lb size by mid-April 1981. Thus far, the growth data indicate that this approach is feasible. The dietary efficiencies and growth rates have been within 3% of the predicted values.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.069 CRIS0077918
BIOFILTER PERFORMANCE FACTORS

KLONTZ G W; LAI V K; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0060 Project Type: STATE
Agency ID: OCI Period: 01 JUL 77 TO 30 DEC 80

OBJECTIVES: Identify and evaluate the effect(s) of the following factors on nitrification capabilities of biological filters: Alkalinity, pH, calcium and magnesium hardness, dissolved oxygen, water flow rates, ammonia-nitrogen, nitrite-nitrogen and nitrate-nitrogen.

APPROACH: Duplicate fish-free biological filtration systems will be established. The chemical parameters will be evaluated dairy pre- and post-feeding with ammonia-nitrogen.

PROGRESS: 80/01 TO 80/12. This study arose out of serious questions being asked about the performance of biofiltration systems at the Dworshak National Fish Hatchery. Experiments were designed and executed to determine the inorganic and organic requirements for the microbial nitrification process. The foregoing data were acquired in a fish-free system fed with measured amounts of the chemicals evaluated. Towards the end of the study, fish, steelhead trout, were put into the systems and monitored for physiological conditions such as gill lamellar configurations and growth rates. The study was necessarily short term - 6 weeks - but at the end the fish were all in good condition.

PUBLICATIONS: 80/01 TO 80/12
LAI, K.V. and KLCNTZ, G.W. 1980. Evaluation of Environmental and Nutritional Factors Influencing the Performance of the Biofilters in Fish Rearing Systems: Final Report. Walla Walla Distr. Corps of Engineers, Tech. Compl. rept. on

004.070

CRIS0082662

DEVELOPMENT AND APPLICATION OF A METHODOLOGY FOR RECOMMENDING SALMONID EGG INCUBATION FLOWS

WHITE R G; FOREST WILDLIFE & RANGE EXP ST; UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.

Proj. No.: IDA-CFU-0069

Project Type: STATE

Agency ID: OCI Period: 01 OCT 77 To 30 APR 80

OBJECTIVES: Develop a usable methodology for recommending egg incubation flows for select salmonid fish species in Idaho. Assess the effects of dewatering and low flow on the egg environment and on egg survival. Experimentally compare flow requirements of different developmental stages of salmonid eggs. Measure physical and hydraulic parameters associated with natural redds whereby spawning criteria can be developed for important salmonid species of Idaho.

APPROACH: Objectives 1-3 were conducted in experimental channels available at the Idaho Dept. of Fish and Game Hayden Creek Research Station and at the University of Idaho's fishery wet lab. Both green and eyed eggs of chinook salmon, steelhead and cutthroat trout were utilized in tests designed to compare egg survival in conditions of varying streamflow and different sediment levels. Objective 4 entailed locating active matured redds of spring chinook, summer chinook, steelhead and dolly varden trout and measuring their associated physical and hydraulic parameters (e.g. water depth, water velocity, reed area, substrate composition).

PROGRESS: 80/01 TO 80/12. From 1977-1979 field and laboratory tests were conducted to determine the impacts of streamflow reduction over redds on salmonid embryo incubation and fry quality. Laboratory tests were conducted in artificial stream channels located at the Hayden Creek Research Station and in incubation chambers installed in the University of Idaho fisheries wet lab. Field tests were designed to evaluate the effects of reducing depths and velocities over redds on spring chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Salmo gairdneri*) embryo incubation success and resulting alevins. Sediment size and level was incorporated into the test design. Measurements on 104 spring chinook salmon redds, 50 summer chinook salmon, redds, and 89 summer steelhead trout redds were taken and spawning criteria developed. Reduction in streamflow over redds containing sediment (<0.84 mm) in quantities from 3-13% resulted in increased embryo mortality with greatest increases associated with levels of 7% sediment, 0.84 mm. Flow reductions retarded development of embryos resulting in alevins which were shorter and lighter at time of hatching. Flow reductions made during early embryonic development may result in higher mortality than if made after the circulatory system is functional (approximate time of eye-up). Sediment was inversely related to embryo survival but unrelated to alevin quality. Sediment sizes <0.84 mm were the most deleterious to embryo survival.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

004.071

CRIS0082663

EFFECTS OF INCREASED FINE SEDIMENT ON INCUBATION AND EMERGENCE OF CHINOOK SALMON AND STEELHEAD TROUT

WHITE R G; FOREST WILDLIFE & RANGE EXP ST; UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.

Proj. No.: IDA-CFU-0070

Project Type: STATE

Agency ID: OCI Period: 25 SEP 78 To 30 SEP 81

OBJECTIVES: We plan to study the survival of salmon and steelhead eggs in various sediment mixtures. Our investigations should result in a reliable model to predict salmon and steelhead spawning success relative to stream bottom composition.

APPROACH: Measurements which describe the entire range of particles in spawning substrate should correlate with fish survival better than previously used point estimates (e.g. percent fines). First, we hope to find a way of accurately describing spawning

gravel using statistics from size frequency distributions. By relating sediment mixtures commonly found in streams to salmonid egg survival, we would be able to predict spawning success.

PROGRESS: 80/01 TO 80/12. By analyzing gravel samples from salmonid spawning areas, we found that the composition of spawning gravels follows a consistent pattern. For material less than 25.4 mm (1 inch) in diameter, the distribution of particles is close to lognormal and can be accurately represented as a straight line on log-probability paper. Based on this phenomena, we proposed a new method of describing spawning gravel quality; this new method uses two sieve sizes to closely approximate gravel composition. Laboratory incubation experiments with steelhead and salmon embryos were conducted at the University of Idaho to test whether or not our method provided a better measure of spawning gravel quality than "percent fines". Steelhead and salmon embryos were buried in a wide range of gravel mixtures, and emerging fry indicated percent survival in each mixture. Using a standard statistical package, we developed models relating steelhead and salmon embryo survival to two variables: percent of the substrate less than 9.50 mm and percent of substrate less than 0.85 mm. Using our method of describing spawning gravel, 90 to 92 percent of the variability in survival-to-emergence was correlated with change in gravel composition. "Percent fines" accounted for only 56 to 86 percent of the variation in survival in the same tests.

PUBLICATIONS: 80/01 TO 80/12

TAPPEL, P.D. and T.C. BJORN. 1980. Effects of sediment composition on salmonid egg survival. Annual report for the period September 1979 through October 1980. Memorandum of Agreement Supplement Number 87 to 12-11-204-11.

004.072

CRIS0082665

THE IMPACT OF POWER PEAKING ON EGG INCUBATION OF FALL CHINOOK SALMON

WHITE R G; FOREST WILDLIFE & RANGE EXP ST; UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.

Proj. No.: IDA-CFU-0072

Project Type: STATE

Agency ID: OCI Period: 10 OCT 78 To 30 JUN 80

OBJECTIVES: Assess the impacts of power peaking and the resulting fluctuating flows on the egg incubation and hatching success of fall chinook salmon in Hells Canyon. Experimentally compare the effects of dewatering and flow fluctuation on survival of various developmental stages of chinook eggs and on quality of fry and experimentally determine the tolerance limits of different developmental stages of eggs to varying periods of complete dewatering and associated effects of fry quality.

APPROACH: This portion of the study is being conducted on the Middle Snake River below Hells Canyon Dam where power peaking may pose a serious threat to the incubation and hatching of fall chinook eggs. Fall chinook eggs were placed in selected artificial and hatching of fall chinook eggs. Fall chinook eggs were placed in selected artificial redds which were, depending on location, dewatered frequently, infrequently or not at all (control). Egg survival will be assessed in early March. Objectives 2 and 3 utilized the field laboratory facilities located at Hayden Creek Research Hatchery. For objective 2, chinook eggs were planted in artificial redds in 2 simulated stream channels. Flows in one channel were subsequently fluctuated while the flow in the second channel remained constant. Objective 3 was achieved by using 16 one foot deep x one foot wide x four feet long gravel filled chambers. Each chamber contained 4, 100 egg lots which were removed at intervals of 1, 2, 3, and 4 weeks of dewatering.

PROGRESS: 80/01 TO 80/12. During the fall and winter of 1979-80, tests were conducted in a section of the Middle Snake River within Hells Canyon to determine the effects of hydroelectric power peaking on fall chinook salmon (*Oncorhynchus tshawytscha*) embryo incubation and fry quality. Additional simulated peaking tests were conducted at the Hayden Creek

Research Station using artificial stream channels. Steelhead trout (*Salmo gairdneri*) and chinook salmon egg dewatering tolerance tests were conducted at the Hayden Creek station using 16 independent flow controllable chambers in Hells Canyon, no definitive relationship was found between embryo survival and the incidence of flow fluctuations and periodic redd exposure. However, the highest embryo survivals occur in areas dewatered the least. There was extensive sediment intrusion into the artificial fall chinook redds within Hells Canyon. In laboratory tests, no significant difference ($P > 0.05$) in survival were found between embryos periodically dewatered (11-12 hr/day) and those continually watered, although alevins from the channel which was dewatered were significantly longer ($P < 0.0037$) and heavier ($P > 0.0391$) than alevins from the control. This resulted from elevated temperatures in the dewatered riffles. Steelhead trout and chinook salmon embryos were tolerant to 1-5 weeks of continuous dewatering with no significant effects on survival to hatching (provided embryos remained moist), alevin quality, growth rates or latent fry quality.

PUBLICATIONS: 80/01 TO 80/12

REISER, DUDLEY W. and REBERTS G. WHITE. 1981.

Effects of flow fluctuation and redd dewatering on salmonid embryo development and fry quality. Final report to Bonneville Power Administration. Contract No. DE-AC75-79BP10848.

004.073 CRIS0082664
EFFECTS OF REDUCED STREAM DISCHARGE ON FISH AND
AQUATIC MACROINVERTEBRATE POPULATIONS

WHITE R G; BENNETT D; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0071 Project Type: STATE
Agency ID: OCI Period: 01 SEP 77 To 30 APR 80

OBJECTIVES: Determine the relationship between fish abundance and increments of reduced stream discharge, determine the response of aquatic macroinvertebrates to increments of reduced stream discharge, determine the order of importance of depth, velocity, cover and if possible, food in limiting fish abundance as affected by increments of reduced stream discharge, assess the primary hydraulic characteristics that are associated with low flow conditions and related biological conditions in a near natural study channel, evaluate the validity of certain predictive models currently being used to describe hydraulic characteristics associated with low-flow conditions, and assess the influence of low-flow conditions on motion of bed material which may affect the biological communities.

APPROACH: Select fish species will be stocked in two experimental stream channels. Flows will be incrementally reduced in one channel, while remaining constant in the other stream channel. Migration rates of fish out of each channel will be compared. Aquatic macroinvertebrate communities will be monitored by benthic and drift sampling. Hydraulic characteristics will be measured during each test flow.

PROGRESS: 79/01 TO 79/12. During the calendar year 1979 two experiments were completed; one during March-April and one during June-July. Important findings of these experiments are: 1) effect of reduced stream discharge on fish extend at least 3 weeks after initiation of flow reduction; 2) wild rainbow-steelhead trout were more severely affected by reduced stream discharge than were hatchery steelhead trout; 3) reduced stream discharge had the immediate effect of increasing aquatic insect drift density (#'s/n 3) but drift density returned to control levels in one week or less; 4) reduced stream discharge resulted in reduced invertebrate drift rates (#'s/hr), which lasted for the duration of tests. Specific effects on individual macroinvertebrate taxon are presently being analyzed as are size variation of fish in channels and direction of migration of the fish as related to flow levels. Hydraulic characteristics of experimental stream channels are being utilized to check the accuracy of the various predictive hydraulic models.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD

004.074 CRIS0027228
EVALUATION OF METHODS FOR INCREASING NATIVE CUTTHROAT
STOCKS IN NORTHERN IDAHO

HJORN T C; FORESTRY; UNIVERSITY OF IDAHO, MOSCOW,
IDAHO. 83843.
Proj. No.: IDA-CFU-0003 Project Type: STATE
Agency ID: OCI Period: 01 JUL 66 To 01 JAN 99

OBJECTIVES: Ascertain ecological factors limiting production of cutthroat in northern Idaho. Develop management techniques to maximize production of cutthroat.

APPROACH: Survey St. Joe River drainage to locate cutthroat rearing areas and classify them as to quality. Study ecology of cutthroat trout with special emphasis on movements, growth, and seasonal distribution. Evaluate squawfish as a potential predator and competitor for cutthroat.

PROGRESS: 76/01 TO 76/12. We studied the fish and fisheries of three Northern Idaho streams to assess the impact of catch-and-release (Kelly Creek), trophy-fish (upper St. Joe River), and standard (North Fork of the Clearwater River) angling regulations on native cutthroat trout populations. Since the initiation of the special regulations, cutthroat abundance increased in Kelly Creek (7-fold) and the upper St. Joe River (3- to 7-fold), but has not changed on the North Fork. The mean size of the cutthroat, the number of large cutthroat, and the catch rate of cutthroat per hour have increased as a result of the special regulations. The annual mortality rates of cutthroat declined and allowed more cutthroat to mature and spawn. The catch of cutthroat by anglers increased, but the angler harvest of cutthroat decreased. Angler effort declined initially, but had recovered by 1975 to 20% of 1969 effort on Kelly Creek and to 100% of 1969 effort on the upper St. Joe River. Characteristics of anglers fishing Kelly Creek (angling method, age, sex, residency) and the upper St. Joe River (method, residency) changed since the special regulations. Tagged cutthroat migrated from the study areas to overwinter in the lower drainage and returned the following spring and early summer. Multiple recaptures of tagged cutthroat was common during the summer.

PUBLICATIONS: 76/01 TO 76/12
JOHNSON, T. B. and T. C. ECKEN. Special angling regulations in the management of cutthroat trout in northern Idaho streams. Job Performance Report, Project F-59-R-7, Idaho Fish and Game Department. 1977.

004.075 CRIS0072414
AQUATIC RESOURCES OF SILVER CREEK AT THE NATURE
CONSERVANCY SITE

EJORN T C; FORESTRY & WILDLIFE; UNIVERSITY OF IDAHO,
MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0045 Project Type: STATE
Agency ID: OCI Period: 01 SEP 76 To 30 OCT 78

OBJECTIVES: Describe the aquatic ecosystem in Silver Creek at the Nature Conservancy site and in up and downstream sections of the stream; assess primary productivity as related to water chemistry, temperature, aquatic plants, nutrients from headwater streams and farmland runoff and to compare with other portions of the creek and with other streams. Assess abundance and distribution of aquatic insects and the role they play in stream ecosystems; assess abundance, distribution movements, age structure, recruitment and survival of juveniles and the effects of the fishery on the fish stocks in Silver Creek.

APPROACH: We will sample the aquatic insect and fish populations periodically and relate biota to water temperatures, nutrients and plant growth in Silver Creek. Maps of the plant communities will be prepared

as they develop through the summer, distribution and composition of insect and fish populations will be compared to plant distribution. Growth of fish in Silver Creek will be related to food available, time of year and other physical features.

PROGRESS: 80/01 TO 80/12. Some of the aquatic resources of Silver Creek, a renowned trout stream in South Central Idaho, were studied on the Nature Conservancy section of the stream during 1977. The temperature range (average 10-12C, maximum 22C) was found to be good for production and growth of coldwater organisms. Stream discharge at Picabo was relatively stable in 1974-75 and 1975-76 (range 3-13 m³/sec). Stream discharge in 1976-1977 (low water year) ranged from 2-7.5m³/sec. Stream substrate consists of silt (including fine sands) and gravel with particle size less than 7 cm in diameter. Silt covered from 42 to 56% of the stream bottom during the year. Twenty-nine species of aquatic plants were found. Vegetation was most abundant in August, and least abundant in March. Thirty-one genera of algae which colonized on microscope slides were identified, of which Navicula, Fragillaria, and Gomphonema were the most abundant genera. Fifty-three families and seventy-eight genera of aquatic insects were identified. Six species of fish were present in the Nature Conservancy portion of the stream. In decreasing order of abundance these were rainbow trout (*Salmo gairdneri*), bridgeline suckers (*Catostomus columbianus*), longnose dace (*Rhynchichthys cataractae*), mountain whitefish (*Prosopium williamsoni*), Wood River sculpin (*Cottus leopomus*) and brook trout (*Salvelinus fontinalis*). Brown trout (*Salmo trutta*) and reddsider shiner (*Richardsonius balteatus*) were also present below Purdy's irrigation dam.

PUBLICATIONS: 80/01 TO 80/12

FRANCIS, L.J. and EJOENN, T.C. 1979. Aquatic Resources in the Nature Conservancy Portion of Silver Creek. Final Report to The Nature Conservancy. Technical Report 9, Contribution No. 165. Forest, Wildlife and Range Exp.

004.076

CRIS0072815

LOWER SNAKE RIVER LIMNOLOGY

FALTER C M; FORESTRY & WILDLIFE; UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: ILA-CFU-0048 Project Type: STATE
Agency ID: OCI Period: 14 MAY 75 To 30 SEP 78

OBJECTIVES: Describe the water quality of the lower Snake River as it flows through four sequential run-of-river impoundments; relate reservoir benthos to sediment composition and aquatic vasculars in the lower Snake River.

APPROACH: Year-round water quality and biota analyses are being made in the lower Snake River to relate open water and littoral communities to the changing water quality with passage through four reservoirs. Special attention is being given to the impact of fluctuating pool levels on the aquatic communities.

PROGRESS: 80/01 TO 80/12. Limnological characteristics of the lower Snake River (150 mile reach from the Clearwater to the Columbia River) were studied from February 1975 to December 1978. The four lower Snake River reservoirs are flow-through pools which showed little thermal stratification or oxygen depletion. The reservoirs function as nutrient traps removing plant nutrients and other components of the dissolved load from the Snake River. Algal productivity likewise declined downstream with distance below nutrient inputs at the Snake-Clearwater confluence. Aquatic macrophytes were limited primarily by low light to 3 meters depth with the near surface band restricted by daily surface fluctuations.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

004.077

CRIS0072918

LIMNOLOGICAL EVALUATION AND ZOOPLANKTON DYNAMICS OF LAKE KOOCANUSA, NORTHWESTERN MONTANA

FALTER C M; FORESTRY & WILDLIFE; UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.

Proj. No.: IDA-CFU-0051 Project Type: STATE
Agency ID: OCI Period: 16 AUG 76 To 30 SEP 77

OBJECTIVES: Prepare a limnological description of Lake Koocanusa, Montana in the first four years after impoundment; describe the biomass and composition of zooplankton in Lake Koocanusa, Montana; relate zooplankton community characteristics to operation of the selective withdrawal system of Libby Dam.

APPROACH: A comprehensive study is being made of water quality and aquatic biological data collected by the U.S. Army Corps of Engineers, the U.S. Geological Survey, and private contractors on Lake Koocanusa from 1972-1976. From this existing data, we will prepare an overview of the early limnology of Lake Koocanusa in the first four years after filling. Through a stratified random sampling regime of large volume metered flows, we are measuring zooplankton communities throughout Lake Koocanusa. Particular emphasis is being placed on population dynamics in water masses near the dam, those more susceptible to vertical mixing as a result of water withdrawal.

PROGRESS: 80/01 TO 80/12. An extensive water quality data base collected from Lake Koocanusa in Northwestern Montana was analyzed to determine which limnological factors controlled primary productivity from initial impoundment in 1972 through 1975. Early predictions of eutrophic levels of algal production (based on N and P loading rates) were not achieved after impoundment. Data analysis showed that primary productivity was limited to oligotrophic values because phytoplankton photosynthesis was suppressed by physical limnological factors. Large scale water movements within the reservoir as a result of low hydraulic residence time and reservoir operations resulted in weakly developed thermoclines which were usually substantially deeper than the euphotic zone, thereby depressing phytoplankton productivity to oligotrophic levels. Circulation effects on photosynthesis were further compounded by highly turbid inflows received during annual reservoir filling. The nonconformity of Lake Koocanusa to its predicted eutrophic response to large loadings of nutrients suggests that caution be used in applying nutrient loading models to reservoirs with complex hydrodynamics.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

004.078

CRIS0071722

EFFECTS OF DISSOLVED CHEMICALS ON AQUATIC LIFE

SPACIE A; FORESTRY & NATURAL RESOURCES; PURDUE UNIVERSITY, LAFAYETTE, INDIANA. 47907.

Proj. No.: IND059042 Project Type: BATCH
Agency ID: CSRS Period: 15 NOV 76 To 30 SEP 81

OBJECTIVES: Evaluate the impact of selected municipal and industrial discharges on the productivity of fish, macroinvertebrates, and periphyton on the Wabash River system. To determine the long term influence of nutrient enrichment (cultural eutrophication) on the productivity and composition of lake communities, particularly those in the littoral zone.

APPROACH: Community productivity will be measured in the field through biomass estimates, photosynthetic rates, trophic relationships, and changes in species abundance. Physical and chemical water quality parameters will also be measured at the same locations. Emphasis will be placed on comparisons between stressed communities. Quantitative relationships between the concentration of dissolved chemicals and productivity will be tested in the laboratory.

PROGRESS: 80/01 TO 80/12. One of the most widespread pollutants in municipal and industrial wastewater is ammonia. Ammonia discharges occur at a number of points along the Wabash River in areas where our surveys have shown fish populations to be depressed. Industrial production is currently limited by the permissible ammonia loadings to the river, as stipulated by NPDES discharge permits. We are conducting laboratory bioassays to predict the concentration of ammonia toxic to warmwater fish during low flow conditions in the river. To date, species including white sucker, golden shiner, channel catfish, and bluegill have been tested in acute bioassays. Thirty-day embryo-larval tests on fathead minnows and channel catfish were also completed. Reduced growth of the fry appears to be a sensitive indicator of sublethal ammonia exposure. Future tests will measure the interaction of ammonia with low dissolved oxygen. In addition, research on the uptake of polycyclic aromatic hydrocarbons (PAH) in bluegills was completed. Although PAH are important environmental contaminants, they are also of theoretical interest because the series include a wide-range of physicochemical properties. Based on the PAH results, as well as information on a large number of other trace organics, we have developed a new general theory of chemical bioconcentration in fish. The theory derives from an existing drug-transport model used in pharmacology.

PUBLICATIONS: 80/01 TO 80/12

- SPACIE, A. 1980. Phosphorus Loading Models for Indiana Lakes. Purdue Univ. Ag. Exp. Sta. Res. Bull. #963, 11 pp.
- CURRY, K.D. and SPACIE, A. 1980. A Temperature Controlled Recirculating System for Hatching Catostomid Larvae. Prog. Fish Cult. 42(3):151-152.
- SPACIE, A. and BELL, J. 1980. Trophic Status of Fifteen Indiana Lakes in 1977. Purdue Univ. Ag. Exp. Sta. Bull. #966, 23 pp.
- SPACIE, A. 1980. Biological Effects of Organic Detergent Builders. In: Ecological Effects of Non-Phosphate Detergent Builders Other Than NTA. Great Lakes Res. Ad. Board, Intl. Joint Commission, pp. 51-60.

004.079* CRIS0074624
THE USE OF FISH BEHAVIOR IN TOXICITY TESTING

ATCHISON G J; ANIMAL ECOLOGY; ICWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: ICW02284 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 82

OBJECTIVES: Determine the relative sensitivities of a variety of behaviors of fish (such as coughing, feeding, mating and hierarchy formation) to toxic substances. Determine the effect of a variety of toxic substances on specific behavior patterns of fish. Compare the utility of behavioral toxicity tests and standard EPA chronic exposure tests in establishing safe levels of toxicants in aquatic ecosystems.

APPROACH: Observe and quantify the behavior patterns of fish exposed to varying levels of toxicants compared to the behavior patterns of control fish.

PROGRESS: 80/01 TO 80/12. Research this past year centered on the effects of copper and methyl parathion on bluegill behavior. The methyl parathion tests are completed, except for statistical analysis. The copper work will continue through this spring and early summer. Eight populations of five bluegill (ranging from 11.5 to 14.0 cm in total length) were maintained in separate 315 liter flow through aquaria. After an acclimation period of sufficient time to allow establishment of stable social hierarchies and territories, nine behaviors were monitored for 56 hours before treatment and 56 hours during exposure to methyl parathion. Treatments consisted of two replicates of a control tank and tanks receiving 0.35, 0.035, and 0.0035 mg/l methyl parathion. Statistically, unanalyzed trends from these two runs of the experiment indicate that low levels of methyl parathion increased the frequency of "flinches" and "fin flickering," both of which are

maintenance behaviors and behavioral manifestations of nervous system effects. General activity levels appeared to become elevated during the early stages of toxicant administration and were followed by subsequent increases in aggression. After approximately 15 hours these increased activity levels began to subside in all but the lowest exposure concentration. Feeding behavior was also affected by methyl parathion. Dominant individual feeding success rates dropped as these fish became less successful at capturing the fathead minnows that were used as prey.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.080* CRIS0064201
ORGANIZATION AND RETRIEVAL OF FRESHWATER FISHERY DATA

CARLANDER K D; ANIMAL ECOLOGY; ICWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: ICW02002 Project Type: STATE
Agency ID: SAES Period: 01 JUL 73 To 30 JUN 79

OBJECTIVES: Compile all available data on life histories of freshwater fishes for United States and Canada; coordinate for comparison; publish summaries; maintain bibliography, cross-indexed.

APPROACH: A cross-indexed filing system and standardized tabulation have been developed. Much of the data have to be transformed to metric system and uniform definition of parameters. Manuscript summaries will be made available in special order as they are prepared for publication in Volume II of "Handbook of Freshwater Fisheries Biology".

PROGRESS: 73/07 TO 79/06. Volume II of Handbook of Freshwater Fisheries Biology. Life History data of the centrarchid fishes of United States and Canada was published by Iowa State University Press in 1977, and 1955 copies had been sold as of April 30, 1978. The Handbook is frequently cited in publication and reportedly is widely used as a reference, saving much research time and permitting more effective use of the data. Prior to publication, sections of the manuscript were provided upon request and payment of expenses of copying to other scientists for use on on-going projects or on environmental impact studies. The cross-indexed library is used quite extensively by the graduate students and staff of Iowa State University in their research. Data on species other than centrarchid fishes have been cross-indexed for use in Volume III, and in possible future revisions or supplements. The new literature on the species covered in Volume I is probably at least one-third that covered in the 1969 publication.

PUBLICATIONS: 73/07 TO 79/06
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

004.081 CRIS0083590
BIOLOGICAL AND RECREATIONAL ASPECTS OF WATER LEVEL MANAGEMENT OF CLEAR LAKE, IOWA

HUBERT W A; NICKUM J G; CARLANDER K D; ANIMAL ECOLOGY; IOWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: ICW02478 Project Type: STATE
Agency ID: SAES Period: 01 OCT 80 To 30 SEP 82

OBJECTIVES: To describe littoral plant and fish communities of Clear Lake. To determine the influence of continued water level fluctuations and water level. Stabilization on littoral plant and fish communities of Clear Lake. To determine the attitudes of water-oriented users toward water level fluctuations or stabilization and to assess how they are likely to respond to future water level management of lack of it.

APPROACH: Littoral plant communities will be identified, relative abundance estimated, mapped, and water depths measured. Fish will be sampled with gill nets, fyke nets, electrofishing and other techniques. Recreational user attitudes will be assessed by attitude surveys of water-oriented users.

PROGRESS: 80/06 TO 81/01. Field studies were conducted during the summer to assess the relative abundance of fish in different channel types and sampling areas. Thirty-five species were collected. A report on the reconnaissance and site selection study to design future fish movement studies associated with navigation and pool level fluctuations were submitted to the Upper Mississippi River Basin Commission. Due to the Congressional action involving reporting dates and funding, the follow-up study will not be conducted.

PUBLICATIONS: 80/06 TO 81/01
NO PUBLICATIONS REPORTED THIS PERIOD.

004.082 CRIS0078976
BIOLOGY AND SPORT FISHING HARVEST OF YELLOW PERCH

HUBERT W A; SANDHEINRICH M B; ANIMAL ECOLOGY; IOWA STATE UNIVERSITY, AMES, ICWA. 50011.
Proj. No.: ICW02345 Project Type: STATE
Agency ID: SAES Period: 01 MAR 79 To 30 JUN 82

OBJECTIVES: To determine the physical and biological factors governing the spatial distribution of yellow perch in West Lake Okoboji. To determine the population structure. To determine the impact of angler harvest.

APPROACH: Methods for assessing spatial distribution will involve primarily measures of catch per unit of effort with gill nets and fyke nets as well as tag return data. Population structure will be assessed using experimental gill nets and other sampling gear.

PROGRESS: 80/01 TO 80/12. The influence of exploitation on West Lake Okoboji yellow perch is unknown. In 1978 and 1979 the growth and condition of East and West Okoboji Lake perch was compared and the extent of interlake movement was evaluated. During the summer of 1980, research was initiated to compare present abundance to early 1950s' data and to determine physical and biological factors influencing depth distribution of perch in West Lake Okoboji. Monofilament gill nets were set at three locations over five depths during dawn, mid-day, and dusk time periods. Well defined trends in catch-per-unit-effort and perch diet were observed relative to depth and water temperature.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.083* CRIS0073096
BEHAVIOR OF IOWA SPORT FISHES

MENZEL B W; ANIMAL ECOLOGY; IOWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: IOW02234 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 82

OBJECTIVES: The research program will involve long term behavioral studies of Iowa sport fishes in nature using ultrasonic tagging techniques. For each species studied, the major objectives shall be: Determine size and nature of home ranges, including physical features of the preferred habitat, determine daily and seasonal activity patterns and effects of natural environmental variation upon these patterns, and ascertain the effects of human influences upon behavior.

APPROACH: Ultrasonic transmitters will be surgically implanted into the abdominal cavity of experimental fish. The fish will be released into nature and tracked using a boat-mounted hydrophone and receiver. Observation locations will be determined by triangulation and plotted on a map. Fish movements will be compared with habitat features and other environmental parameters.

PROGRESS: 80/01 TO 80/12. During 1980, data were analysed from a 2 year telemetry study of the movements and behavior of adult muskellunge in Lake West Okoboji, Iowa. These analyses confirm the preliminary findings reported last year. The basic

elements of the populations' seasonal behavioral patterns are: reproductive activities along shallow shoreline areas in early spring, active foraging in pelagic areas during late spring and early summer, feeding as ambush predators in the outer littoral zone in late summer and early fall, overwintering in deeper areas. During the growing season, the fish occupy well-defined home ranges averaging about 10% of the lake's surface area. Some fish maintain two disjunct home areas and travel back and forth between them. There is no evidence of territorial behavior, however. Throughout this time, the fish are primarily suspended in the upper and middle portions of the water column. All 9 study fish exhibited these general behavioral patterns although there were individual differences in home ranges and timing of the major behavioral shifts. Because of the seasonally changing fish behaviors, there is a marked seasonality in angling success for muskellunge in the lake. A M.S. thesis on the research will be completed in spring 1981.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.084* CRIS0073106
ECCOLOGY OF LARVAL STREAM FISHES

MENZEL B W; ANIMAL ECOLOGY; ICWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: IOW02234 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 79

OBJECTIVES: Develop methods for collecting larval fishes in Iowa warmwater streams and rivers, develop procedures for the identification of such larval fishes, determine species composition, distribution, and abundance of larval fishes in selected rivers, and compare the above parameters with reference to various forms of habitat, stream alteration and water use.

APPROACH: Larval stream fishes will be collected by drift nets and a water pumping apparatus. Collecting will be done at several stations in a stream which represent different habitat conditions and at various times of day. Species identification will be accomplished by standard morphological methods and by electrophoresis of tissue proteins.

PROGRESS: 77/07 TO 79/06. A study was completed on the taxonomy and ecology of drifting larval fishes in the upper Skunk River, Iowa. Collections were made in Spring 1977 using stationary drift nets at eight river stations in the vicinity of Ames. Larvae of more than 20 fish species were collected, minnows (Cyprinidae) being the most abundant group. Taxonomic descriptions were made for larvae of nine minnow species: stoneroller, brassy minnow, common shiner, bigmouth shiner, red shiner, sand shiner, bluntnose minnow, fathead minnow and creek chub. Larval fish drift was greatest at night and consisted primarily of prolarval and early post-larval stages. Numbers of drifting larvae were not associated with either river discharge or turbidity. Occurrence and abundance of larvae was similar over the 30 km length of river sampled and was not related to local habitat characteristics. Phenological patterns of larvae abundance exhibited a close correlation with the known spawning periodicity of Skunk River fishes. A purpose of drifting behavior may be to transport larvae from low order spawning streams to higher order streams where planktonic food organisms are more abundant.

PUBLICATIONS: 77/07 TO 79/06
PERRY, L.G. 1979. I. Identification of nine larval cyprinids inhabiting small northern rivers. II. Spatial and temporal patterns of larval fish drift in the upper Skunk River. M.S. Thesis. Iowa State University, Ames. 73 pp.
PERRY, L.G. and MENZEL, B.W. 1979. Identification of nine larval cyprinids inhabiting small northern rivers, pp. 141-173. In: Wallus, R. and Voightlander (eds.), Proceedings of a workshop on freshwater larval fishes, Tennessee Valley

004.085 CRIS00S0610
EFFECTS OF LAND USE PRACTICES ON STREAM BICTA

MENZEL B W; ANIMAL ECOLOGY; ICWA STATE UNIVERSITY,
AMES, ICWA. 50011.
Proj. No.: ICW02410 Project Type: STATE
Agency ID: SAES Period: 01 SEP 79 To 30 JUN 84

OBJECTIVES: Determine the ecological impact of nonpoint source agricultural pollution on the biotic communities of small warmwater streams, and evaluate the efficacy of Best Management Practices (BMPs) for mitigating the negative impacts of such pollution.

APPROACH: The biotic communities of several streams of the Cedar River drainage, east-central Iowa, will be monitored over a five-year period. During this time one stream, Four-Mile Creek, will have BMPs applied to its watershed through cooperation of landowners and government agencies. A nearby stream, Twelve-Mile Creek, will not receive a subsidized BMP program and, thus, will serve as a control. Other streams already receiving considerable voluntary BMPs on their watersheds, will also be compared to the target stream, four-Mile Creek.

PROGRESS: 80/01 TO 80/12. Sampling of fishes and measurement of water quality parameters was carried out in 10 headwater streams of the Cedar River basin in east-central Iowa during Spring 1980. This represented a continuation and expansion of field work initiated in Summer 1979 as a portion of a multi-disciplinary study on the utility of agricultural Best Management Practices for improving water quality. Sediment loads appear to be the salient feature determining habitat conditions for aquatic life in the 10 study streams. On the basis of their high flow and chronic sediment loads, the streams were distinguishable into 3 categories: Clear (2 streams), Moderately Turbid (4 streams), and Chronically Turbid (4 streams). The Clear streams also carried the lowest levels of plant nutrients (P and N) and featured a diversified bottom structure of riffles and pools and larger substrate particle sizes. The Chronically Turbid streams contained high levels of plant nutrients and generally featureless, sand-silt bottoms. The Moderately Turbid streams tended to be intermediate in these characteristics. Fish species richness and diversity, and total biomass were typically highest in the Clear streams and lowest in the Chronically Turbid streams. In all streams, the greater portion of the fish community was composed of fishes regarded as moderately tolerant of sediment and turbidity.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.086* CRIS0072499
FACTORS AFFECTING FISH POPULATIONS OF IOWA STREAMS

MUNCY R J; BULKLEY R V; ANIMAL ECOLOGY; ICWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: ICW02225 Project Type: STATE
Agency ID: SAES Period: 01 MAR 77 To 30 JUN 80

OBJECTIVES: Determine fluctuations in abundance of selected populations of stream fishes and factors affecting these fluctuations. Identify man-made habitat alterations that can enhance environmental conditions for aquatic life. Increase knowledge of environmental pollutants transport and dynamics in flowing and impounded waters.

APPROACH: Research will consist of field investigation on length, weight and distribution of fish species in several Iowa rivers in relation to selected environmental parameters. Data on pesticide and polychlorinated biphenyls concentration in muscle tissue will be obtained by gas chromatography on fish inhabiting the Des Moines River and Red Rock Lake.

PROGRESS: 77/03 TO 80/06. Common carp were used to monitor organochlorine pesticide residues in fish from the Des Moines River. Residues were below U.S. Food and Drug Administration allowable levels in food fish. Reservoir sampling locations, Red Rock and Saylorville, tended to have higher dieldrin levels

than riverine locations. This trend was not observed for DDT residues. Missouri river environmental gap evaluation--notches cut in rock revetments to increase habitat density were evaluated. Species composition and sizes of fish associated with notches were described. Smallmouth bass in the Skunk River--during the 1976-77 drought, the population was decimated by winter kill. Survival, growth, production, movement, and habitat associations of fingerlings stocked following the drought was assessed.

PUBLICATIONS: 77/03 TO 80/06
HUBERT, W.A. 1980. Aldrin and DDT Residues in Carp from Impounded and Riverine Segments of the Des Moines River, 1979. In: Proceedings of the Seminar on the Water Quality in the Corps of Engineers' Reservoirs in Iowa. U.S. Army Corps

004.087* CRIS0082533
FACTORS AFFECTING FISH POPULATIONS IN IOWA WATERS

NICKUM J G; HUBERT W A; ANIMAL ECOLOGY; ICWA STATE UNIVERSITY, AMES, ICWA. 50011.
Proj. No.: IOW02465 Project Type: STATE
Agency ID: SAES Period: 31 JUL 80 To 30 SEP 85

OBJECTIVES: To determine the factors influencing fluctuations in abundance of selected populations. To identify man-made habitat alterations that impact or enhance environmental conditions for aquatic life. To increase understanding of environmental contaminants transport and dynamics. To evaluate fishery management techniques aimed at enhancing fishery quality or productivity.

APPROACH: Research will consist of field and laboratory studies on the life history, environmental requirements, and population dynamics of fish species in Iowa waters. Data on environmental contaminants in fish and their habitats will be obtained by standard analytical procedures. Established methods for population assessment will be used to determine the effects of various management techniques.

PROGRESS: 80/07 TO 80/12. Two individual studies were conducted within the scope of this project: one dealing with pesticide residues in the Des Moines River and another concerned with the propagation of walleyes, *Stizostedion vitreum*, (propagated walleyes may be stocked so as to manipulate resident fish populations). Concentrations of dieldrin and DDT in muscle tissue of carp, *Cyprinus carpio*, from the Des Moines River, Iowa, were compared relative to month of collection, age of fish, and sampling location. Statistically significant differences were observed for all three factors. Expression of pesticide levels on the basis of wet weight of flesh often produced different results than when comparisons were made on a fat basis. Samples from reservoir locations tended to have higher dieldrin levels than samples from riverine locations. However, no similar trend was detected for DDT levels. Walleye fry fed a mixture of a diatom (*Melosira* sp.), decapsulated brine shrimp eggs, and dry feed (W-7) exhibited higher survival rates than those fed any of these items alone or in pairs. Walleye fingerlings were reared in ponds to a length of 35 mm and successfully transferred to hatchery production units. Substantial mortality occurred later, apparently due to stress from subsequent handling. Acceptance of dry feed by walleye fingerlings was highest in those rearing units in which water flow patterns held the feed in suspension for the longest times. Research in the coming year will proceed along similar lines for each study.

PUBLICATIONS: 80/07 TO 80/12
HUBERT, W.A. 1980. Aldrin and DDT Residues in Carp from Impounded and Riverine Segments of the Des Moines River 1979. In: Proceedings of a Seminar on the Water Quality in Corps of Engineers Reservoirs in Iowa. U.S. Army Corps of

004.088 CRIS0073386
WATER QUALITY ENHANCEMENT OF LAKES BY MECHANICAL
PUMPING

SUMMERFELT R C; MCALEXANDER A K; BOLT E R; ANIMAL
ECOLOGY; IOWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: ICW02233 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 82

OBJECTIVES: Enhance water quality of lakes by in situ
aeration with an axial-flow, mechanical pump.
Specially, pumping will be done to increase total
content of dissolved oxygen, and to decrease the
concentration of organic matter, and the toxic
substances, namely ammonia and hydrogen sulfide.

APPROACH: Dissolved oxygen, BOD, hydrogen sulfide and
ammonia will be measured by standard procedures at
intervals and depths which will allow
characterization of total mass of these chemical
characteristics of water quality. Pumping will be
done with an axial-flow mechanical pump of the
Quintero-Garton design. Evaluation will be done on
the basis of changes in these water quality variables
and improvement in species diversity of aquatic life.

PROGRESS: 80/01 TO 80/12. An axial-flow pump of the
Quintero-Garton (1969) design, with a 120-cm diameter
impeller, was operated on McFarland Lake, Story
County, Iowa from 13 May through 22 October 1980 to
prevent normal summer stratification. The
temperature, and concentration of dissolved oxygen,
chlorophyll a, BOD, CO(2), H(2)S, total phosphate,
and orthophosphate were measured once each month at
three sample sites in the lake and at each depth
contour from 1 to 5 meters. During mid-summer, when
expected temperature and chemical stratification in
this lake would be substantial, maximum temperature
difference was less than 2.0 C, and the substrate of
the lake was warmed nearly 10 C over the expected
temperature without artificial destratification.
Without pumping, the lake would be anoxic below 4
meters, but with pumping, oxygen in the deepest
contour was never less than 1.6 mg/l (25 June) and
otherwise between 2.1 and 3.6, June through August.
Long-term trends in lake improvement could be seen by
comparing conditions occurring in the summers of
1978, 1979, and 1980. BOD values for the summer of
1980 were about half that of previous two summers and
Chlorophyll a concentration in the surface (0-1
meter) stratum of the lake for the June through
August period was the lowest of the years.
Transparency (Secchi disc) was higher than in
previous years.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.089 CRIS0066196
NATURAL MARSHES AS NUTRIENT SINKS FOR AGRICULTURAL
RUNOFF

VAN DER VALK A G; JOHNSON H P; BAKER J I; ECTANY G
PLANT PATHELOGY; IOWA STATE UNIVERSITY, AMES, IOWA.
50011.
Proj. No.: ICW02071 Project Type: STATE
Agency ID: SAES Period: 01 JUL 74 To 30 JUN 80

OBJECTIVES: Examine the efficiency of natural marshes
as nutrient sinks for nitrogen and phosphorus
entering as a result of agricultural runoff; the fate
of these nutrients in a marsh; practical methods to
increase the efficiency of marshes as nutrient sinks.

APPROACH: Construct an annual nutrient budget for a
marsh receiving agricultural runoff from input,
output, plant, and litter nutrient measurements.
Examine the effects of water level manipulations,
baffles or dredging new channels on the efficiency of
nutrient removal by increasing retention time and/or
the dispersion of incoming nutrients.

PROGRESS: 74/01 TO 80/06. During years that had below
normal precipitation (1976-1978), Eagle Lake had no
effluent and it was a perfect sink for the nutrients
in the agricultural runoff passing through it. During
a wet year (1979) when the marsh had a significant
effluent, it removed 86% of the nitrate entering it,

78% of the ammonia, but total or Kjeldahl-N was not
reduced significantly. The marsh was not as effective
in removing phosphorus from runoff flowing through it
in 1979. Only about 20% of the inorganic phosphorus
was removed and even less of the total phosphorus
input. The marsh was a net exporter of soluble carbon
in 1979. Overall prairie glacial marshes have a
beneficial impact on agricultural runoff passing
through them. They effectively remove most of the
inorganic nitrogen, particularly nitrates. The use of
natural and/or constructed marshes as an integral
part of a tile drainage network is a cheap and
effective method for reducing the potential water
pollution problems that could be caused by the
inorganic nitrogen levels found in agricultural
runoff.

PUBLICATIONS: 74/01 TO 80/06
VAN DER VALK, A.G. 1981. Succession in wetlands: a
Gleasonian approach. Ecology 62: 688-696.

004.090 CRIS0084199
NAVIGATION IMPACTS ON CHANNEL FISHES, UPPER
MISSISSIPPI RIVER

HUBERT W A; COOPERATIVE FISHERY RES UNIT; ICWA STATE
UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: IOW02489 Project Type: STATE
Agency ID: SAES Period: 01 APR 81 To 30 JUN 83

OBJECTIVES: To assess potential navigation impacts on
channel fishes of the Upper Mississippi utilizing
habitat evaluation procedures and literature review.

APPROACH: Data from the 1980 reconnaissance study
will be utilized to assess navigation impacts using
two approaches. The first approach will entail
procedures similar to those employed by the U.S. Fish
and Wildlife Service for habitat evaluation. The
second approach will involve a detailed statistical
analysis of main channel and side channel fish
samples from 1980.

004.091 CRIS0073396
DETERMINATION OF WATER QUALITY CRITERIA FOR THE
SUPPORT OF AQUATIC LIFE IN TWO SMALL KANSAS STREAMS

BURKHEAD C E; BUGGINS D G; WATER RESOURCES INSTITUTE;
KANSAS STATE UNIVERSITY, MANHATTAN, KANSAS. 66506.
Proj. No.: KAN-05-136 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 31 DEC 80

OBJECTIVES: Determine the toxicity levels for
selected fauna-bioassay tests of ammonia,
chloramines, chlorine and their mixtures.

APPROACH: Standard, laboratory bioassay tests will be
made to determine the toxicity levels and then
intensive biosurveys will be made on Cedar and Mill
Creeks in Kansas.

PROGRESS: 80/01 TO 80/12. Terminated 12-31-80.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.092* CRIS0055844
ECOLOGICAL STUDIES WITH RED SWAMP CRAWFISH AND WHITE
RIVER CRAWFISH

AVAVULT J W; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA
STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB01192 Project Type: STATE
Agency ID: SAES Period: 11 AUG 64 To 31 OCT 80

OBJECTIVES: Study factors influencing ecology of
crawfish, such as temperature, season, water quality
and depth, vegetation, soil type, and agricultural
practices, in relation to feeding, growth,
reproduction, behavior, populations, diseases,
predators, and competitors.

APPROACH: Experiments will be set up in aquaria to determine temperature tolerance of crawfish. Past crawfish production records for certain areas will be compared to weather records. Small ponds will be stocked with crawfish and effects of water level fluctuations studied. Crawfish movements will be studied in laboratory and in the field. Methods for food habits studies will be developed and applied in the laboratory. Water from natural crawfish habitats will be analyzed. Natural crawfish populations will be studied in relation to soil fertility. Population dynamics of crawfish will be studied, including mortality and predators. Crawfish carrying capacity will be determined from small ponds.

PROGRESS: 80/01 TO 80/10. Studies conducted during reporting period on influence of pesticides, rice residue, and planted rice on crawfish production indicated: No differences in growth, survival and yield of crawfish in tanks planted with untreated rice, planted with untreated rice, or planted with treated rice plus receiving Propanil, Crdram and Furadan. No pesticide residues were detected in flesh. In lab studies, a combination of Propanil, Crdram and Furadan was more toxic to crawfish than any single pesticide. After rice was harvested in crawfish ponds the stubble was left standing (S), baled (B) and added back to ponds periodically, or disked (D) into the soil. Half the ponds were flooded early (E), Sept. 20, and half late (L), Oct. 10. Crawfish in S, B and D ponds grew to 19, 18, and 17 g respectively. Crawfish in E and L flooded ponds grew to 92 and 83 mm in length, respectively. Rice straw decomposed fastest in E ponds, followed by S and D ponds, with weight loss of 77, 67, and 49%, respectively, after 5-months. Dissolved oxygen was consistently higher in E flooded ponds than in L flooded ponds; 18 weeks after flooding, periphyton in g/r 2 was E 337, L 216, S 358, E 333, D 307. Ponds containing crawfish were planted with or without rice. Ponds with no rice receiving range pellets (crude protein 9.0%) from Sept. 25 to May 3 produced 881 kg of crawfish/ha. Ponds with rice receiving range pellets from March 1 through May 3 produced 2016 kg.

PUBLICATIONS: 80/01 TO 80/10

- WITZIG, J.F. 1980. Spatial and Temporal Patterns of Macroinvertebrate Communities in a Small Drawfish Pond. M.S. Thesis. LSU, 113 pp.
- CHIEN, Y.H. 1980. Effects of Flooding Dates and Disposal of Rice Straw on Crayfish, *Procambarus clarkii* (Girard), Culture in Rice Fields. Ph.D. Dissert. LSU, 120 pp.
- WITZIG, J.F., AVAULT JR., J.W. and CCNNER, J.V. 1980. Insect Dynamics in a Crawfish Pond with Emphasis on Predaceous Insects (Abstract Only). In Abstr. of Fish Culture Sect. of the Amer. Fish. Soc. 14.
- CHIEN, Y.H. and AVAULT JR., J.N. 1980. Effects of Flooding Dates and Type Disposal of Rice *Oryza sativa*, Straw on the Crawfish, *Procambarus clarkii* (Girard), Culture in Rice Fields, In: Abstr. of Fish Culture Sect. of the
- JOHNSON, W.B. and AVAULT JR., J.W. 1980. Some Effects of Poultry Manures Supplementation to Rice/Crawfish Experimental Earthen Ponds. In Abstr. of Fish Culture Sect. of the Amer. Fish. Soc. 15. (Abstract Only).

004.093* CRIS0030722
DEVELOPMENT OF METHODS FOR MASS PRODUCTION AND MANAGEMENT OF BULLFROGS

CULLEY D D JF; FORESTRY & WILDLIFE MANAGEMENT;
LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA.
70803.
Proj. No.: LAH01445 Project Type: STATE
Agency ID: SAES Period: 01 SEP 68 To 31 JAN 84

OBJECTIVES: Determine the effects on tadpoles of diet and water quality. Development of pelleted diets for bullfrogs. Determine methods of disease control in tadpoles and bullfrogs. Effect of environmental factors and hormone injections on controlled reproduction. Influence of selective breeding on improved growth, acceptance of artificial foods and other useful characteristics.

APPROACH: Modify protein, fats, carbohydrates, vitamins and minerals in tadpole diets and determine the effect on food conversion, growth, abnormalities, etc.; modify water pH and determine effects on growth, mortality and disease occurrence. Determine the effect of temperature, photoperiod and hormone injections on reproductive development. Determine the relationship between diet and mortality due to gut pathogens. Attempt to develop a method to immunize bullfrogs.

PROGRESS: 80/01 TO 80/12. Studies involving the effect of pH of the culture water on disease occurrence in the larvae showed that mortality related to disease increased at pH values above 7.0. The optimum pH appears to be between 6.5 to 6.9. The presence or absence of calcium in the water could not be related to disease at various pH levels. Abnormalities increased when calcium was low (less than 2mg/l in water and less than 0.5% in diet). Addition of calcium to the water did not reduce abnormalities, but addition to the food (and not water) up to 5% did reduce abnormalities. Selection of bullfrogs for accepting non-living food (F(3) generation) showed no improvement in the number of animals responding over previous generations. This phase of the study was terminated. Selection studies for rapid growth produced an F(3) generation. Growth rates are currently being monitored. Reproduction studies showed that wild-caught females could be brought into ovalatable condition in the laboratory within eight weeks when placed on a heavy feeding program, 20-25 degrees C and 12 hr light. Repeated ovulations were achieved within 8 to 12 weeks. Transition metals play significant roles in controlling the production of toxins by pathogenic bacterial in the presence of certain amino acids. The addition of Zinc stimulated production and iron inhibited production.

PUBLICATIONS: 80/01 TO 80/12

MEYERS, S.P., CULLEY JR., D.D., MARSCHALL, D.G. and MARSHALL, G.A. 1980. Evaluation of Binders in Larval Bullfrog Diets. *J. Aquaric.* 1:20-28.

004.094* CRIS0076507
THE RELATIONSHIP OF SALINITY AND DISTANCE FROM THE SEA, TO THE DISTRIBUTION OF JUVENILE FISHES

BERKE W H; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB02008 Project Type: STATE
Agency ID: SAES Period: 01 AUG 78 To 31 DEC 80

OBJECTIVES: Determine how far inland the young menhaden, genus *Brevoortia*, Atlantic croaker, *Micropogon undulatus*, and spot, *Leiostomus xanthurus*, move in the Barataria Bay drainage. Correlate their abundance and size with the salinities, and the location, where they are caught.

APPROACH: A transect about 75 km long contains 15 sample sites. Salinity declines in a northerly direction, from saline or brackish to pure fresh water. Samples will be taken every 2 weeks with a 4.9-m otter trawl. On alternate trips each site will also be sampled with Surface trawl and high speed sampler, or 1.8-m beam trawl and plankton net. Salinity, temperature & water depth will be recorded for each sample. Total biomass, total number, and length of individuals will be recorded for every sample, for menhaden, spot and croaker. Length-frequencies will be analyzed. Abundance at the stations will be analyzed to determine the inland extent of penetration of each species.

PROGRESS: 78/01 TO 80/12. Inshore shrimp trawling was the primary cause for a rapid decline in abundance of Atlantic croaker, *Micropogon undulatus*, after May. No relationship between salinity and croaker size was found. Trawl catches of croaker were an order of magnitude greater at night than during the day. Gulf menhaden, *Brevoortia patronus*, and blue crabs, *Callinectes sapidus*, were also taken in significantly greater numbers in nighttime trawls. The surface trawl was more efficient on 5-25 mm crabs than the otter trawl; researchers on small crabs should consider its use. Menhaden and crabs were taken in

greater numbers in shallow, protected waters than in larger, open waters within the marsh. All three species were taken well above the brackish/freshwater line; menhaden were taken in numbers at several stations 20 km above. The entire coastal marsh, including the freshwater zone, is an important nursery and should be protected from environmental degradation

PUBLICATIONS: 78/01 TO 80/12

ROGBERS, B.E. 1979. The Spatial and Temporal Distribution of Atlantic Croaker, *Micropogon undulatus*, and Spot, *Leiostomus xanthurus*, in the Upper Drainage Basin of Barataria Bay, Louisiana, M.S. Thesis, La. State Univ., Baton Rouge
SIMONEAUX, L.F. 1979. The Distribution of Menhaden, Genus *Erevoortia*, with Respect to Salinity, in the Upper Drainage Basin of Barataria Bay, Louisiana. M.S. Thesis, La. State Univ., Baton Rouge, 96 pp.
DAUD, N.M. 1979. Distribution and Recruitment of Juvenile Blue Crabs, *Callinectes sapidus*, in a Louisiana Estuarine System. M.S. Thesis, La. State Univ., Baton Rouge, 83 pp.

004.095* CRIS0080171
PRESENCE, ABUNDANCE, MOVEMENTS, AND HABITAT USAGE OF ESTUARINE-DEPENDENT FISHES AND CRUSTACEANS.

BERKE W B; ROGBERS B D; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB02076 Project Type: STATE
Agency ID: SAES Period: 20 AUG 79 To 15 AUG 83

OBJECTIVES: To determine: seasonal presence and relative abundance of important larval and juvenile organisms entering and leaving Sabine National Wildlife Refuge; their ingress and egress routes; the relative use made of several habitat types, and to search literature for allied information.

APPROACH: Traps and plankton nets will be fished 1 to 3 times/week on all (6) major possible migration channels for 3 years. The shallow habitat within the Refuge will be sampled monthly using an airboat for transportation, and whatever gear can be found to work satisfactorily in very shallow water. (Gear type to be determined in preliminary work.) Movements will be studied using fluorescent marking techniques. All catches will be recorded by species, numbers, lengths, and habitat types, and searched for marks.

PROGRESS: 80/01 TO 80/12. Field work began in March 1980. Twenty-six traps have been installed and are now in operation. Trapping and trawling is being conducted on established schedules. Nearly 1/2 million organisms were processed by end of July; about 1/2 were fishes (39 families, 88 species) and the rest were crustaceans (5 families, 10 species). Ingress and egress appears to be mainly from Calcasieu Lake side. Much of the marsh was used as nursery at different times.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.096 CRIS0083021
EFFECTS OF ENVIRONMENTAL CONDITIONS AND MANAGEMENT PRACTICES ON COMMERCIAL PRODUCTION OF CRAWFISH

ROMAIRE E P; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB02138 Project Type: STATE
Agency ID: SABS Period: 01 NOV 80 To 31 DEC 85

OBJECTIVES: To delineate the major environmental factors that regulate production of crawfish in commercial ponds. To develop management strategies that optimize economic yields of crawfish from commercial ponds. To evaluate new management techniques developed by the La. Agricultural Experiment Station in commercial crawfish ponds.

APPROACH: Environmental factors that regulate production of crawfish in commercial ponds will be evaluated. Initial investigations will concentrate on water quality dynamics, effluent discharge determination of mineral requirements, and the effects of agricultural pesticides on crawfish. Decay dynamics of forage biomass will be assayed and its effects on crawfish population dynamics ascertained. Conventional traps and new traps designs will be tested for efficiency in harvesting. Forage research will concentrate changes in nutritive quality, biomass production and preference of vegetation types by crawfish.

PROGRESS: 80/11 TO 80/12. Harvesting crawfish with traps is the largest variable expense to commercial producers in Louisiana, generally comprising 40 to 60% of the gross revenues. Six type of traps presently used in the commercial industry and three new trap designs are being evaluated for harvest efficiency in three commercial ponds during the 1980-81 crawfish season. Concomitantly, trap placement, trap density, frequency with which traps are emptied and manipulation of environmental parameters, such as water circulation, are being investigated to ascertain those combinations of harvesting strategies that minimize cost and maximize catch. Seven commercial crawfish ponds are being sampled biweekly with dip nets, seines, and small and large mesh traps during 1980-81 season to quantitate growth, mortality, and recruitment patterns of crawfish populations. Seasonal changes in vegetation cover and plant species composition are being determined by the line-intercept method. These data along with catch and effort data supplied by cooperating producers are being used to develop a mathematical model capable of evaluating management strategies that optimize crawfish yields.

PUBLICATIONS: 80/11 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.097* CRIS0078594
MOVEMENTS OF SONIC-TAGGED FISHES IN RELATION TO WATER QUALITY IN LOWER ATCHAFALAYA RIVER BASIN

BRYAN C F; RANGE SCIENCE; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB02023 Project Type: STATE
Agency ID: SAES Period: 01 NOV 78 To 31 DEC 82

OBJECTIVES: To develop, from the diversity of systems available, a radio tracking system suitable for the study of largemouth bass, *Micropterus salmoides* (Lacepede), black drabble, *Pomoxis nigromaculatus* (Lesuer) and white crappie, *Pomoxis annularis* Rafinesque. To relate movements of largemouth bass and crappies to changes in physicochemical characteristics of water and hydrographic regime in lower Basin habitats. To compare home range dimensions of the largemouth bass and crappies in various habitats. To gain insight into seasonal and diel patterns of movements of the above sport fishes insofar as these movements may be related to water quality variations in the annual hydrographic cycle.

APPROACH: Bass will be electrofished from at least two habitat types in the Atchafalaya River Basin. Radio tags will be implanted surgically and fish will be released immediately. Fish and a physicochemical description of their home ranges will be monitored on a diel and seasonal basis, to gain insight into possible relationships between a changing water quality and fish movements.

PROGRESS: 80/01 TO 80/12. The role of water quality in selection of microhabitats and home ranges of sport fishes has been inferred from laboratory experiments wherein most variables (except one) are held constant. However, a better way to gain insight into water quality preferences may be to follow fishes tagged with telemetry devices while monitoring the water quality in their natural habitat. We surgically implanted radio transmitters in 15 largemouth bass in the Atchafalaya River Basin and tracked them for as many as 117 days. Water temperature, dissolved oxygen, pH, specific conductance, and oxidation-reduction potential were

recorded at each release site and subsequently, at the previous, and at each new location for each tracking day until the fish was no longer detected. We found that bass preferred a water temperature of 27 degrees C and made significantly more movements toward increasing dissolved oxygen. Other water quality characteristics measured did not appear to influence movements. Most locations of bass were made near shore in water less than 1.5 m deep and neither movements nor home range sizes were associated with river stage unless stages were sufficiently high to inundate the swamp floor.

PUBLICATIONS: 80/01 TO 80/12

DOERZEACHER, J.F. 1980. Movement and Home Range of Largemouth Bass (*Micropterus salmoides*) in Relation to Water Quality of the Atchafalaya River Basin, Louisiana. M.S. Thesis, La. State Univ., Baton Rouge, Louisiana.

004.099* CRIS0083896
ULTRASTRUCTURAL CHANGES IN TELEOST GILLS: EFFECTS OF SUBTLE ALTERATIONS IN THE ENVIRONMENT

BAUCK W N; TAYLOR B W; VETERINARY SCIENCE; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Agency ID: CSVM0180-SVM Period: 01 JUL 80 To 30 JUN 81

OBJECTIVES: To develop techniques for ultrastructural examination of fish gills. To compare by light and electron microscopy, normal gill morphology to morphology in which fish have been subjected to specific environmental changes. To correlate morphopathology and environmental changes and propose a pathogenic basis for disease development. To examine random gill samples from clear and polluted fresh, estuarine and marine populations of both cultured and feral fish. These samples will be compared to those which have been previously examined.

APPROACH: Gills will be collected from laboratory cultured fish which have been exposed to pH and dissolved oxygen alteration, addition of ammonia and sewage effluent and increase in fish population density. Gills will be collected from apparently healthy and sick feral and propagated food fish. These samples will be processed and sectioned according to standard methods and examined with the light and electron microscope. An attempt will be made to quantify and correlate lesions with the damaging agent involved.

004.099* CRIS0082633
CRAWFISH CULTURE STUDIES IN SMALL PONDS: BURROWING, POLYCULTURE AND NATURAL POND FLOODING

HUNER J V; COLLEGE OF AGRICULTURE; SOUTHERN UNIVERSITY, BATON ROUGE, LOUISIANA. 70813.
Proj. No.: LA-X-81-2003-2044 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 80 To 30 SEP 85

OBJECTIVES: Determine the spatial and seasonal burrowing patterns of crawfish in small, open crawfish ponds. Assess the effectiveness of various techniques for facilitating successful burrowing of crawfish in crawfish ponds. Determine the effects of soil tilling practices on crawfish burrows in crawfish ponds. Determine the commercial feasibility of cultivating channel catfish and crawfish together in small, open south Louisiana crawfish ponds. Determine the commercial feasibility of using rainfall to flood crawfish ponds in south Louisiana.

APPROACH: Objectives 1, 2, 4 and 5 will be pursued in the four, one acre crawfish ponds located at Southern University. Objective 3 will be pursued in a nearby commercial pond. During the first two years, burrows will be marked and mapped on a biweekly basis and several types of materials will be tested to determine their effectiveness as burrowing facilitators. Also, during the first two years, marked burrows will be subjected to disking and tractor-bush hog compaction early and late during the

dry season to determine their impact on the occupants. In years 2 and 3, channel catfish will be stocked in test ponds after they have been filled with water in the fall. Catfish production and catfish impact on crawfish production will be recorded. In years 4 and 5, test ponds will be permitted to fill naturally in the fall and winter. The impact on this action on crawfish production will be measured.

004.100* CRIS0060712
METABOLISM AND FUNCTION OF CELLULAR LIPIDS

DESIERVO A J; AGRICULTURAL EXPER. STATION; UNIVERSITY OF MAINE, ORONO, MAINE. 04469.
Proj. No.: ME08752 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 78 To 30 SEP 86

OBJECTIVES: Analysis of lipid and lipid enzymes in detergent-resistant and pigmentation mutants of *M. lysodeikticus*. Studies of lipid composition and lipid identification in marine caulobacter species. The effect of herpesvirus infection on the lipid metabolism of cultured animal and human cells.

APPROACH: Comparative studies between wild-type and detergent resistant mutants are planned to elucidate the mechanism of resistance and the relationship between resistance and the lipid composition by analyzing the changes in lipid composition during growth in the presence of different levels of detergent. Pigmentation mutants will be compared with respect to lipid composition and fatty acid analysis. Evidence has accumulated which indicates that *Caulobacter halobacteroides* and other marine caulobacters have an unusual lipid composition. We propose to identify the glycolipids of these organisms, analyze isolated membranes, and determine if typical phospholipid biosynthetic pathways play a role in the metabolism of these organisms. A study of the effects of MDV infection on cellular lipid composition and the breakdown and synthesis of cholesterol ester in an in vitro, primary cell system is planned. Vascular smooth muscle and cardiac muscle cell cultures will be infected with NDV and HVT cell-associated viruses.

PROGRESS: 80/01 TO 80/12. In studies of Triton X-100 (TX) resistant mutants of *M. lysodeikticus*, a comparison of the release of label from wild-type and mutant cells suggested that it was not the penetration of the detergent through the cell walls that was responsible for resistance. The lipid compositions of the wild-type and mutant were different when grown in the absence of TX. The lipid alterations during growth of the mutant in the presence and absence of TX were significantly different, indicating that the presence of TX does affect the regulation of lipid composition and metabolism. Experiments designed to determine differences between two pigmented mutants and the wild-type of *M. lysodeikticus* were undertaken. The wild-type contains derivatives of the yellow carotenoid, neurosporene; the pink mutant was shown to have large amounts of lycopene; and the white mutants has only trace amounts of visible pigments. Since it had been suggested that carotenoids may act to reinforce the membrane bilayer, we compared the growth rates of these three cultures at different temperatures. All three cultures had the same optimal growth temperature, 35C. The pink mutants, however, had a more narrow temperature growth range. Studies of the lipid composition of the marine bacterium, *Caulobacter halobacteroides*, indicate that this organism contains little, if any, phospholipid; most of the extractable lipid being glycolipid. The nature of this glycolipid is currently being investigated.

PUBLICATIONS: 80/01 TO 80/12
DE SIERVO, A.J. and HOMOLA, A.D. 1980. Analysis of *Caulobacter crescentus* Lipids. J. Bacteriol. 143:1215-1222.
DE SIERVO, A.J. and HOMOLA, A.D. 1980. Growth and Lipid Changes of Detergent Resistant Isolates of *Micrococcus lysodeikticus*. Abt. Ann. Mtg. Amer. Soc. Microbiol. K217:162.

004.101

CRIS0075102

EFFECTS OF ATMOSPHERIC INPUTS OF ACIDS AND HEAVY METALS ON LAKE PLANKTON

DAVIS R H; NORTON S A; BCTANY & PLANT PATHOLOGY; UNIVERSITY OF MAINE, ORONO, MAINE. 04469.
Proj. No.: ME08465 Project Type: HATCH
Agency ID: CSRS Period: 01 MAY 78 To 30 SEP 80

OBJECTIVES: Assess the proposition that changes in the planktonic flora and fauna in many northern New England lakes are responses to changes in heavy metal loading from the atmosphere, acidic precipitation, or both.

APPROACH: Taking sediment cores from montane lakes having watersheds essentially unaltered by humans, determining sediment chronology by Cs¹³⁷, Pb-210, and palynological methods, and analyzing geo-chemical and microfossil (incl. diatoms and cladocerans) stratigraphy.

PROGRESS: 80/01 TO 80/12. Sediment cores (ca. 0.5 m long) were obtained from six high altitude Maine lakes with pristine, granitic water sheds. The cores have been analysed for sediment chronology (pollen, Pb-210, Cs-137), natural watershed disturbance (pollen, charcoal, chemistry), geochemistry (water, total organic matter, K, Na Mg, Ca, Ti, Al, Fe, Mn, Pb, Zn, Cu), diatom assemblages (five lakes completed), and chydorid Cladocera (three lakes completed). The present median pH of weekly precipitation in the region is about 4.3. Elevated zinc and lead concentrations in precipitation are associated with acid pollution. An increase in Pb and Zn concentrations in the sediments starts in the late 1800's regardless of limnological and geological factors and present lake water pH. However, in subsequently acidified lakes (pH lowered to less than ca. 5), concentrations of Ca, Mg, K, Mn, and Zn decrease in recently deposited sediment. These elements are more soluble at low pH. A proposed mechanism for the decreasing concentrations is the accelerated leaching of the elements from watershed soils (sediment precursors) and from lake sediments at the sediment/water interface. This implies a concurrent increase in concentrations of these metals in soil leachate and lake (and stream) water. Sediment surface diatom assemblages from 30 northern New England lakes of known water pH have been used to derive multiple regression coefficients which are applied down-core for inferring past lake water pH.

PUBLICATIONS: 80/01 TO 80/12

DAVIS, R.H., NORTON, S.A., BRAKKE, D.F. and BESS, C.T. 1980. Atmospheric Deposition in Norway During the Last 300 Years as Recorded in S.N.S.F. Lake Sediments. IV. Synthesis and Comparisons With New England.
NORTON, S.A., BESS, C.T. and DAVIS, R.H. 1980. Rates of Accumulation of Heavy Metals in Pre- and Post-European Sediments in New England Lakes. In: Input of Atmospheric Pollutants to Natural Waters, pp. 409-421, Eisenreich, S.J., Ed.
DAVIS, R.H. 1980. Acidic Precipitation in Maine. Update. Products and Progress in Life Sciences and Agricultural Research 8(4):1-3. Univ. of Maine, Orono.
NORTON, S.A. and GALLOWAY, J.N. 1980. Changing pH and Metal Levels in Streams and Lake in Eastern United States. International Symposium for Inland Waters and Lake Restoration, Spons. E.P.A. and OCEC, p. 10.

004.102*

CRIS0064835

DISTRIBUTION, ABUNDANCE AND ECOLOGY OF ASCOPHYLLUM NODOSUM (1) LB JOIS

VADAS R L; BCTANY & PLANT PATHOLOGY; UNIVERSITY OF MAINE, ORONO, MAINE. 04469.
Proj. No.: ME08459 Project Type: HATCH
Agency ID: CSRS Period: 13 FEB 74 To 30 SEP 82

OBJECTIVES: Determine: Distribution and abundance patterns of *A. nodosum* in Main, growth, reproductive, age and biomass patterns on exposed, semi-exposed and sheltered shores; biomass of *Fucus* spp., value of aerial photography and infrared film for *A. nodosum*

surveys; methods to enhance colonization of *A. nodosum*; harvestable yields of *A. nodosum*.

APPROACH: Permanent and randomly selected sites will be utilized to survey the algal resource and study growth patterns. Samples will be taken seasonally. Experimental studies on colonization will be conducted in situ and in simulated tide cycles in running seawater tanks.

PROGRESS: 80/01 TO 80/12. Four study areas were established in 1980 making a total of six in two major areas (Northeast and Southeast) of the coast. The percent cover and biomass of *Ascophyllum* and *Fucus* spp. were determined in belt transects and in 10 x 100 cm quadrats, respectively. Samples were stratified by intertidal height. Biomass and growth and density of plants and apical growing points were measured to determine growth and productivity potentials. Reproductive output was measured in Fall 1980 for plants at the six sites. Data measurements are nearly complete for these sites (through Fall 1980). Computer programming and analysis will be initiated in spring 1981. Field colonization studies involving *Ascophyllum* during 1980 were not successful. Only a few recruits developed (to 2-5 mm) from approximately 130 experimental plots involving millions of fertilized eggs. Some promising leads will be followed up during 1981. Colonization experiments in running sea water from these same eggs showed excellent growth and survival for 1 to 2 months until adversely affected by sedimentation.

PUBLICATIONS: 80/01 TO 80/12

LARSON, E.R., VADAS, R.L. and KESER, M. 1980. Feeding and Nutritional Ecology of the Sea Urchin *Strongylocentrotus brachiensis* in Maine, USA. Mar. Biol. 59:49-62.
KESER, M., VADAS, R.L. and LARSON, E.R. 1981. Regrowth of *Ascophyllum nodosum* and *Fucus vesiculosus* Under Harvesting Regimes in Maine, USA. Bot. Mar. 24:29-38.

004.103

CRIS0074475

BLACK FLY DAMAGE THRESHOLDS, BIOLOGY AND CONTROL

GIBBS K E; ENTOMOLOGY; UNIVERSITY OF MAINE, ORONO, MAINE. 04469.
Proj. No.: ME08039 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 77 To 30 SEP 82

OBJECTIVES: Analyze the population dynamics of black flies, and factors contributing to their distribution and abundance.

APPROACH: The role of invertebrate and vertebrate predators in the population dynamics of black fly larvae will be examined. Sampling methods will be devised which will give information on black fly larval populations and associated invertebrates. The gut contents of invertebrate predators will be examined for the presence of black fly larvae. Both the larvae and the predators will be classified according to size. Fish will be sampled by electro-fishing and the stomach contents analyzed for the presence of black fly larvae.

PROGRESS: 80/01 TO 80/12. The roles of fish (*Catostomus commersonii* (white suckers), *Semotilus corporalis* (fallfish), *Micropterus dolomieu* (smallmouth bass) and *Lepomis* sp. (sunfish) and hydropterychid caddisfly larvae (*Symphytosyche morosa*, *S. sparna* and *Hydropsyche scalaris*) as predators of larvae of *Simulium penobscotensis* in the Penobscot River are being investigated. Sampling took place at weekly intervals between May and October, 1980. On each date approximately 20 specimens of each species of fish were taken from the beds of *Potamogeton* spp. to which the black fly larvae were attached. The fish length and weight, volume of stomach content, and the presence of blackfly larvae (numbers and percent volume in the stomach) will be recorded for each fish. Quantitative weekly samples of invertebrates were taken from the *Potamogeton* spp. the substrate and the drift. The numbers and head widths of the caddisfly larvae will be recorded as will the numbers of black fly larvae in the gut content. Emergence of caddisfly adults was

monitored by weekly light trap collections. Processing of these samples is in progress and analyses of these data should allow an evaluation of the role of the different fish species as predators throughout the season, life history analysis of the various caddisfly species and their role as predators.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.104 CRIS0074522
COMPARATIVE STUDY OF THE FLEXIBACTER-CYTOPHAGA GROUP BACTERIA

PRATT D B; MILLAED P; FOSE G; MICROBIOLOGY;
UNIVERSITY OF MAINE, OBCNC, MAINE. 04469.
Proj. No.: ME08755 Project Type: HATCH
Agency ID: CSRS Period: 23 JAN 78 To 30 SEP 80

OBJECTIVES: Isolate and representative members of Flexibacter and Cytophaga from marine, aquatic, and soil samples. Improve procedures for detection and recognition of these microorganisms.

APPROACH: The proposed research can be divided into two phases. Representative cultures will be isolated from marine, aquatic, and soil samples. Various selective and differential media will be tested. Cultures from each source along with named strains will be thoroughly characterized. Comparisons will be made using numerical taxonomy.

PROGRESS: 78/01 TO 80/09. Studies by James Sutton (M.S. Student) concerning the identification and variability of a Flexibacter sp. have indicated a high rate of spontaneous variation in this organism. The organism was similar to Flexibacter auranticus var. copepodarum (Lewin) and to the organisms in Fager's Group 16. The natural variability of the organism was such that species identification would be easily compromised. Twelve spontaneous variants were studied as to the biochemical and morphological characteristics. Variations were shown in pigment formation, colonial size, roughness, gliding motility, catalase activity, proteolysis, tyrosinase activity, and maximum growth temperature. The nature of the high rate of variability requires further study to learn if it results from chromosomal gene mutation or plasmid loss. Substrate utilization tests using an agar based medium were not useful for agarolytic cytophagas since agar served as a carbon source; the flexibacters examined failed to grow on the defined medium. A study of the toxic effects of electron transfer compounds showed that most of the strains tested were sensitive to methylene blue (2ppm) and to diquat (2-20ppm) but methyl viologen and triphenyl tetrazolium chloride were relatively less toxic. No correlation to sensitivity and catalase activity was observed. Further studies of the nutritional and growth characteristics of these bacteria are the subject of a new project.

PUBLICATIONS: 78/01 TO 80/09
MILLAED, P. and PRATT, D. 1980. Sensitivity of Marine Cytophagas and Related Species to Ultraviolet Radiation. Abstract of the Annual Meeting ASM.
SUTTON, E.J. 1980. The Characterization of Colonial Mutants of a Marine Flexibacter. M.S. Thesis. Department of Microbiology, University of Maine at Croton.

004.105 CRIS0082911
CLOSED CYCLE FISH CULTURE WATER FILTRATION USING BIOLOGICAL SYSTEMS

WHEATON F W; LAWSON I E; KARLANDER E P; AGEI
ENGINEERING; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MC-EK-066 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 80 To 30 SEP 83

OBJECTIVES: Determine efficiency of nitrification filters for closed cycle aquacultural systems as a function of various operating parameters. Determine effectiveness of aquatic plants in removing nutrients from aquatic closed cycle culture systems. Use the data gathered from objectives one and two above to develop design equations for nitrification and plant filters.

APPROACH: Design equations for nitrification filters will be developed by operating pilot scale filters using an inorganic nitrogen source. Filter inlet ammonia concentration, oxygen concentration, temperature and pH will be varied and the filter's efficiency for converting ammonia to nitrate monitored. Macroscopic plants will be used to filter water containing an inorganic nutrient mix. The nitrogen and phosphate concentrations, water temperature, water retention time in the filter, pH and physical filter dimensions will be varied and related to nutrient extraction rates. Light levels will be maintained at a constant value. Filter design equations will be developed from the data collected.

004.106 CRIS0083580
EFFECTS OF HERBICIDES ON CHESAPEAKE BAY PHYTOPLANKTON

CALLOWAY R A; ECTANY; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MD-K-022 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 81 To 30 SEP 83

OBJECTIVES: Test the effects of atrazine and linuron on the growth and photosynthesis of several genera of algae, such as Isochrysis, known to be important to the fisheries industry. Other herbicides may be included pending discovery of what would appear to be significant concentrations in the Chesapeake Bay. If an organism is discovered to be resistant to a given herbicide, it will be determined if this results from simply exclusion of the compound, or if the organism takes up the compound and detoxifies it or metabolizes it in some way. If the latter be the case, further tests will be made to see if products injurious to other species are contained by or released from the resistant organism.

APPROACH: Pure algal cultures will be grown in controlled environments at appropriate temperatures, light intensities and ranges of salinities and exposed to herbicides. Growth and photosynthesis will be monitored by conventional methods. Unaffected organisms will be further tested for herbicide uptake. Where uptake has occurred, the organism will be used in feeding experiments rendered them unfit for or perhaps dangerous to consumers. Additionally, the culture medium will be assayed for metabolites which may affect other organisms. Radioisotopes and gas chromatography will be employed.

004.107* CRIS0067857
PHYSIOLOGY OF CHESAPEAKE BAY PHYTOPLANKTON

KARLANDER E P; BOTANY; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MD-K-013 Project Type: STATE
Agency ID: SAES Period: 01 MAY 75 To 30 SEP 80

OBJECTIVES: Characterization of the major food and oxygen producing plants supporting the seafood industry of Maryland is the major objective. Environmental factors including light, nutrients, temperature, energy, and interspecific interactions will be measured.

APPROACH: The research will be carried out primarily through the University of Maryland. Some work on the Chesapeake Bay will be necessary to obtain samples. Controlled natural, and possible variations in the environment will be introduced in naturally occurring and cultured communities. Initial investigations will concentrate on growth, production, and pigmentation.

Absorbance, spectrophotometry, oxygen determination, and carbon uptake techniques will be used with cultured phytoplankton.

PROGRESS: 75/05 TO 80/09. Three algae from the Chesapeake Bay were characterized in terms of their growth rate response to various environmental conditions of light, temperature, nutrition and salinity. The effects of grazing at various phases of growth was measured in a fourth algae. Results of the grazing work showed that as net primary production decreased from exponential phase to declining phase to stationary phase that an equal level of grazing removed an increasing proportion of net primary production from each phase. The golden-brown planktonic alga, *Pseudopedinella pyriforme* grew best between 2 1/2 and 5 g/kg salinity. *Mychozoetes ruminatus*, a unicellular alga grew best between 10 and 20 g/kg salinity at 0.78 m W/cm white light, and 25C. The phytoplankton, *Nannochloris oculata* had a maximal growth rate at 30 C, 15 g/kg salinity, and 1.35 m W/cm white light on ammonium. The nitrogen source showing the best growth was dependent on interactions among the physical parameters of the environment. It is concluded that the production of Chesapeake Bay and the species composition of the primary plants will depend on the management of the environmental parameters affected by nutritional pollution, sedimentation, temperature manipulation and salinity control.

PUBLICATIONS: 75/05 TO 80/09

OSTROFF, C.R., KARLANDER, E. F., VAN VALKENBURG, S.D. 1980. Growth rates of *Pseudopedinella pyriforme* (Chrysothrixaceae) in response to 75 combinations of light, temperature, and salinity. *J. Phycol.* 16:421-423.

TERLIZZI, D.E. and E.P. KARLANDER. 1979. The role of light, temperature, salinity, and nitrogen source, in factorial combination on the growth of *Nannochloris oculata* Droop. Paper 42 Ann. Mtg. Am. Soc. Limnol. Oceanogr.

TERLIZZI, D. E. and E.P. KARLANDER. 1979. Soil algae from a Maryland Serpentine Formation. *Soil Biol. Biochem.* 11:205-207.

SPERLING, A.M. and E.P. KARLANDER. 1979. Effects of light on the low temperature autotrophic metabolism of *Chlorella eorokiniana*. Shihira and Krauss. *Environ. Exptl. Botany* 19:237-243.

SIMPSON, P.D., KARLANDER, E.P., and S.D. VAN VALKENBURG. 1978. The growth rate of *Mychozoetes ruminatus* Simpson et Van Valkenburg under various light, temperature and salinity regimes. *Br. Phycol. J.* 13:291-298.

004.108* CRIS0073934
MORPHOLOGICAL, ULTRASTRUCTURAL, AND BIOCHEMICAL CHARACTERIZATION OF NANOPLANKTON FROM CHESAPEAKE BAY

PATTERSON G W; VAN VALKENBURG S D; BOTANY; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MD-K-016 Project Type: STATE
Agency ID: SAES Period: 01 OCT 77 TO 30 SEP 80

OBJECTIVES: Screen various nanoplankton organisms already brought into culture from the Chesapeake Bay, in order to select for "new" organisms--those which cannot be identified through use of standard keys. Study in detail the morphology and microanatomy of the organisms selected as above in order to determine their taxonomic affinities. Characterize the photosynthetic pigments of these organisms, particularly the chlorophylls, the presence or absence of phycobilins, and the xanthophylls, in order to determine their taxonomic affinities. Characterize the biochemical composition of these organisms, especially the protein and lipid composition, in order to evaluate the organism as food for Chesapeake Bay shellfish.

APPROACH: Screening procedures involve morphological description by light microscopy, a scan of the major pigments by acetone-extraction techniques and a cursory examination by transmission electron microscopy, sufficient to determine the basic cytological condition of the organism. In-depth studies by light, scanning electron and transmission electron microscopy will be done in order to produce

definitive descriptions of these organisms. Pigments will be studied by photospectrophometric scanning of acetone extract, and by both thin layer and column separation and extraction procedures. Total protein composition will be determined by Kjeldahl analysis and lipid analysis will be performed by standard extraction methods followed by thin layer and gas chromatography.

PROGRESS: 77/10 TO 80/09. Over thirty species of *Chlorella* have been examined for sterol and fatty acid composition. The major fatty acids were palmitic, oleic, linoleic and linolenic. Some strains had major quantities of palmitoleic as well as di- and triunsaturated sixteen carbon acids. Tetra-unsaturated acids with 16 and 18 carbons were found in a few strains. *Chlorella* could be divided into 3 major groups based on sterol compositions: Delta 5-sterols Delta 7-sterols Delta 5, 7-sterols. One strain contained Delta 5, 8-sterols, which are extremely rare in living organisms. These lipid constituents show promise as biochemical markers for taxonomic groupings. Most of the *Chlorella* species and strains would appear to be unlikely as oyster food based on their sterol composition and that of the oyster. Several diatoms which are of the proper size for ingestion by the oyster, appear to have the same sterol composition as the oyster, indicating that they could be the oyster's food source.

PUBLICATIONS: 77/10 TO 80/09

NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

004.109* CRIS0064213
ACTIVITY RHYTHMS OF THE NORTHERN ROCK CRAB IN RELATION TO ENVIRONMENTAL AND SOCIAL FACTORS

REBACH S; UNIVERSITY OF MARYLAND EASTERN SHORE, PINECESS ANN, MARYLAND. 21853.
Proj. No.: MDX-PR-0001-URP31/73

Agency ID: CSRS Period: 25 MAY 73 TO 24 MAY 78

OBJECTIVES: Develop a simple and accurate way to measure activity rhythms in *Cancer borealis* and determine the importance and effect of photoperiod, tidal cycle, temperature, salinity, age, sex and stage of the reproductive and molting cycles on its activity and movements.

APPROACH: Crabs will be maintained under varying regimes of temperature, salinity, photoperiod and tidal cycle. The crabs will be tested in aquaria utilizing photocells connected to a recording device to measure activity under these different conditions. Observations will be made on crabs of both sexes, various ages and different physiological states, such as molt phase and reproductive condition, determine how these factors effect responses to solar and lunar rhythms. A knowledge of these factors and periods of optimum activity should provide basic information to the crabbing industry in relation to the timing and techniques of harvesting this species. This study might also lead to the ability to advance the reproductive season or increase the number of annual reproductive periods in *C. borealis* and, therefore, make commercial aquaculture of crabs a profitable venture.

PROGRESS: 79/01 TO 79/12. Data obtained from measurements of locomotor activity of *Cancer irroratus* held under varying photoperiods is presently being reanalyzed to determine if size or stage of the molt cycle influenced the amplitude or periodicity of activity

PUBLICATIONS: 79/01 TO 79/12

NO PUBLICATIONS REPORTED THIS PERIOD.

004.110* CRIS0070148
BEHAVIOR, ECOLOGY AND RHYTHMICITY IN THE COMMON ROCK CRAB

REBACH S; NATURAL RESOURCES; UNIVERSITY OF MARYLAND
EASTERN SHORE, PRINCESS ANN, MARYLAND. 21853.
Proj. No.: MEX-PR-0001-URF4S Project Type: GEANT
Agency ID: CSFS Period: 15 MAR 76 To 14 DEC 80

OBJECTIVES: Develop a method to maintain crabs under laboratory conditions for prolonged periods. Develop a simple and accurate method to measure activity rhythms. Determine the importance and effect of photoperiod, tidal cycle, temperature, salinity, age, sex and stage of reproductive and molt cycles on activity and movement. Study population structure and the distribution of *Cancer irroratus*. Determine the nutritional requirements of experimental animals.

APPROACH: Design and construct a recirculating, temperature-controlled activity testing facility. Design infrared photoelectric cell sensors, amplify signal, record and collect data. Measure activity rhythms under varying conditions of photoperiod, tidal cycle, temperature, salinity, age, sex, reproductive and molt cycles. Develop a high-protein pelleted diet and compare to other feeds that might be used in commercial mariculture of crustacea. Analyze population structure utilizing catch data on size, sex ratio, and distribution in various local areas.

PROGRESS: 80/01 TO 80/12. In studies of the ecology and behavior of the common rock crab (*Cancer irroratus*) (Febach, 1977, 1978) conducted in the laboratory, it was necessary to maintain 20 to 50 animals for periods in excess of one year. A pelleted diet developed by the principal investigator was compared to other diets fed to the crabs and resulted in greater weight gain, lower mortality and greater molt success in the laboratory. The high levels of calcium and phosphate maythion diet may contribute to molt success and survival. It has been hypothesized that the physical form and high water stability of the pellets were especially suited to benthic decapod crustaceans. The pellets can be stored in the laboratory for indefinite periods, are easy to handle and can be adapted to mechanical delivery systems.

PUBLICATIONS: 80/01 TO 80/12

REBACH, S. 1981. A Pelletized Diet for Captive Benthic Crustaceans. See Grant Publication UM-SG-IS-81-01. 8 pp.

004.111 CRIS0077475
THE FATE AND EFFECTS OF CHEMICALS IN AQUATIC ECOSYSTEMS

JOHNSON B E; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: MICH03078-S Project Type: STATE
Agency ID: SAES Period: 26 DEC 78 To 25 DEC 83

OBJECTIVES: Develop and test laboratory methods for evaluating the fate and chronic toxicity of agricultural and industrial chemicals in aquatic environments. Determine the environmental requirements of aquatic organisms that are useful indicators of water quality.

APPROACH: Simple laboratory microcosms and semi-natural aquatic environments, i.e. experimental ponds and streams treated with chemicals to determine the fate and toxicity of chemicals to selected aquatic organisms. Various aquatic species will be reared in the laboratory to determine their value as test organisms.

PROGRESS: 80/01 TO 80/12. Beta-naphthoflavone was found to stimulate in-vitro metabolism of two selected substrates over that of untreated goldfish. This is the first confirmation of the induction in goldfish and establishes the basis for further identification of sublethal effects of chemicals in aquatic ecosystems. Reproductive performance in mink was suboptimum when fed diets containing 30% Great Lakes fish on fish scraps. Because PCB levels in Great Lakes fish have declined, this study is continuing to evaluate the possible value of this food source for commercial mink production.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.112 CRIS0012991
FARM FISH POND MANAGEMENT

KEVERN N R; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: MICH00064 Project Type: BATCE
Agency ID: CSRS Period: 22 JUL 44 To 01 JAN 99

OBJECTIVES: Estimate production of plants and animals per unit area or volume of water in farm type ponds, and natural ponds. Determine extent fertilization of ponds will increase production of fish food (plankton, insects) and fish. Devise practical management programs for farm ponds; this includes the number of fish to plant and harvest. Detect and measure possible detrimental effects of use of fertilizers in fish ponds.

APPROACH: Measurement release of stored nutrients in the subaqueous soils by addition of chelating (EDTA, etc.) materials to the waters. Tracing the paths of nutrients added to the waters through tagging nutrients with radioactive tracers (P^{32}), rates of fixation of nutrients and accumulation of organic material (basic productivity) will be measured by the C^{14} light-and-dark bottle technic. Input of solar radiation will be measured.

PROGRESS: 44/07 TO 79/10. The research has contributed significantly to the management techniques of fish ponds in northern, midwestern areas of the United States. These techniques relate to the stocking densities of fish, the species of fish suitable, fertilization rates for ponds and fish and fish food relationships. Northern ponds must be stocked and fertilized differently than southern ponds in many aspects. Competition among sport versus rough fish in ponds results in reduced growth rates of sport fish when ponds are fertilized. This results apparently from lower dissolved oxygen levels in fertilized ponds. Raising of catfish in Michigan for sale is successful when starting the season with advanced fingerlings.

PUBLICATIONS: 44/07 TO 79/10

- GALLOWAY, J. E. AND N. R. KEVERN. 1976. Michigan suckers, their life histories, abundance and potential for harvest. Mich. Sea Grant Tech. Rpt. 53: 46 pp.
- LU, J. D. AND N. R. KEVERN. 1975. The feasibility of using waste materials as supplemental fish feed. Prog. Fish-Cult. 37(4): 241-244.
- BAINES, T. A. 1973. Effects of nutrient enrichment and a rough fish population (carp) on a game fish population (small mouth bass). Trans. Am. Fish. Soc. Vol. 102: 346-354.
- BABR, T. G., R. C. BALL AND F. F. HOPPER. 1969. Some ecological changes in ponds resulting from treatments of sodium arsenite and copper sulfate. Michigan Academician, Vol. 1, Nos. 3 and 4.
- BALLS, J. D. AND R. C. BALL. 1976. Response of pond metabolism to sodium arsenite. Papers of Mich. Acad. of Sci., Arts, and Lett., Vol. 11.

004.113 CRIS0012996
ECOLOGICAL RELATIONSHIPS OF PESTICIDES, RADIONUCLIDES & NUTRIENTS WITH ORGANISMS IN AQUATIC COMMUNIT

KEVERN N R; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: MICH00940 Project Type: BATCE
Agency ID: CSRS Period: 11 MAR 64 To 01 JAN 99

OBJECTIVES: Evaluate amount, storage, build-up and release of pesticides under varying biological and chemical-conditions.

APPROACH: Studies on contamination and levels necessary to produce injury, debility, sterility or mortality will be conducted. The physiological effects of pesticides on energy exchange measured at the cellular level. Direct bioassay and gas chromatography employed to monitor the accumulation

of pesticides in aquatic systems. Determine site of damage and identification of effects of detergents, metallic ions, BOD and other chemicals. Rate of transfer, buildup and exchange within the biota of aquatic systems will be determined.

PROGRESS: 80/01 TO 80/12. Gross primary productivity (phytoplankton) and community respiration were measured in western Lake Erie in the vicinity of the Monroe Power Plant to assess the impact of the once-through cooling system waters on the aquatic ecosystem. Samples were collected from the lake and river source waters; the discharge canal, where water temperature increased 6 to 10 C after passage through the condensers; and the thermal plume. Data were collected monthly for one year for preoperational estimates and for one year for post-operational estimates. The temperature increase of the water mass from the passage through the power plant usually resulted in a depression of the productivity in the discharge canal waters. Corresponding community respiration rates almost doubled as a result of elevated water temperature. Depressed productivity recovered partially as the water mass cooled and moved through the canal. A slight simulation occurred as ambient temperatures were approached in the lake proper. Elevated respiration rates decreased as the water mass cooled. The study revealed the impact of the thermal discharge to be significant over a small area; however, the phytoplankton community did recover.

PUBLICATIONS: 80/01 TO 80/12

WAENE, C.C. 1980. Community Metabolism in Thermally and Organically Enriched Waters of Western Lake Erie. M.S. Thesis. Mich. State Univ. East Lansing. 84 pp.

004.114 CRIS0054680
MECHANISTIC FACTORS DETERMINE AQUATIC FERTILITY

KING D D; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: M1CLO1387-B Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 81 To 30 SEP 86

OBJECTIVES: Determination of factors causing bluegreen algal dominance in ponds, lakes, and reservoirs. Determination of the role of the aquatic animal community in determining type and amount of aquatic plant production. Establishment of management criteria for maintenance of the optimal aquatic community and for optimal nutrient use, recycle, and removal within ponds, lakes and reservoirs.

APPROACH: A combination of laboratory microcosms and field study in enriched ponds will be used to determine the mechanisms controlling each portion of the aquatic ecosystem as well as the interactive feedback controls among and between the various physical, chemical and biological components.

004.115* CRIS0075621
ECOLOGY OF FISHES AND LIMNOLOGY OF UPPER GREAT LAKES AND TRIBUTARIES IN RELATION TO ENVIRONMENTAL IMPACTS

LISTON C R; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: M1CLO1312 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 78 To 30 JUN 83

OBJECTIVES: Understand the biology and ecology of fishes in near-shore waters of Lake Michigan near Ludington, Michigan, and in selected tributaries of Lake Michigan. Examine limnological aspects in these waters including temperature, water transparency, turbidity, dissolved oxygen, and benthos. Relate findings to impacts of resource utilization, and to agencies responsible for the management of important sport and commercial fish species.

APPROACH: Sample adult, juvenile, and larval fishes using standard gill nets, trawls, seines, and meter nets during ice-free periods. Identify species and record total numbers and weights for each method. Record length, weight, sex and age for individuals of all species and determine food habits and fecundity for selected species. Determine limnological parameters at location of fish sampling sites.

PROGRESS: 80/01 TO 80/12. Studies continued in four areas: impacts on Lake Michigan fisheries from the Ludington Pumped Storage Power Plant; ecology of connecting waters between Lakes Superior and Huron (St. Mary's River) in relation to winter navigation; fish stock assessment in Whitefish Bay, Lake Superior; ecology of fish in the Red Cedar River. Losses of larval, juvenile, and adult fishes (mainly alewives, smelt, and salmonids) were greater at Ludington than for any other existing power plants on Lake Michigan. Regulatory agencies are now using results to determine a mitigation policy for Michigan. Forty-seven fish species use the St. Mary's River, and young of important sport fish depend upon aquatic plants in shallow water for food and protection. Shallow areas are most likely to be impacted from winter shipping. Adult fish were dominated by lake herring, yellow perch, smelt, northern pike, and white sucker. At least 18 species spawn successfully in the St. Mary's River. Commercial catches of whitefish in Whitefish Bay were comprised mainly of Ages V, VI, and VII Fish. Average catch was 69.7 kg. Results are used by the U.S. Department of Interior to assess stocksize.

PUBLICATIONS: 80/01 TO 80/12

LISTON, C.R., BRAZO, D.C., BOHR, J., IIGMAN, R., ONEAL, R. and PETERSON, G. 1980. Studies of Entrainment of Fish and Invertebrates, Turbine Mortalities, Netting and Hydroacoustic Surveys, and Water Currents at the Ludington Pumped Storage Power Plant. Michigan State University. 100 pp.
BOHR, J.R. 1980. Abundance, Distribution and Community Interactions of Demersal Fishes Inhabiting a new Pumped Storage Reservoir on Lake Michigan M.S. Thesis, Mich. State Univ. 62 pp.
LISTON, C.R., DUFFY, W., ASBTON, D., MCNABB, C. and Evaluation of the St. Mary's River KOBLEK, F. 1980. Environmental Baseline and Evaluation of the St. Mary's River Dredging. Mich. State Univ. Dept. Fish Wildl., Rep to U.S. Fish. Wildl. Service. 295 pp.
PETERSON, G.F., BRAZO, D.C. and LISTON, C.R. 1980. Food Habits of Predatory Fish in Lake Michigan Near the Tailrace of the Ludington Pumped Storage Power Plant. Mich. Acad. Sci., Arts, Letters. Vol. 10.

004.116* CRIS0012668
AN EVALUATION OF WIDELY USED HERBICIDES ON AQUATIC PLANTS, FISH AND FISH-FOOD ORGANISMS

MCNABB C D; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: M1CLO0959 Project Type: HATCH
Agency ID: CSRS Period: 28 OCT 64 To 01 JAN 99

OBJECTIVES: Assess the influence of total alkalinity, pH and temperature of the water on the effectiveness of several widely used herbicides. Test the effect of weed control by chemical means on fish-food organisms. Evaluate fertilization as a method of controlling higher aquatic plants.

APPROACH: Preliminary work in the laboratory will include study of influence of water quality on effectiveness of various herbicides. Toxicity of herbicides to fish will be studied in conjunction with the laboratory, experiments. While some fertilization studies can be done in the laboratory, the major effort here will be in farm ponds and small lakes.

PROGRESS: 80/01 TO 80/12. Lake Lansing, Michigan was treated with sodium arsenite for aquatic weed control in 1957. Two 2.5 m cores from deep portions of the lake basin showed the historical consequence of this treatment. Maxima of 330-340 µg As/g - 1 dry weight occurred at depth interval 0.15-0.30 m; background was 17-20 ppm As. An arsenic mass balance budget for

the lake for June 1978 to June 1979 showed it lost more arsenic than it received from the watershed. Internal loading of the water from the sediments was occurring; the surface of the sediments in greater than 85% of the lake had concentrations 2-6 times background. From laboratory experiments, we hypothesize Fe 3 + controls As concentration over aerobic sediments; As(III) increases in anoxic water with conversion of Fe 3 + to Fe 2 + and As(V) to As(III) at the sediment surface. As(III) in water decreases during prolonged anoxia by reaction with S 2 -. As(III) and Fe 2 + are oxidized upon aeration of anoxic water, and As(V) is taken out of solution with ferric iron in a manner similar to phosphate. Arsenic measurements in the lake over an annual cycle fit these expectations. Studies are underway to determine the impact of the annual arsenic cycle on fish food organisms of the lake.

PUBLICATIONS: 80/01 TO 80/12

EATTEKSON, T.R. 1980. Arsenic in Lake Lansing, Michigan. Ph.D. Thesis. Mich. State Univ., East Lansing. 79 pp.

004.117

CRIS0063625

EFFECTS OF AQUATIC PLANT COMMUNITIES ON WATER QUALITY IN HYPEREUTROPHIC AQUATIC ENVIRONMENT

MCNABB C D; FISBERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: MICL01157 Project Type: HATCB
Agency ID: CSRS Period: 12 APR 73 To 30 SEP 79

OBJECTIVES: Develop management strategies for aquatic plants in water purification systems.

APPROACH: Plots of submersed plants will be assayed for growth rate, seed production and seed success; effect on pH, O(2) and redox; and uptake of macronutrients, micronutrients and toxic metals in wastewater ponds. Elements will be measured in pond influents and effluents so that efficiencies of removal by plant communities can be calculated.

PROGRESS: 73/04 TO 79/10. The crop producing species of submersed vascular plants of municipal wastewater ponds in Michigan are restricted to a few representatives of the regional flora. Potamogeton foliosus, Elodea canadensis, and Ceratophyllum demersum are principal among them. Lemna minor is commonly abundant on the surface of these ponds. The latter is a bio-accumulator of boron relative to other species of aquatic macrophytes. A maximum annual yield of 400 g dry weight per meter square can be expected from harvest of aquatic vascular plants from hypereutrophic ponds in Michigan. This yield would remove a quantity of phosphorus equivalent to 20-25% of the total phosphorus influent in the growing season to ponds having a retention time on the order of 28 days. Similarly calculated estimates are 50-70% for nitrogen, 80-100% for manganese, 20-30% for iron, 5-10% for copper and zinc, and 1-3% for cadmium, chromium, cobalt and nickel.

PUBLICATIONS: 73/04 TO 79/10

BULTBUIS, D. A., J. E. CRAIG AND C. D. MCNABB. 1974. Metal dynamics in municipal stabilization ponds. In Trace Substances in Environmental Health-VII, Ed. D.D. Bempfill, Univ. of Missouri, Columbia. pp. 117-125.
LISIECKI, J. B. AND C. D. MCNABB. 1975. Dynamics of hazardous elements in wastewater ponds. Natl. Tech. Inform. Serv., PE 248404, Washington, D.C. 88 pp.
MCNABB, C. D. 1976. The potential of submersed vascular plants for reclamation of wastewater in temperate zone ponds. In Biol. Control of Water Poll., Eds. J. Tourbier and R. W. Pearson, Phila., The Univ. Press. 380 pp.
GLANDON, R. P. AND C. D. MCNABB. 1978. The uptake of boron by Lemna minor. Aquatic Bot. 4: 53-64.
ANON. 1976. Making aquatic weeds useful: some perspectives for devel. countries. Rept. of an Ad Hoc Panel of the Adv. Comm. on Tech. Innovation, Bd. of Sci. and Tech. for Intl. Dev., Com. on Intl. Rel. NAS, Wash.D.C.174pp.

004.118

CRIS0062584

ECOLOGY OF ANAEROBIC HETEROTROPHIC BACTERIA

KLUG M J; MICROBIOLOGY AND PUBLIC HEALTH; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: MICL03120 Project Type: STATE
Agency ID: SAES Period: 01 JUL 72 To 16 JUL 83

OBJECTIVES: Determine the extent of degradation of blue-green algal cells in anaerobic lake sediments; establish the rate limiting stage in this decomposition; elucidate the role of the heterotrophic organisms in the metabolism of volatile fatty acids evolved during this decomposition.

APPROACH: Establish the rate of loading of algae in to the sediments and establishment of pool sizes of intermediates and products evolved during its decomposition. The kinetics of the turnover of radioactively labeled intermediate are followed in laboratory reactions and from this information the rate limiting processes are determined.

PROGRESS: 80/01 TO 80/12. Studies on anaerobic decomposition in lake sediments were continued through a study of the distribution and mineralization of sulfur containing compounds in sediments. Approximately 46 and 42% of the annual total sulfur and ester sulfate sulfur, and 75% of the calculated protein-sulfur inputs were mineralized in sediments. Activity of alky-aryl sulphydrolase were readily demonstrated in sediments. However, ester sulfate hydrolysis only represented 10% of the sulfate consumed in the sediments. We conclude that organic sulfur compounds are more slowly mineralized than other organic compounds and that they constitute a significant contribution to end products of lake sediment diagenesis such as coal and oil deposits.

PUBLICATIONS: 80/01 TO 80/12

KING, G.M. and KLUG, M.J. 1980. Sulphydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan. Appl. Environ. Microbiol. 39:850-856.

004.119*

CRIS0076398

EFFECTS OF POLLUTANTS ON GILLS OF FRESHWATER FISHES

FRCMM P O; PHYSIOLOGY; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Agency ID: CSVMV-0010 Period: 01 JUL 77 To 30 JUN 82

OBJECTIVES: Develop the isolated perfused gill preparation as a model for the study of the effect of pollutants on fish.

APPROACH: Experimental investigation of the permeability properties (flux of water across) isolated perfused gills and the effect of pollutants on same, a study of the salt transport capabilities (ATPase levels) in gills exposed to pollutants, and biotransformation of pollutants by gills during transit of materials from the ventilate to the blood vascular space. Test toxicologically some 'model' compounds which represent classes of chemical compounds found in the process water from in situ gasification of coal.

PROGRESS: 80/01 TO 80/12. During 1980 research continued on development of the isolated trout gill preparation as a model for the study of the effects of pollutants on fish. Movement of tritiated water from a bath solution into the vascular compartment is a good qualitative measure of diffusive transfer capacity (PdA) of the gill. PdA is not constant but can be altered by changes in physical factors such as ventilation, total blood flow, blood pressure, pattern of blood flow and the exchange surfaces and by varying the number of lamellae (exchange surfaces) perfused. These factors which are regulated by humoral and neural means provides fish with elegant control of diffusional mass transport of materials across their gills. In acute experiments of 4 hours duration increasing the acidity of the bath from pH 7.2 to 3.5 by addition of sulfuric acid had no effect on PdA but it did increase gill vascular resistance. This response was greater in gills perfused with saline alone than in those perfused with saline

containing epinephrine, a potent dilator of gill vessels. In separate experiments with frogs it was found that acid stress caused a reduction in short-circuit current and electrical conductance of isolated skins but with intact animals there was no change in osmotic permeability upon exposure to acid conditions. The data supports the hypothesis that acid stress decreases influx of sodium ions into skins thereby reducing active (inward) sodium transport.

PUBLICATIONS: 80/01 TO 80/12

- JACKSON, W.F. and FRCMM, P.O. 1980. Intrinsic Hypoxic Vasoconstriction in Saline Perfused Trout Gills (*Salmo gairdneri*). *The Physiologist* 23(Abstract):175.
- PROMM, P.O. 1980. A Review of Some Physiological and Toxicological Responses of Freshwater Fish to Acid Stress. *Env. Biol. Fish.* 5:79-93.
- JACKSON, W.F. and FRCMM, P.O. 1980. Effect of Acute Acid Stress on Isolated Perfused Gills of Rainbow Trout. *Comp. Biochem. Physiol.* 67C:141-145.

004.120

CFIS0027015

TAXONOMY, BIOLOGY, AND ECOLOGICAL RELATIONSHIPS OF AQUATIC INSECTS

COOK E F; ENTOMOLOGY, FISHERIES & WILDLIFE; UNIVERSITY OF MINNESOTA, ST PAUL, MINNESOTA. 55108.
Proj. No.: MIN-17-017 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 63 To 30 JUN 81

OBJECTIVES: Study the taxonomy and biology of Orthocladinae (Chironomidae: Diptera) and Hydropsychidae (Trichoptera) and other aquatic taxa and further out knowledge of the aquatic insect fauna of Minnesota. The completion of such studies will help to make possible meaningful environmental impact statements in regard to aquatic habitats.

APPROACH: Systematic studies of selected genera will require anatomical, distributional, life history and ecological investigations. The attempt will be made to incorporate work with living material but not to the exclusion of preserved museum specimens.

PROGRESS: 63/07 TO 81/06. This project was originally concerned with biological studies of systematic problems in Arthropods. The groups worked with initially were Aphididae and Anoplura and there were several papers published on the Anoplura studies that resulted. In 1967 the project was restricted to include groups in a systematic fashion throughout the state. All of this material has been incorporated into the insect collection where it is readily available to interested investigators. Specific biological and systematic investigations were also started in 1967. The results of such studies have been published, are in press or (in 3 instances) are still in preparation on coleoptera (Enocbrus and Hygrotris); Ephemeroptera (Tricorythodes and Callibaetis); Diptera (Chaoboridae and Chironomidae, Diamesa, Polypedilum, and Microtendipes); and the semiaquatic Hemiptera of Minnesota.

PUBLICATIONS: 63/07 TO 81/06

- COOK, e.F. 1981. Chaoboridae pp. 335-339. In Handbook of the Nearctic Diptera I. Monograph #27, Research Branch, Agricultural Canada, Ottawa 674 pp.

004.121*

CRIS0080081

ECOLOGY, POPULATION DYNAMICS AND MANAGEMENT OF MULTI-SPECIES FISH RESOURCES OF LARGE LAKES

SPANGLER G R; ENTOMOLOGY, FISHERIES & WILDLIFE; UNIVERSITY OF MINNESOTA, ST PAUL, MINNESOTA. 55108.
Proj. No.: MIN-17-077 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 79 To 30 SEP 82

OBJECTIVES: To develop an improved biological basis for the management of the fish communities of large lakes through an increased understanding of interspecific relationships; analysis of the role of fishery exploitation in the dynamics of fish communities; and use of simulation modelling to

explore the impact of management measures on the structure and productivity of fish communities.

APPROACH: The response of lake whitefish to predation by sea lampreys will be estimated by analysis of stock dynamics prevailing during the years preceding and following lamprey control. The role of fishery exploitation will be examined with respect to its effects in competition with lampreys for available whitefish and as a singular force of mortality on smelt. Results of these studies will be synthesized into simulation models for the exploration of management strategies appropriate to multi-species fish communities.

PROGRESS: 80/01 TO 80/12. During 1980 the biological basis for management of lake whitefish (*Coregonus clupeaformis*) was examined with respect to stock discreteness in Canadian waters of Lake Huron. Data from tagging studies together with electrophoretic, morphometric and meristic data were analyzed to determine the utility of these approaches in defining stock discreteness. Recoveries of tagged fish indicated the existence of at least 11 stocks differing sufficiently in their population characteristics that yield to the fishery could be significantly influenced by stock-specific management. Electrophoretic analyses indicated that genetic differences between Lake Huron stocks were fewer than those detected between Lake Huron and inland lake populations. Morphological characteristics were relatively insensitive indicators of stock discreteness. Estimates of the influence of lamprey predation on one of these stocks and a preliminary analysis of lamprey stock structure in the Great Lakes were published in 1980. An analysis of the effects of exploitation on smelt (*Osmerus mordax*) was initiated in 1980 with an examination of gillnet selectivity. Comparison of length distribution from graded mesh experimental nets indicated that mesh sizes greater than 38 cm. (stretched measure) were relatively unselective with respect to smelt size. Tabulation of historical data and verification of ages from scale samples will be completed in 1981.

PUBLICATIONS: 80/01 TO 80/12

- SPANGLER, G.R. and COLLINS, J.J. 1980. Response of Lake Whitefish (*Coregonus clupeaformis*) to the Control of Sea Lamprey (*Petromyzon marinus*) in Lake Huron. *Can. J. Fish. Aquat. Sci.* 37(11):2039-2046.
- SPANGLER, G.R., ROEBSON, D.S. and REGIER, B.A. 1980. Estimates of Lamprey-Induced Mortality in Lake Whitefish, *Coregonus clupeaformis*. *Can. J. Fish. Aquat. Sci.* 37(11):2146-2150.
- WALTERS, C.J., STEER, G. and SPANGLER, G. 1980. Responses of Lake Trout (*Salvelinus namaycush*) to Harvesting, Stocking, and Lamprey Reduction. *Can. J. Fish. Aquat. Sci.* 37(11):2133-2145.
- KRUEGER, C.C. 1980. Detection of Variability at Isozyme loci in Sea Lamprey, *Petromyzon marinus*. *Can. J. Fish. Aquat. Sci.* 37(11):1630-1634.

004.122

CRIS0071129

TOXICITY AND ECOLOGICAL EFFECTS OF SELECTED INSECTICIDES AND HERBICIDES

EDNEY N A; LATIF A; BIOLOGY; ALCORN A AND M COLLEGE, LEBANON, MISSISSIPPI. 39096.
Proj. No.: WISX-PR-0002-1976-2 Project Type: GRANT
Agency ID: CSRS Period: 18 MAY 76 To 17 MAY 81

OBJECTIVES: Determine the toxicity level for Mirex, Toxaphene, Methyl parathion, EPN, Treflan, Cotoran with MSMA and Dyanap. Assess the long-term effects of the above mentioned insecticides and herbicides on selected fish and fish food organisms.

APPROACH: Toxicity levels of commonly used insecticides (carbamates, organophosphorus and chlorinated hydrocarbon) will be determined for selected animal species. Continuous flow-thru and static bio-assay tests will be conducted. The long-term effects on growth rate, reproductive success and natural animal mortality will be assessed. Biological magnification of chlorinated compounds due to normal usage and accidental

contamination will be investigated.

PROGRESS: 80/01 TO 80/12. This year trials were conducted on National Pickling and Carolina Gynecious varieties of cucumbers. This was one in continuation of the field trials of 1979, which evaluated the effect of Naptalam on the sex expression of cucumber. Applications of Alanap were made at the rate of 1, 2, and 4 lbs. per acre. It was found that an application of 2 lbs. of Alanap increased femaleness in the National Pickling variety and also increased the number of abortive flowers in the control and treatments. A series of trials were undertaken in the greenhouse. It was found that only one application of 25 microliters of Naptalam in a dilution of 10-2 stopped the growth of the main stem and enhanced the number of axillary branches. This indicated a loss of apical dominance; therefore, it can be concluded that Naptalam or its metabolite directly or indirectly affects the endogenous auxin system of the cucumber. An application of 10 microliters of 10-2 and 10-3 dilutions of Naptalam decreased maleness of 52% and 15%, but increased femaleness by 77% and 10%, respectively. There was no significant difference in the number of abortive flowers in the control and treatment groups. The effects of Naptalam on sex expression confirmed the assumption formulated in previous studies. Keeping in view the sequence of male and female flowers under normal conditions, it can be further assumed that the application of Naptalam has a close relationship with aging.

PUBLICATIONS: 80/01 TO 80/12

- EDNEY, N.A., RIZVI, M. and PARKER, A. 1980. Evaluating the Effect of Naptalam on Sex Expression of Cucumber. Journal of Mississippi Academy of Sciences, 25:59-62.
- EDNEY, N.A., RIZVI, M. and PARKER, A. 1980. Evaluating the Effect of Naptalam on Sex Expression of Cucumber. Abstract. Journal of Mississippi Academy of Sciences.
- EDNEY, N.A., RIZVI, M. and RIZVI, N. 1980. Growth Kinetics of Cucumber Hypocotyl and Leaf Area Under Stresses of Dalapon. Abstract. Journal of Mississippi Academy of Sciences.
- EDNEY, N.A., RIZVI, M. and CLE-LOCKLEY, C. 1980. Evaluating the Effect of Alanap on Sex Expression and Abortive Flowers on Two Selected Varieties of Cucumber. Abstract. Journal of Mississippi Academy of Sciences.
- EDNEY, N.A., RIZVI, M., RIZVI, N. and COLE-LOCKLEY, C. 1980. Evaluating the Effect of an Exogenous Application of Naptalam on Growth, Sex Expression and Abortive Flowers in Cucumber. Abstract. Journal of Mississippi Academy of Sciences

004.123 CRIS0077745
MIREX FEEDING STUDY IN CHANNEL CATFISH (ICTALURUS PUNCTATUS)

MERCER B D; FIDALGO R J; KITZMAN J V; ANIMAL HEALTH RESEARCH; MISSISSIPPI STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI. 39762.
Proj. No.: MIS-0837 Project Type: BATCH
Agency ID: CSRS Period: 18 APR 79 To 30 SEP 81

OBJECTIVES: Determine the mathematical relationships between dietary intake of mirex and ferramicide and the resulting whole body residues. Determine time/dose response relationships between dietary intake of mirex and ferramicide and whole body residues, selected tissue residues, mortality, pathophysiology of certain organs, growth and collagen formation. Determine correlation between mirex and ferramicide whole-body residues with organ residues, pathophysiology of organs and mortality.

APPROACH: Fifty channel catfish will be maintained in each of 45 separate 200-L tanks. Body weights of fish in each tank will be made every two weeks throughout the experiments. In separate experiments, 8 levels of mirex and ferramicide will be administered in a defined synthetic diet. Each dose level will be fed to fish in 4 or 5 tanks for 52 weeks. Fish fed each dose level and appropriate controls will be sacrificed at prescribed intervals and appropriate samples collected for assay and histopathology.

Pesticide levels in feed, water and fish scales will be analyzed at the National Monitoring and Residue Analysis Laboratory, USDA, Gulfport, Mississippi.

PROGRESS: 80/01 TO 80/12. Forty-eight groups of fish in separate aquariums were fed purified mirex at levels of 0.01 - 32.0 ppm in a purified fish diet. Tissues collected at intervals up to 240 days were subjected to quantitative mirex analysis and histopathologic examinations. Growth rates and collagen assays were also determined. There were no histopathologic nor growth parameter changes that could be correlated with exposure rates of mirex. Results of mirex analysis indicated a direct correlation between total dietary intake and tissue residue levels. The kinetic and mathematical models have yet to be completed. The feeding segment of the project was terminated at 240 days (January 6, 1981) due to excessive mortality resulting from several outbreaks of *Aeromonas hydrophila* attributable to stress factors. Statistical analysis to determine if there is any time/dose relationship between dietary intake of mirex and morbidity or mortality is underway. The project will terminate in April 1981, at which time the objectives of this project will have been completed.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

004.124 CRIS0080533
ECOLOGICAL STUDY OF CUTOFF BENDWAYS AND OXBOWS WITHIN THE TENNESSEE-TOMBIGBEE WATERWAY

ROBINETTE B K; LORIO W J; FISHERIES & WILDLIFE; MISSISSIPPI STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI. 39762.

Proj. No.: MIS-0840 Project Type: STATE
Agency ID: SAES Period: 01 OCT 79 To 30 SEP 80

OBJECTIVES: Obtain data on the value of cutoff bendways as aquatic habitat relative to other defined waterway aquatic habitats. Define the ecological and hydraulic factors important in cutoff bendway development and maintenance. Provide data useful in design and management of bendways to achieve environmental quality objectives.

APPROACH: Bathymetry, sedimentation rates, etc. will be provided by the ACE. Sampling will correspond to the four normal seasonal river stages at four selected cutoff bendways and two oxbows. Fish populations will be sampled with hoop and gill nets, minnow traps, and by electrofishing. Benthic, sediment, phytoplankton, and water quality samples will be analyzed.

PROGRESS: 80/01 TO 80/12. Oxbow lakes were deleted from the study after the December 1979 sampling, but bendway study sites remained the same. Bendway cutoff channels and impoundment of the river behind lock and dam complexes were the two overriding ecological factors influencing the results. The alteration of current or flow patterns is a dominant factor in the changing Tombigbee riverine ecosystem. Current in bendways with cutoff channels averaged less than one-half of the current in the river above and below the bendway. There was no difference in current between the river and within the bendway where there was no cutoff channel. The bendway with no cutoff channel had little stratification, but cutoff, bendways had distinct dissolved oxygen stratification from July through September. Lower water column strata often had less than 2.0 mg/l dissolved oxygen. Above normal sediment deposition occurred in some bendways. Plankton density was generally greater within bendways than in the river proper. Higher numbers of species and numbers of fish caught corresponded to the bendways with older cutoff channels. Length of time since the creation of the cutoff channel and the impoundment of the pool may be important from the standpoint of allowing the new ecosystem to mature. Greatest benthic diversity occurred in the bendway with no cutoff channel. Greatest macrophyte density occurred in the oldest impounded bendway.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

COOPER, C. 1980. Bivalve Mollusca of the Yalobusha River, Miss. The Nautilus 94:22-24.

004.125 CRIS0082872
WINTER FEEDING OF CHANNEL CATFISH IN MISSISSIPPI

ROBINETTE B F; BUSCH F; WALDROP J; WILDLIFE & FISHERIES SCI; MISSISSIPPI STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI. 39762.
Proj. No.: MIS-0851 Project Type: STATE
Agency ID: SAES Period: 15 NOV 80 TO 30 SEP 83

OBJECTIVES: Evaluate growth rates, economic implications and water quality of fingerling and food-sized channel catfish winter feeding programs.

APPROACH: There will be four treatments (two experimental feeds two fish sizes) and two controls (no feed x two fish sizes) each replicated three times (18 .04 ha ponds). Fish will be fed as a percent of body weight depending upon water temperature. Fish weight gain, survival, feed conversion and body proximate analysis will be analyzed using a two-way ANOVA. Economic and water quality evaluations will be conducted.

PROGRESS: 80/11 TO 80/12. Project was initiated 15 Nov 1980. All ponds were stocked and feeding adjusted to water temperature is proceeding.

PUBLICATIONS: 80/11 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.126 CRIS0045110
EFFECTS OF SEDIMENTS ON BIOLOGICAL SYSTEMS

COOPER C M; FITCHE J C; USDA-ARS SEDIMENTATION LAB, CXFORD, MISSISSIPPI. 38655.
Proj. No.: 7415-20805-004 Project Type: INHOUSE
Agency ID: ARS Period: 13 MAR 79 TO 30 SEP 80

OBJECTIVES: Determine effects of sediments and other products of agriculture, particularly of primary and secondary production, and on production, composition, and quality of fisheries.

APPROACH: Research on primary and secondary productivity in the food chain will be done by comparing lakes with sediment problems and similar lakes with none. Production will be monitored in aquatic systems where agricultural practices are increasing sediment loads and where conservation practices are decreasing loads. Evaluation will be made to find relationships between sediments, both suspended and deposited, and biological activities to determine changes in communities caused by sediment stress. In addition to a similar approach, controlled experiments are planned on relationships between fish and sediments.

PROGRESS: 79/01 TO 80/09. A 3 year biological field study on Bear Creek, a flatland watershed, was completed. Research centered upon the effects of sediments and other products of agricultural runoff upon the structure of aquatic communities. Collections of net plankton, benthos, coliform bacteria, BOD's, fishes and aquatic and semi-aquatic plants were supplemented with suspended and deposited sediment data, physical and nutrient chemical parameters, and residual pesticide data. Ecological studies on Lake Chicot were continued with major emphasis on chlorophyll-suspended sediment relationships. Primary productivity, the basis of the aquatic food chain was dependent upon suspended sediment levels and their influence upon light penetration. In the isolated upper lake, where suspended sediment concentrations were much lower, productivity levels were much higher. Lake Chicot studies are being continued under a new WEU.

PUBLICATIONS: 79/01 TO 80/09
COOPER, C. 1980. Effects of abnormal thermal stratification on a reservoir benthic macroinvertebrate community. Amer. Midland Naturalist, 103:149-154.

004.127* CRIS0065163
EFFECTS OF AN ALTERED TEMPERATURE REGIME AND CHEMICAL CONTAMINANTS ON THE AQUATIC ECOSYSTEM

WITT JR A; CAMPBELL R S; JONES J F; FORESTRY; UNIVERSITY OF MISSOURI, COLUMBIA, MISSOURI. 65211.
Proj. No.: MC00171 Project Type: STATE
Agency ID: SAES Period: 19 APR 74 TO 30 SEP 80

OBJECTIVES: Ascertain effect of altered thermal regime on incidence of diseased fish, growth of diseased fish, and their resistance to thermal stress. Ascertain effect of altered thermal regime on reproduction in fishes. Ascertain the degradation products of phthalic acid (PAEs) in the hydrosol and their effects on microbial processes. Ascertain effects on phthalic acid on aquatic insects in the hydrosol.

APPROACH: Fish sampled from thermal effluent and reservoir will indicate incidence of lymphocystis. Infected & healthy fish and experimentally for difference in growth & temperature stress. Caged control fish & fish in thermal effluent fed ad libitum. Reproduction cycle and fecundity determined from gonads. Eggs & larvae tested for differences in viability. Natural hydrosols & their microbial populations will be subjected to PAEs. Nitrogen, sulfur and phosphate cycles will be monitored to determine effects of PAEs. PAEs will be added to cultures of the blood worm and egg production, viability, and emergence will be monitored.

PROGRESS: 80/01 TO 80/12. However, some of our earlier work (Jennings 1979) was used and incorporated by the U. S. Army Corps of Engineers in their "Missouri River Bank Stabilization and Navigation Project Draft Feasibility Report and Draft EIS for the Fish and Wildlife Mitigation Plan" for the Missouri River. Life history aspects of the southern cavefish, from springs and caves of Camden County were studied. Length frequency distributions failed to delineate age groups, nor did the scales, indicating continuous growth in their constant environment. A sex ratio of 0.56 males to 1.0 females was found and did not vary with increasing length. Spawning appears to occur in May because of the decrease in the gonosomatic index. Females matured at 45 mm and egg number ranged from 20 to 80. Only one male, 58 mm, was mature, the internal anatomy was described by gross dissection and histological sectioning.

PUBLICATIONS: 80/01 TO 80/12
SMITH, V.J. 1980. Some Aspects of the Life History of the Southern Cavefish (Typhlichthys subterranean Girard) in Missouri. M.S. Thesis 123 pp.

004.128 CRIS0077908
ECOLOGY AND MANAGEMENT OF MISSOURI STREAM FISHES

FINGER T R; FORESTRY WILDLIFE & FISHERIES; UNIVERSITY OF MISSOURI, COLUMBIA, MISSOURI. 65211.
Proj. No.: MO-00178 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 79 TO 30 JUN 84

OBJECTIVES: To determine the ecological factors governing the distribution, abundance and growth of Missouri stream fishes; develop management strategies for these fishes.

APPROACH: The ecological factors determining the distribution, abundance, and growth of Missouri stream fishes will be determined using correlative field evidence and experimental manipulation of ecological parameters, both in the field and in the laboratory. Missouri streams will be characterized by their physical, chemical, and biological characteristics. These in turn will be related to fish species distribution and their production. A management strategy will be developed for certain fishes based on their ecology and the desires of the

public.

PROGRESS: 80/01 TO 80/12. A study is underway on population of rock bass (*Ambloplites rupestris*) smallmouth bass (*Micropterus dolomieu*) and redbreast (*Moxostoma spp.*) in the Current and Jacks Fork rivers in southern Missouri. This investigation is examining the population dynamics of these important sport species in relation to habitat, food resources and fishing pressure. It should be completed during 1981. A new study is beginning on use of seasonally flooded lowland hardwood wetlands as spawning and nursery areas by many sport and commercial stream fishes. These areas are adjacent to the Mingo River in southeastern Missouri and appear to be critical to maintaining the excellent fishery in the area. Fieldwork on this study is scheduled to begin in early 1981.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.129 CRIS0068246
AQUATIC INSECTS AS INDICATORS OF WATER QUALITY AND
PRODUCTIVITY: A COORDINATED STUDY

ROEMHILD G R; BIOLOGY; MONTANA STATE UNIVERSITY,
BOZEMAN, MONTANA. 59715.
Proj. No.: MCNE00418 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 75 To 30 JUN 80

OBJECTIVES: Correlate water quality with the presence of specific aquatic invertebrates. Develop and publish keys for the aquatic invertebrates of Montana. Measure changes at various areas being developed for mining, recreation, or agricultural activities.

APPROACH: Survey of species present in all areas of state, concurrent with water analysis for quality data. Entails: Collecting, identifying, curating, chemicals analysis. Publishing of survey data with distributional records and keys to Montana species of aquatic invertebrates. Sampling of areas where development is taking place to document changes as they occur. Recommend alternate plans, where feasible, to ameliorate undesirable environmental changes.

PROGRESS: 80/01 TO 80/06. A survey of the aquatic insects of Montana was carried out and several hundred thousand specimens were collected, identified and curated. This data has added tremendously to the known distribution and importance of the many species in Montana and in the country. Identification keys were developed and published for Zygoptera and Hemiptera and a number of other groups were partially organized with keys in mind. A computer program correlating water quality parameters with aquatic community composition of invertebrates was developed and will be used extensively to determine and predict changes in communities when water quality characteristics change. Baseline studies in eastern Montana coal fields and in other developmentally impacted areas was carried out and will be used in the computer program noted. Ecological succession of aquatic invertebrate communities in newly established ponds was studied with the objective in mind of establishing the richness and diversity of these communities with the potential of the ponds in supporting duckling populations. A study on the biology, energy flow, and limnology of alpine lakes in the Beartooth Plateau primitive area was carried out but is not as yet analyzed.

PUBLICATIONS: 80/01 TO 80/06

ROEMHILD, G.R. 1978. The Aquatic Heteroptera of Montana, Mont. Agric. Expt. Sta. Research Report 102:70. May.
BARIL, S.F. 1978. Benthic Invertebrate Distribution, Abundance and Diversity in Rosebud Creek, Montana. M.S. Thesis.
BARIL, S.F. and LUDTKE, R.J. 1978. Checklists and Numbers of Macroinvertebrates from Rosebud Creek Montana. NREL-FBL Technical Report No. 3, 99 pp.

ROEMHILD, G.R. 1978. Environmental Effects of Western Coal Combustion. Part II. The Aquatic Macroinvertebrates of Rosebud Creek Montana. EPA, ORD, 600/3078-99, 75 pp.
ROEMHILD, G.R. 1980. Pheromone Glands of Microcaddisflies (Hydroptilidae: Trichoptera). Jour. of Morph. 163:9-12.

004.130 CRIS0079701
IMPACT OF EROSION SILT AND SEDIMENTATION ON FISH
REPRODUCTION AND GROWTH

PETERS E J; FISHERIES & WILDLIFE; UNIVERSITY OF
NEBRASKA, LINCOLN, NEBRASKA. 68583.
Proj. No.: NEB-26-001 Project Type: HATCH
Agency ID: CSRS Period: 14 AUG 79 To 30 JUN 83

OBJECTIVES: Describe populations of fishes exposed to different levels of turbidity, describe behavioral reactions of fish species to turbidity and sediment, determine effects of turbidity and sediment control techniques on fish populations.

APPROACH: Collect, measure, mark and release fish to determine population size, growth rates and movement patterns; tag fish with radio transmitters to determine local movements; experimentally manipulate turbidity levels to determine reaction of fishes in field and in laboratory streams.

PROGRESS: 80/01 TO 80/12. Total inventory of fish populations in a turbid reservoir. This is providing a comparison between mark and recapture population estimates and total inventory - data are being compiled and analyzed at this time. Water clarification using lime has been accomplished. Fish and invertebrate production rates will be compared to preclarification production rates. Impacts of sediment laden runoff on fish populations was documented on several occasions. The most notable occurred at a study site on Maple Creek, Stanton County, Nebraska where fathead minnow (*Pimephales promelas*) densities declined from 28.6 m⁻² before the runoff event to 1.71/m² after the event. Other accomplishments centered on determinations of fish and aquatic invertebrate community structure in areas subjected to different levels of sediment concentration. This is providing baseline information for comparison with future studies.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.131 CRIS0014327
INSECTICIDES AND THEIR FORMULATIONS

SUTHERLAND D J; DELORME D; ADMINISTRATION; RUTGERS
UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ40100 Project Type: HATCH
Agency ID: CSRS Period: 24 SEP 59 To 31 DEC 83

OBJECTIVES: Determine the efficiency of newer insecticide formulations in the control of aquatic and terrestrial pest; recommend design modifications for increasing their efficiency; and to determine optimum chronic thresholds of temephos and dursban to aquatic insect pests.

APPROACH: It is planned that most of the research will deal with the following formulations microencapsulated malathion and fenitrothion (Pennealt Corp; Plastic-core formulations of temephos and chlorpyrifos (Environmental Chemicals and Dow Chemical, respectively); and Microencapsulated formulations of methoprene (Zonecon).

PROGRESS: 80/01 TO 81/12. *Bacillus thuringiensis israelensis* is effective in the control of *Culex pipiens* at rates of 2 and 4 oz/acre. Any residual effect disappears within 5 days and larval populations rapidly renew themselves. The granular formulations so far examined do not extend the activity of the *Bacillus*.

PUBLICATIONS: 80/01 TO 81/12
SUTHERLAND, D.J. 1980. Insecticide Recommendations
for Mosquito Control in New Jersey, 1980. N.J.
Agr. Exp. Sta. Pamphlet.

004.132 CRIS0083273
SALINITY, REDOX POTENTIAL, & MICROBIAL
TRANSFORMATIONS OF MERCURY POLLUTANTS IN ESTUARINE
SEDIMENTS

BARTHA R; BIOCHEMISTRY & MICROBIOLOGY; RUTGERS
UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ01504 Project Type: STATE
Agency ID: SAES Period: 01 MAY 80 To 30 JUL 81

OBJECTIVES: To determine the effect of salinity on
aerobic and anaerobic methylation of mercuric ions in
estuarine sediments. To determine the effect of
salinity on aerobic and anaerobic demethylation of
monomethyl and dimethyl mercury in estuarine
sediments. To clarify the mode of action of salinity
on the methylation and demethylation processes.

APPROACH: Sediment samples spiked with Hg⁺⁺ ions or
methylmercury pollutants will be adjusted to
different salinities and will be incubated under
aerobic or anaerobic conditions. The various forms of
mercury will be analyzed by EO-GC and A approaches.
The theory that SO₄(4) from seawater, after reduction
to H₂S(4), makes Hg⁺⁺ ions unavailable for
methylation will be tested.

PROGRESS: 80/05 TO 80/12. Microbial methylation of
inorganic mercury in aquatic sediments greatly
increases the toxicity and biomagnification of this
heavy metal pollutant. Experiments with Hg⁺⁺-spiked
sediments from Northern New Jersey estuaries
established that redox potential and salinity
strongly influence the rate and extent of mercury
methylation. Low redox potential and low salinity
favored mercury methylation while aerobic conditions
and high salinity had the opposite effect. We are
currently examining the theory that in low redox
potential - high salinity sediments H₂S generated
from the sulfate component of sea salts ties up Hg⁺⁺
ions and thus renders them less available for
microbial methylation.

PUBLICATIONS: 80/05 TO 80/12
BLUM, J.E. and BARTHA, R. 1980. Effect of Salinity
on the Methylation of Mercury. Bull. Env. Contam.
Toxicol. 25:404-408.

004.133 CRIS0013266
CHEMICAL CONTROL OF MOSQUITOES OF NUISANCE AND HEALTH
IMPORTANCE

SUTHERLAND D J; ENTOMOLOGY & ECONOMIC ZOOLOGY;
RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ40401 Project Type: STATE
Agency ID: SAES Period: 01 JAN 79 To 31 DEC 83

OBJECTIVES: Determine the susceptibility of native
New Jersey species to newer toxic-specific chemicals;
determine the incidence and development or resistance
among these species; determine the effect of larval
habitat temperature and aquatic pollutants on larval
susceptibility; and determine the influence of
mosquito age (larval, adult) on susceptibility.

APPROACH: In laboratory experiments, larvae and
adults of NJ species will be bioassayed for
susceptibility to newer compounds. Dependent on
results, certain compounds will be subjected to field
experiments. Resistance incidence and development
will be studied by bioassays of field populations and
laboratory colonies subjected to insecticide
selection. The effect of larval habitat temperature
and of pollution will be studied by varying these
factors and correlating them to susceptibility. The
influence of age will be studied with similar
procedures.

PROGRESS: 80/01 TO 80/12. Larvae of most New Jersey
mosquito species continue to exhibit susceptibility
to the insecticides temephos, fenitron and
chlorpyrifos. Previous tolerance noted in certain
dump populations of Culex pipiens has diminished. In
contrast to the negative temperature coefficient of
chlorinated hydrocarbons, the organophosphate
temephos displays a positive temperature coefficient,
with toxicity decreasing markedly below 15 degrees C.
Toxicity also depends on larval instar generally, but
the degree depends on mosquito species and
insecticide.

PUBLICATIONS: 80/01 TO 80/12
UTBERG, W. 1979. M.S. Thesis. Rutgers University,
N.J.

004.134* CRIS0079854
FEEDING ECOLOGY OF FISHES UTILIZING MARSHES ALTERED
FOR CONTROL OF SALT MARSH MOSQUITOES

SHISLER J; MOSQUITO RES & CONTROL; RUTGERS
UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ40503 Project Type: STATE
Agency ID: SAES Period: 01 JUL 70 To 30 JUN 80

OBJECTIVES: To study the feeding ecology of salt
marsh fishes with emphasis on their role as mosquito
predators.

APPROACH: Survey of fishes utilizing salt marsh
altered for mosquito control. Study the food habits
of the dominant species as determined from the survey
in order to determine the most effective mosquito
predator. Identification of larval fishes which occur
in mosquito breeding areas because these may be
important predators on the early mosquito instars.

PROGRESS: 80/01 TO 80/12. Fish populations were
sampled throughout the year in both natural marshes
and marshes that have been altered for mosquito
control. Fish species composition varied between
study sites with a typical freshwater assemblage
common at sites with freshwater or lower salinities
and typical estuarine assemblage at high salinities.
Fundulus heteroclitus, F. luciae and Cyprinodon
variegatus were dominant estuarine fish while
freshwater dominate species were F. daphanus,
Gambusia affinis, Lepomis gibbosus and Notemigonus
crysoleuca. Seasonal changes in both salinity and
faunal populations were noted in impoundments.

PUBLICATIONS: 80/01 TO 80/12
ABLE, K.W., SHISLER, J.K. and TALBOT, C.W. 1979.
Preliminary Survey of Fishes Utilizing New Jersey
Marshes Altered for Control of Salt Marsh
Mosquitoes. Proc. N.J. Mosq. Control Assoc.
66:103-115.
TALBOT, C.W., ABLE, K.W., SHISLER, J.K. and COFFEY,
D. 1980. Seasonal Variation in Composition of
Fresh and Brackish Water Fishes of New Jersey
Mosquito Control Impoundments. Proc. N.J. Mosq.
Control Assoc. 67:50-63.

004.135* CRIS0028620
NATURAL OYSTER BEDS OF THE DELAWARE BAY

HASKIN H B; OYSTER CULTURE; RUTGERS UNIVERSITY, NEW
BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ32500 Project Type: STATE
Agency ID: SAES Period: 01 OCT 62 To 01 JAN 99

OBJECTIVES: Develop information on and conduct
research leading to the goal of disease-free oysters
in the Delaware Bay area.

APPROACH: Conduct such field and laboratory studies
on MSX in oyster populations as required. Advise the
Delaware Bay authorities of the best management
practices to preserve good seed beds and develop new
beds.

PROGRESS: 80/01 TO 80/12. The oyster planters of
Delaware Bay depend almost exclusively on the
State-controlled natural seed beds of the upper Bay
for their supply of seed oysters which are planted on

privately-leased beds in the lower Bay. Under this project our laboratory provides basic information on the seed beds and recommendations for their management to the State Division of Fish, Game and Shell-fisheries. In 1980 over 400,000 bushels of seed oysters were removed from the beds in the regular spring planting season. Based on our recommendations, two of the Beds, Egg Island and the Ledge, and a major portion of New Beds, were closed to the taking of seed because of a preponderance of small oysters of the 1978 and 1979 year classes. Following the spring-early summer dredging, a moderate to light general set of 1980 year class oysters occurred on the seed beds. MSX disease mortalities in the 1980 planted stocks were unusually heavy in the summer, fall and early winter of 1980-81. Mortalities in oysters on the lower seed beds were 1/2 to 1/3 those on the planted grounds immediately below the boundary, the Southwest line separating seed beds and leased bottom. Based on these data and those of the preceding 20 years establishing that similar differential mortalities between seed beds and planting grounds have been the general rule.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.136 CRIS0066259
SURF CLAM MANAGEMENT STUDIES

HASKIN H H; CYSTER CULTURE; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJG2503 Project Type: STATE
Agency ID: SAES Period: 26 JUN 74 To 30 JUN 82

OBJECTIVES: Determine the capacity of inshore surf clam beds near Atlantic City to sustain increased commercial harvest because of the partial depletion of the large offshore beds.

APPROACH: Selected bed areas sampled in 1972 will be open to dredging and two 6-square mile areas including high density clam populations will be closed to commercial harvest. Monitoring of all beds will include settling intensity of larvae, juvenile mortality, juvenile growth, to determine if retaining brood stock is necessary to maintain recruitments.

PROGRESS: 80/01 TO 80/12. The surf clam resource off the coast of New Jersey lies both in State waters, inside the three-mile limit, and offshore in Federal waters. Under State and Federal financing the population in New Jersey waters has been under detailed study since 1872, that in Federal waters has had some attention in this project since 1978. New Jersey began its management of the State resource in January 1977 and has based its annual quota and its decisions on areas closed to harvest on the results of our annual inventories. The work in Federal waters has resulted in the closure of a 120-square-mile area off Atlantic City and similar, though smaller, areas off Maryland and Virginia. The closures in all cases have been designed to prevent wasteful harvest of small clams. Until 1976 the New Jersey inshore resource was in steady decline under harvest pressure with no significant recruitment. The 1976 year class of clams set heavily in the Atlantic City area and survived well. The population of this year class in an area extending roughly 20 miles along the coast and centered on Absecon Inlet has more than doubled the standing stock of clams in New Jersey waters between Shark River and Cape May Inlet. The same year class also set and survived in Federal waters. The 120-square-mile closed area off Atlantic City has a population which we estimate at 17 million bushels.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

004.137* CRIS0078908
OVERBOARD DISPOSAL STUDY

HASKIN H H; DURAND J; OYSTER CULTURE; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.

Proj. No.: NJG2501 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 82

OBJECTIVES: Determine the effects of overboard disposal of dredge spoil on the benthic macroinvertebrate community with particular emphasis on the hard clam, *Mercenaria mercenaria*.

APPROACH: In Absecon Creek, where channel dredging is required for navigation purposes, two study areas have been selected. Following an initial baseline study of both areas, one area has been partially covered by dredge spoil; the second has been held largely undisturbed as a control area. Follow-up studies will be centered largely on recolonization of the spoil area. At selected stations a minimum of 7 Peterson or ponar grabs will be taken and sieved. All + 1 mm organisms will be sorted out, identified and counted to enable description of community structure, diversity and biomass. Complete sampling of all areas will be done quarterly. Experimental plantings of small clams before and periodically after dredging will permit detailed studies of the effect of dredging on mortalities, growth and condition. Invertebrate data will be supplemented by water quality studies and geological studies designed to determine effects of dredging disturbance on nutrient releases from the bottom and stability of bottom as it affects survival and growth of clam.

PROGRESS: 80/01 TO 80/12. Overboard disposal of dredge spoil has resulted in a dramatic effect on benthic infaunal polychaetes. Water chemistry (nutrients), benthic nutrient cycling, sediment structure, and benthic invertebrate communities all were affected. Some effects were transitory. Effects upon nutrient regeneration from bottom sediments, structure of bottom sediments, and benthic invertebrates in the dredge spoil have persisted. The Control Site and the Dredged Channel Site showed marked differences in nutrient cycling and in the benthic invertebrate community following dredging. Both have since returned to pre-dredge levels. The Dredge Spoil Site remains in a disturbed condition with respect to the sediments, nutrient cycling, and the invertebrate community. Regeneration of ammonium-N from bottom muds is suppressed below the rates observed in the Control Site and in the Dredged Channel Site. Counts of benthic invertebrates remain high and the dominant organisms exhibit both wide fluctuations in numbers and higher counts than during the pre-dredge time. Species make-up at the Dredge Spoil Site is unstable. Different species have shown explosive growth in numbers at different times but not according to a particular sequence. At this time it is not possible to estimate when stability will be reached.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.138 CRIS0081257
BIOLOGICAL ANALYSIS OF THE AGE AND GROWTH RATE OF THE OCEAN QUAHOG *ARCTICA ISLANDICA*

LUTZ R A; OYSTER CULTURE; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJG2505 Project Type: STATE
Agency ID: SAES Period: 15 SEP 79 To 15 MAR 81

OBJECTIVES: Analyze seasonal and/or annual variation in growth patterns within the shell of the ocean quahog, *Arctica islandica*. Determine the relationship between dissolved oxygen and shell structural changes in *A. islandica*. Determine the age of various sized specimens of *A. islandica* from natural populations off New England and New Jersey.

APPROACH: Analyze fractured sections and growth surfaces of clams from field and laboratory experiments dealing with burrowing activity of clams. Label specimens with strontium chloride and place in field. Analyze acetate peels and fractured sections (using optical and scanning electron microscopy) of clams sacrificed during various times of the year.

PROGRESS: 80/01 TO 80/12. Ocean quahog (*Arctica islandica*) shells were collected at approximately monthly intervals from two separate localities (Narragansett, RI and Cape May, NJ) for an entire year. Analyses conducted to date of longitudinally sectioned and fractured shells suggest that internal banding patterns may reflect annual cycles of growth. One and only one prismatic sublayer was formed within the shells of specimens from the Narragansett population during the year in which the organisms were sampled. Cooperative laboratory and field studies with Dr. Alan Taylor from the University of Glasgow have revealed no relationship between dissolved oxygen concentration (and/or burrowing activity) and internal shell banding patterns in *A. islandica*. No detectable shell growth was observed in ocean quahogs experimentally planted in 90 ft. of water off Cape May, NJ during the period from May to August, 1980. Cooperative field studies with Dr. Roger Mann of Woods Hole Oceanographic Institution revealed similar slow growth rates in New England waters. Results of our studies were presented to the shellfish industry and individuals from state and federal agencies at the annual meeting of the Shellfish Institute of North America. It is concluded that the growth of this species is exceedingly slow relative to the majority of other species of bivalves and that the maximum age of specimens in natural populations may be in excess of 50 years.

PUBLICATIONS: 80/01 TO 80/12

LUTZ, R.A. and RHOADS, D.C. 1980. Growth Patterns Within the Molluscan Shell: An Overview. In: Skeletal Growth of Aquatic Organisms, Rhoads, D.C. and Lutz, R.A., (Eds.), pp. 203-254. Plenum Press: New York. 750 pp.

RHOADS, D.C. and LUTZ, R.A. 1980. Skeletal Records of Environmental Change. In: Skeletal Growth of Aquatic Organisms, Rhoads, D.C. and Lutz, R.A., (Eds.), pp. 1-19. Plenum Press: New York. 750 pp.

KENNISH, W.J., LUTZ, R.A. and RHOADS, D.C. 1980. Preparation of Acetate Peels and Fractured Sections for Observation of Growth Patterns Within the Bivalve Shell. In: Skeletal Growth of Aquatic Organisms, Rhoads, D.C. and Lutz, R.A.,

004.139 CRIS0083693
ECONOM. IMPORTANT DISEASES OF BIVALVE SHELLFISH, INCLUDING THEIR PREVENTION, CONTROL AND ERADICATION

LEIBOVITZ L; AVIAN & AQUATIC ANIMAL MEDICIN; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Agency ID: CSVM-426-438 Period: 01 JAN 80 To 31 DEC 81

OBJECTIVES: The research is intended to quantify and quality the toxicity of common estuarine pollutants, bilge cleaners and fuel oil for *C. virginica* and *M. mercenaria* and selected species of finfish.

APPROACH: Bivalve larvae of separate age groups of *C. virginica* and *M. mercenaria* will be exposed to varying concentrations of bilge cleaners and fuel oils for variable periods of time to evaluate possible acute or chronic toxicities.

004.140 CRIS0065391
NUTRIENT INTERACTIONS AND CHANGES IN ALGAL QUALITY IN CAYUGA LAKE

BARLOW J P; ECOLOGY AND SYSTEMATICS SEC; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-183406 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 77 To 30 SEP 81

OBJECTIVES: Determine effect of changes in nutrient ratios on composition of phytoplankton associations in Cayuga Lake.

APPROACH: Isolate representative species from the natural community in Cayuga Lake and determine their reactions to changes in nutrient ratios in laboratory experiments. Results of these experiments will be used to interpret nutrient perturbation experiments made with the mixed community, and predict changes in

this community that could result from changes in P and Si loading.

PROGRESS: 80/01 TO 80/12. Interactions between light and nutrient may be particularly important in controlling growth of phytoplankton in deep stratified lakes such as Cayuga because there are often distinct vertical gradients of both properties in the mixed layer. The objective of the current research has been to investigate these interactions with experiments on both mixed natural assemblages and single species in pure culture. The experiments with mixed assemblages have been made by impounding samples of water from Cayuga Lake in large volume continuous flow apparatus maintained in the laboratory. Effects of perturbations of nutrients, light and temperature on growth rate, chemical composition and species makeup of contained communities were measured in a series of four experiments run during the Summers of 1979 and 1980. Data from these experiments is still being analyzed. The results of the mixed population experiments will be compared with parallel studies on single species in pure culture. For this purpose Mr. David Mitchell has isolated a diatom, *Cyclotella glomerata* from Cayuga Lake. This is now axenic culture. During the summer of 1980 he ran a series of experiments on growth of this alga under various light, temperature and nutrient conditions using continuous culture facilities of Dr. G. Y. Rhee of the N.Y. State Department of Public Health in Albany. These studies are being completed here at Cornell.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.141 CRIS0081163
RESEARCH IN SYSTEMS ECOLOGY

HALL C A S; CLEVELAND C; MCVOY C; ECOLOGY AND SYSTEMATICS SEC; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-183315 Project Type: STATE
Agency ID: SAES Period: 01 JAN 80 To 30 SEP 83

OBJECTIVES: Completion and publication of "Yield per effort and net energy analysis of the American Petroleum Industry", including sensitivity analysis of underlying assumptions. Extension of methodology to other energy-related issues and to a more general economic format if and as appropriate. Completion and publication of three papers on concentration and production patterns for oxygen, nutrients and fish in New York and Massachusetts estuaries. Integrate these studies as possible to look at the relation between nutrient patterns, low oxygen and fish production.

APPROACH: Collate statistics from the U.S. petroleum industry and examine relation between effort, yield, and energy cost of effort. Finish statistical and computer analysis of fish, nutrients and oxygen. Quantify data on a per square meter basis. Relate patterns of fish production over space and especially time to patterns of primary production, nutrient supply and low oxygen. If and as time and data permit develop a general estuarine model to predict fish production from data on nutrients oxygen and other environmental parameters. Test model against other data sets.

PROGRESS: 80/01 TO 80/12. During the past year we have successfully completed one of the major parts of our proposed work (analysis of U.S. Petroleum Industry history using methods borrowed from fisheries analysis) and have made significant progress on two other parts of our research. More specifically, the petroleum analysis is in press in Science and will be coming out in about a month. We have finished the conceptual analysis of the North River Estuary studies, including a set of computer analysis and the preparation of what is essentially a final draft manuscript. We have some final sensitivity analysis to run, after which the manuscript will be ready for internal review and submission. We believe that will occur by about March. We have made some additional progress on the statistical analysis of fish production in Flax Pond Estuary, but progress on the final analysis has been

frustratingly slow. Finally, I spent the month of August at the University of British Columbia, working on our North Pacific Ocean food chain model and its application to salmon biology. We successfully restructured the model into a series of more readily understood and analyzed subroutines, and worked further on our manuscript. We believe that a final, soft cover report (to be published in a unreviewed 'soft-cover' form at the University of British Columbia) will be completed sometime this spring, and it will be submitted in this form for consideration for publication as a monograph probably next summer.

PUBLICATIONS: 80/01 TO 80/12

BALL, C., CLEVELAND, C., KAUFMANN, R., DEWILEK, P. and BEGER, M. 1981. Yield Per Effort as a Function of Time and Effort for Several Energy Industries. Abstract for Symposium on Energy and Ecological Modeling, University of

004.142

CRIS0064193

NITROGEN FIXATION BY MICROBES INHABITING SURFACES OF AQUATIC MACROPHYTES

SEELEY B W; FOOD SCIENCE; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.

Proj. No.: NYC-144418 Project Type: BATCB
Agency ID: CSRS Period: 01 JUL 73 To 30 SEP 79

OBJECTIVES: Study of the chemical interrelationships between certain common water plants (macrophytes) and the large microbial populations (epiphytes) inhabiting their surfaces. A quantitative study of nitrogen fixation by epiphytes will be emphasized and will be converted to an estimate of their contribution to the growth potential of the aquatic eco-system. Total populations and dominant species of epiphytic microbes will be determined. An effort will be made to determine the relative proportions of total nitrogen fixed by bacteria and blue-green algae.

APPROACH: Nitrogen fixation (nitrogenase activity) will be measured by a Hewlett and Packard High Efficiency gas chromatograph through the conversion of acetylene to ethylene. Microbial populations will be measured by embedding techniques that allow direct counting, by the Winogradsky slide culture method, by an AMR model 900 scanning electron microscope and by plating on various total count and nitrogen-free media. Identification of microbes will be by standard techniques.

PROGRESS: 74/01 TO 76/12. Acetylene reduction techniques were used to follow diurnal cycles of nitrogen-fixing activity and the seasonal course of such activity over a 15-month period in a pond heavily colonized by *Myriophyllum spicatum*. Reduction was maximal between noon and 6 p.m., with nighttime activities 40% those of the day. Mean rates of activity were calculated for each month. From diurnal and seasonal cycles it was calculated that a mean of 12.5 µg N was added annually by epiphyte N-fixation per mg. dry wt. plant sample. This is significant when compared with actual N contact of such samples, estimated to be 25 µg per mg dry wt. *Gloeotrichia* was to be primarily responsible for the N-fixation. A unicelgal culture of *Gloeotrichia* reduced acetylene in light at rates of 0.6 to 0.8 n moles/mg dry wt. min. Enrichment and isolation procedures failed to disclose any significant numbers of aerobic or anaerobic heterotrophic bacteria. *Rhodospirillum rubrum* appeared in some numbers at certain times in the cycle. A strain of *R. gelatinosa* reduced acetylene anaerobically at a maximal rate of 16 n moles/dry wt. min. N-fixation by these bacteria in situ would compare favorably with that of blue-green bacteria if the potential is fully expressed in conditions of the epiphytic niche.

PUBLICATIONS: 74/01 TO 76/12

FINKE, L. A. In Situ and Laboratory Studies of Nitrogen Fixation by Epiphyte Populations of Aquatic Plants, Ph.D. Thesis, Cornell University (1976).

004.143

CRIS0011916

STUDIES IN PHYCOLOGY

KINGSBURY J M; GENETICS DEV AND PHYSIOL SEC; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.

Proj. No.: NYC-185404 Project Type: BATCB
Agency ID: CSRS Period: 26 DEC 61 To 30 SEP 79

OBJECTIVES: Describe quantitatively the relationship of important algae with their environment and the converse; manipulate the environment for enhancing or inhibiting algae growth as desired; predict the effect of projected change in environment on same.

APPROACH: Isles of Shoals project - Initial comparison of transect data from Star Island from 1967 - 1972 and from Appledore Island, 1973, completed. Permanent transect sites on Appledore Island surveyed and marked for 1974 data collection. Work in this project will be directed entirely toward elucidating the ecology of marine algae at the Isles of Shoals this year.

PROGRESS: 79/01 TO 79/12. Project terminated 12/31/78.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.144

CRIS0080866

LUMINOUS BACTERIA AS INDICATORS OF SHELLFISH CONTAMINATION BY PATHOGENIC VIBRIOS

GREENBERG E P; MICROBIOLOGY; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.

Proj. No.: NYC-144381 Project Type: STATE
Agency ID: SAES Period: 01 JAN 80 To 30 SEP 82

OBJECTIVES: Assess the potential use of luminous marine bacteria as indicators of shellfish contamination by pathogenic marine vibrios. Thus, to attempt to develop a simple and inexpensive method that can be routinely used to screen for these pathogens. Study the effects of various conditions of depuration on the rate of removal of these bacteria.

APPROACH: Both laboratory and field studies will be undertaken to assess the potential of luminous *Vibrio* (*Beneckea*) *harveyi* as an indicator of *V. parahaemolyticus*. Field studies will involve sampling both clams and water from various areas of the Great South Bay. Total counts of *V. parahaemolyticus* and *V. harveyi* will be determined. Laboratory experiments will involve pretreatment of shellfish with the bacterial species mentioned above followed by depuration. The persistence of the bacteria in the shellfish will be followed during the time of depuration.

PROGRESS: 80/01 TO 80/12. A depuration chamber was used to study the persistence of marine vibrios in the hardshell clam, *Mercenaria mercenaria*. Clams were incubated for 2 h in artificial seawater containing 10³ cells/ml of *Vibrio parahaemolyticus*, *Vibrio harveyi* and *Escherichia coli*, and then transferred to the depuration chamber (a tank through which U.V.-sterilized artificial seawater was continually flowing). Numbers of the three bacterial species in meat of clams removed from the chamber at various times over a 72 h period were determined by differential plating techniques. The number of each species ranged from 10² to 10³ colony-forming units/gram of meat immediately after transfer to the depuration chamber. After 24 h at 25 degrees C the number of *E. coli* cells detected had decreased over 100-fold. Generally, *V. parahaemolyticus* and *V. harveyi* were found in increased abundance after 24 h. The abundance of *V. parahaemolyticus* and *V. harveyi* in clams that had been incubated in the depuration chamber for 72 h at 25 degrees C was approximately 10% of the abundance of these species immediately after transfer to the chamber. Similar results were obtained when the incubation temperature was 8 or 15 degrees C. Thus, *V. harveyi* and the potential human pathogen *V. parahaemolyticus* which are both of marine origin were not removed from *M. mercenaria* at a rate comparable to the rate at which *M. mercenaria* depurated cells of *E. coli*.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.145* CRIS0076313
ANTIBACTERIAL MECHANISMS IN CLAMS; CONTRIBUTION OF THE
WATER STREAM

TIMONEY J F; MICROBIOLOGY; CORNELL UNIVERSITY,
ITHACA, NEW YORK. 14853.
Proj. No.: NYC-433379 Project Type: STATE
Agency ID: SAES Period: 01 JAN 78 To 31 DEC 80

OBJECTIVES: Determine the rate of removal in the
waterstream of Salmonella typhimurium, Shigella
flexneri, Escherichia coli, and Vibrio
parahaemolyticus from hard clams. Examine the binding
properties of clam mucus for these test bacteria.

APPROACH: Clams will be exposed to the test bacteria
for one hour and then removed for u/v irradiation of
their outer surfaces to inactivate bacteria on their
shells. The clams will then be placed in a model
depuration tank which is designed for removal of all
bacteria from the water. The rate of disappearance of
the test organisms from the clam tissues will then be
measured by timed samplings of randomly chosen clams.
Mucus will be collected using a suitable irritant.
The homogenized mucus will then be mixed with the
test bacteria incubated at 20C and timed samples
taken and centrifuged. Bacterial counts will be
performed on the supernatant and sediment.

PROGRESS: 79/01 TO 80/12. The uptake and clearance of
Salmonella typhimurium and Escherichia coli by
actively siphoning clams was studied. The following
conclusions are possible from the experiments
performed. Enteric bacteria are rapidly concentrated
100X within actively siphoning clams. Accumulated
bacteria are then rapidly cleared. Counts of bacteria
are reduced 1,000X within 8 hours. A further 10X
reduction occurs by 24 hours. Bacteria are cleared in
the form of mucus-fecal aggregates which rapidly
sediment in the water. Very few free bacteria are
released. Clams which are prevented from siphoning
do not clear themselves of bacteria within 24 hours.
Ionic phenomena are not important in binding of
bacteria to mucus-fecal aggregates.

PUBLICATIONS: 79/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.146 CRIS0014431
SOURCES AND MANAGEMENT OF MORTALITY IN EARLY LIFE
STAGES OF FISHES

GLOSS S P; NATURAL RESOURCES; CORNELL UNIVERSITY,
ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147404 Project Type: HATCH
Agency ID: CSRS Period: 12 MAY 64 To 30 SEP 83

OBJECTIVES: Specific objectives will be to determine:
Acute toxicity levels of metals and other pollutants
through standard bioassay procedures for freshwater
fishes at various stages of their early life history.
Sublethal effects of various pollutants on early life
history stages of various freshwater fishes - e.g.,
reduced growth rates, stamina, oxygen uptake, enzyme
activities, etc. Develop testing procedures which are
amenable to use with small fish - numerous techniques
which measure sub-lethal effects mentioned under
objective 2 are available for sub-adult or adult fish
where relatively large volume tissue, blood, weight
and other samples are available. Adapting these
techniques or developing others for early life history
stages is necessary to assess sub-lethal impacts of
pollutants. Rearing and maintenance capabilities for
early life history stages of the more predaceous
species of fish are problematic and will be studied
and hopefully improved upon for various species as a
result of these studies.

APPROACH: Standardized bioassay techniques involving
either static or flow through exposure systems will
be utilized to determine acute toxicity levels of
pollutants. Proportional diluters will be used to
vary concentration of pollutants in the flow through

systems. Each metal or synthetic organic pollutant
and various species of fish will be studied
individually with appropriate experimental design
considerations for statistical reliability of the
resultant data.

PROGRESS: 80/01 TO 80/12. The increasing acidity of
many surface waters from acid precipitation increases
the solubility and potential adverse effects of
metals in these systems. Lead contamination results
primarily from its release during combustion of
various fuels and in combination with low pH may
present a threat to fishes. Lead inhibits the
activity of the enzyme amino levulinic dehydrase
(ALAD) which plays an important role in hemoalbumin
synthesis. Reduction in ALAD activity may reduce
stamina while simultaneously increasing locomotor
activity due to perceived oxygen deficit; both
reactions antagonistically stressing the fish. The
effects of lead on smallmouth bass are being studied
in the laboratory to determine activity, stamina, and
hemoalbumin relationships. Preliminary estimates of 96
hr LC(50) levels for sac fry have been made and
apparatus set up for stamina tests of fish, etc.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.147 CRIS0083022
ECOLOGICAL FACTORS AFFECTING POTENTIALLY THREATENED
OR ENDANGERED FISH SPECIES IN NY

GLOSS S P; NATURAL RESOURCES; CORNELL UNIVERSITY,
ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147335 Project Type: STATE
Agency ID: SAES Period: 01 OCT 80 To 30 SEP 83

OBJECTIVES: Determine distribution and abundance of
primarily non-game fish species in selected lakes and
streams of New York; determine habitat preference of
rare species and species associations with common
habitat preference; determine historical or present
day changes in habitat which may affect the
distribution of rare species.

APPROACH: Standard fisheries collection techniques
(seining, electrofishing, etc.) will be used to
collect fishes. Other physical, chemical and
biological aspects of their habitat will be measured.

PROGRESS: 80/01 TO 80/12. Electrofishing and seining
surveys of fishes in French Creek, Chautauqua County,
NY were conducted. No longhead darter Percina
macrocephala, were collected. The silverjaw minnow,
Epiplatys buccata was collected and represents the
first report of this species from New York State. The
spotted darter, Etheostoma maculatum, population was
confirmed in the system and continues to represent
the only known locale in NY State for this species.
Concurrent collections of benthic fishes and
invertebrates were made throughout the summer to
better determine the importance of food organisms as
possible controlling factors in the distribution of
darter species. Data analysis is incomplete. A single
sampling of Cattaraugus Creek headwaters, Cattaraugus
and Chautauqua Counties, NY was conducted as the
survey is expanded to other waters.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.148 CRIS0083270
METHODOLOGY AND ASSESSMENT OF ENVIRONMENTAL EFFECTS
AT LOW HEAD HYDRO POWER SITES

GLOSS S P; NATURAL RESOURCES; CORNELL UNIVERSITY,
ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147334 Project Type: STATE
Agency ID: SAES Period: 01 JUN 80 To 30 SEP 83

OBJECTIVES: Research undertaken at hydroelectric
sites will address the following objectives:
Development of reliable and practical methods for
assessing turbine mortality and other effects
associated with fish passage at low-head hydropower
facilities, Estimation of species and size specific

effects caused by design of lowhead hydropower facilities using methodology determined in the first objective or alternative methods.

APPROACH: Studies will involve insitu introduction of various species and sizes of fish into the headrace of low-head hydro power plants and their recapture or recovery in the tailrace. Recovery will be studied using passive (stationary) trawling in the tailrace with efficiency of capture determined for fishes in live, dead, and injured condition. Several anadromous species from the northeast U.S. will be tested dependent upon their availability. Factors such as turbine type, stream flows, water temperature, etc. may be contributing variables.

PROGRESS: 80/08 TO 80/12. Testing of introduction and recovery methodology for estimating turbine mortality incurred by anadromous fishes passing through Casberger-Cross Flow turbines was begun. Direct introduction from live holding tanks to a subsurface point directly upstream of turbine intakes utilizing a 13 cm irrigation pipe appears most feasible. Recovery is accomplished by modified butterfly nets attached directly to the discharge end of the draft tubes. Preliminary data on rainbow trout (proxy Atlantic salmon) and striped bass has been obtained for turbine mortality. No complete results are available.

PUBLICATIONS: 80/08 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.149 CRIS0084203
MODELS TO ASSESS BIOMAGNIFICATION POTENTIAL OF PERSISTENT TOXIC SUBSTANCES IN AQUATIC FOOD CHAINS

GLCSS S P; NATURAL RESOURCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147336 Project Type: STATE
Agency ID: SAES Period: 01 JAN 81 To 30 SEP 82

OBJECTIVES: Undertake laboratory evaluation of three types of microcosms for estimating the uptake, transfer, and degradation of xenobiotic chemicals in aquatic food chains. The results of these studies will be used in assessing the suitability of one or more of the three microcosms for industrial testing which may be required under the Toxic Substances Control Act (Public Law 94-469).

APPROACH: Comparative evaluation of: recirculating static; flow through multiple-species microcosms; and a modular food-chain model using p, p' DDT (base line or reference xenobiotic) and one of more halogenated hydrocarbons and one or more phthalate esters selected from the EPA list of 129 priority pollutants. A literature review of the selected test chemicals and at least one representative chemical from each of the other major classes of toxicants to document occurrence in freshwater habitats, persistence, and pathways and processes (if known) that result in potential hazards to man via aquatic food chains. An investigation of the feasibility of incorporating a sediment phase in one or more of the compartments of the modular food-chain model.

004.150 CRIS0071348
SCOPE OF WORK FOR PRELIMINARY STUDY OF PRIMARY AND SECONDARY PRODUCTION OF THE ST. LAWRENCE RIVER

MILLS E L; FORNEY J L; NATURAL RESOURCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147323 Project Type: STATE
Agency ID: SAES Period: 06 AUG 76 To 30 SEP 79

OBJECTIVES: Obtain preliminary data on species composition and biomass of primary producers (phytoplankton, periphyton, and macrophytes) and consumers (zooplankton and benthic invertebrates). Assess the relative contribution of various communities to primary and secondary production in the St. Lawrence River. Evaluate methods of measuring biomass and production. Incorporate preliminary data

in a comprehensive plan of study.

APPROACH: Review literature, obtain preliminary data using standard techniques, on species composition and biomass of primary producers (phytoplankton, periphyton, and macrophytes) and consumers (zooplankton and benthic invertebrates). Collect vertically integrated samples for water quality and assess in conjunction with other field studies. Outline possible food webs and their probable importance in energy transfer. Prepare a comprehensive proposal identifying areas requiring further research and outlining methods of attack.

PROGRESS: 79/01 TO 79/12. Standing stock of phytoplankton in the St. Lawrence River was estimated at five sites between Cape Vincent near Lake Ontario and Waddington, New York, Winter through Summer 1978. Decreasing algal and zooplankton standing crops downriver supported the conclusion from earlier years that inputs from Lake Ontario determine phytoplankton abundance. Grazing, rapid downstream movement below Ogdensburg and the straining potential of vegetation were suspected as affecting composition and gradations of algal populations downriver while increased current flow, turbulence and a rapid transport partially accounted for decreasing stocks of zooplankton in Lake St. Lawrence. Mean sedimentation rates of detrital material range between 3.6 and 6.5 g/m²/day. Significant losses of organic drift was transported downriver from Lake St. Lawrence; only 0.001 g/m³/day entered the St. Lawrence from Lake Ontario while 0.15 g/m³/day was in transport in Lake St. Lawrence. A wide variety of benthic invertebrates were identified in bottom samples; chironomids, oligochaetes, amphipods and mollusks were the dominant forms; the potential for benthic production was greatest for inshore waters at Galop Island and offshore sites near Cape Vincent. Food habits of St. Lawrence River fish under ice cover generally preferred isopods and amphipods; however, mollusk shells, organic detritus and other fish composed the diet of some fish.

PUBLICATIONS: 79/01 TO 79/12
MILLS, E.L., SMITH, S.B. and FORNEY, J.L. 1978. Primary producers, secondary consumers and water quality in the St. Lawrence River and Mills, et al. 1978b. Benthic sampling and substrate analysis at ice boom sites.
MILLS, E.L., SMITH, S.B. and FORNEY, J.L. 1978. Characterization of the primary and secondary components of the St. Lawrence River food web during Summer 1978. Technical Report submitted to U.S. Fish and Wildlife Service, Department of

004.151 CRIS0067977
BIOLOGICAL, TECHNICAL, AND ECONOMIC STUDIES OF CULTURED AQUATIC RESOURCES

NICKUM J G; NATURAL RESOURCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147319 Project Type: STATE
Agency ID: SAES Period: 12 MAY 75 To 31 DEC 80

OBJECTIVES: The Cornell Aquaculture Program include measurement and evaluation of changes in the effluent quality from oxidation ponds due to filtration by confined populations of daphnids and measurement and evaluation of yield of daphnids from confined populations receiving effluents from oxidation ponds.

APPROACH: Daphnid populations will be confined in partially submerged cages which will receive flows of algae laden water from algal culture systems and/or small oxidation ponds. The effects of variation in concentration of algae, velocity of flow, and cage depth will be tested at three different levels for each parameter. Changes in effluent water quality will be measured by comparing the quality of water entering the daphnid cages with that of the water that has flowed out of the cages. Daphnid populations will be harvested on a pre-determined schedule, dried and weighed to determine production.

PROGRESS: 80/01 TO 80/12. This project was initiated in August 1979 as an investigation of the impacts of manure fertilization on the water quality and production potential of New York fish ponds. The field season (April-October) of 1980 was a period of great activity on the project. Six experimental ponds were fertilized at three levels of manure (no manure, 2500 kg/ha and 12,300 kg/ha) and stocked with larval walleye, *Stizostedion vitreum*. The manure was effluent from an experimental methane digester. The physical and chemical response was monitored through analysis of nitrogen and phosphorus concentrations, light penetration, dissolved oxygen levels, water temperature, pH and alkalinity. The biological response was monitored by measuring production and consumption of oxygen by the phytoplankton community, chlorophyll concentration and form (a, b and c), zooplankton biomass and community structure, and fish growth. Fish survival was estimated. Attempts to model oxygen and ammonia levels, and to assess the variability in predicted values show that minimum oxygen levels can be predicted from manure load, temperature and chlorophyll values. Ammonia levels can be predicted from load, temperature, pH and chlorophyll. The research under this project has been transferred to the Agronomy Department, Cornell University.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.152 CRIS0058307
EUTROPHICATION AND COMPARATIVE LIMNOLOGY OF THE
FINGER LAKES

OGLESBY R T; SCHAFFNER W R; NATURAL RESOURCES;
CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147308 Project Type: STATE
Agency ID: SAES Period: 01 JUL 70 To 30 SEP 83

OBJECTIVES: Further elucidation of the role agriculturally derived phosphorus may play in the eutrophication of lakes.

APPROACH: Water samples are collected from experimental agricultural plot and rural watershed runoff and further samples are prepared by aqueous extraction of manures and decaying vegetation. Analyses are performed for various forms of phosphorus (particulate, dissolved inorganic, dissolved organic). Bioassays of two types are then performed to determine the biological availability of P and algal preferences for the various forms.

PROGRESS: 80/01 TO 80/12. A new phase of work has begun (December 1980) with funding through OWRI for research focussed on the biological availability to phytoplankton of phosphorus derived from agricultural activities. Initial work on this two year project will focus on phosphorus bound in organic form. This is a joint project involving a soil scientist and a phytoplankton ecologist as well as aquatic scientists from Natural Resources. It is anticipated that by Fall 1981 initial chemical characterization of organic P compounds in agricultural runoff and preliminary bioassays of these will be completed. We intend to experimentally release P from these organics by using phosphatase enzymes. Two other phases of work have been completed. In one, four techniques developed by others to assess biological availability of P in natural waters were compared using samples from two different types of New York streams. It was concluded that currently accepted techniques are far from adequate for this purpose. In the second, data from our studies of the Finger Lakes were statistically analyzed to determine the number of years of sampling needed to define specified levels of change in trophic status. A manuscript on this has just been submitted for publication.

PUBLICATIONS: 80/01 TO 80/12
TRAUTMANN, N.W. 1981. Biological Availability of Wastewater Phosphorus in the Sediments of Two New York Streams. M.S. Thesis, 107 p. Cornell Univ., Ithaca.

004.153 CRIS0070504
EFFECTS OF ACID PRECIPITATION ON ADIRONDACK LAKES

SCHOFIELD C L; WEBSTER D A; NATURAL RESOURCES;
CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147321 Project Type: STATE
Agency ID: SAES Period: 01 APR 76 To 30 SEP 83

OBJECTIVES: Investigate lake sensitivity to acidification and determine mechanism leading to chemical and biological changes. Evaluate and develop procedures for restoring and maintaining fisheries in acidified waters.

APPROACH: Sources of acidity and sinks for precipitation strong acids are being investigated in three Adirondack lakes, representative of the regional range in sensitivity to acidification. The roles of aluminum (in soils, as a sink for hydrogen ion; in water, as a toxic species) in the acidification process are currently emphasized. Screening and selection of factors influencing acclimation and adaptation to acid waters. Evaluation of partial or refuge liming in acid lakes for maintenance of fish populations.

PROGRESS: 80/01 TO 80/12. Soil aluminum mobilization by strong acids originating from atmospheric deposition was identified as an integral facet of the acidification process in Adirondack Mountain watersheds. Aluminum discharged from the basins in streamflow accounted for only a small fraction of the total strong acid inputs on an annual basis, but the predominant inorganic species of aluminum present during periods of high discharge were found at levels potentially toxic to fish. High inorganic aluminum levels, approximately equivalent to mobile strong acid anion (SO₄ and NO₃) levels, were also found in soil solution and ground water collected below the spodosol E horizons in the study watersheds. These findings suggest that a large, but as yet unquantified, fraction of the strong acid loading undergoes a two stage neutralization process in the soil system. Thus, initial aluminum dissolution reactions are succeeded by hydrolysis or CEC reactions when deeper flow paths favor longer water retention times in the soil. The primary implication of this working hypothesis is that basin hydrology is the key factor determining the sensitivity of Adirondack watersheds to either acidification or increased basic cation leaching. The potentials for maintaining brook trout fisheries in acidified Adirondack Lakes by utilizing hatchery stocks selected for increased physiological tolerance to acid-aluminum stress or acclimated to recipient lake water quality prior to stocking were demonstrated experimentally.

PUBLICATIONS: 80/01 TO 80/12
SCHOFIELD, C.L. 1980. Processes Limiting Fish Populations in Acidified lakes. In: Atmospheric Sulfur Deposition, Environmental Impact and Health Effects, Ed. Shriner, D.S. et al. Ann Arbor Sci. Publ., pp. 345-356.
SCHOFIELD, C.L. and TROJNAK, J.F. 1980. Aluminum Toxicity to Brook Trout (*Salvelinus fontinalis*) in Acidified Waters. In: Polluted Rain. Ed. Toribara, T.Y., Miller, M.W. and Morrow, P.E. Plenum Press, N.Y. pp. 341-366.
ERISCOLL, C.T., BAKER, J.P., BISOGNI, J.J. and SCHOFIELD, C.L. 1980. Aluminum Speciation in Dilute Acidified Waters and Its Effect on Fish. Nature 284:161-164.
BAKER, J.P. and SCHOFIELD, C.L. 1980. Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality. Proc. Int. Conf. on Ecol. Impact of Acid Precipitation, pp. 292-293. Sandefjord, Norway. March
GALLOWAY, J.N., SCHOFIELD, C.L., BENDRY, G.R., ALTWICKER, E.R. and TROUTMAN, E.E. 1980. An Analysis of Lake Acidification Using Annual Budgets. Proc. Int. Conf. on Ecol. Impact of Acid P precipitation Sandefjord, Norway. March

004.154 CRIS0013142
FATE AND EFFECTS OF TOXICANTS IN AGRICULTURAL AND
ENVIRONMENTAL FOOD CHAINS

LISK D J; OFFICE OF RESEARCH ADMIN.; CORNELL
UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-102315 Project Type: STATE
Agency ID: SAES Period: 01 JUL 57 To 30 SEP 84

OBJECTIVES: To determine the fate of pesticides,
heavy metals and industrial toxicants in
soil-plant-animal and aquatic systems.

APPROACH: The downward movement of pesticides through
sandy soils on Long Island under practical field
applications will be determined. Nutritional
supplements including activated charcoal, microsomal
enzyme inducers and thyroid stimulants will be used
to attempt to rid fish of PCB residues. Forage crops
grown on municipal sludge-amended soils are being fed
to pregnant goats, sheep, swine and quail to study
possible toxic effects such as residues in milk and
meat, mutagenicity and tissue lesions. Additives to
sludge such as fly ash will be studied to hopefully
reduce uptake of cadmium by crops. Additives to grey
muck soils such as sludge and tree bark will be
studied hopefully to improve onion yields by
replacing the lost organic matter and lowering pH. A
nationwide analytical survey of municipal sludges for
toxic elements, nutrients and chlorinated organics is
underway.

PROGRESS: 80/01 TO 80/12. The herbicide Lasso was
found to rapidly disappear from Long Island soils.
Fydrin-treated apples when processed showed that the
insecticide concentrated in the skins, cores and
pomace, not the juice or sauce. Mass spectrometry
showed that Fydrin did not decompose in the rumen of
a cow. Nor was it or its acid metabolite excreted in
urine. Honey which is acidic dissolves iron when
shipped in steel drums and may acquire a dark color
possibly due to an iron-tannin complex formed. Acid
dairy waste may be effectively incorporated in fish
diets. Radioactivity was not found in honeys
collected near the Three Mile Island Nuclear Power
Plant. Carcinogenic polynuclear aromatic compounds
were found in municipal sludge ashes of American
cities. Metals in municipal sewage wastewater
contaminated a marine fish food chain raised in the
water. Crops grown on sludge ashes absorb lower
levels of Cd probably due to its presence as
refractory compounds formed during the ashing. No
significant differences were found in absorption of
Cd, Ni and Zn by 8 varieties of field corn grown on
sludge amended soil. Wheat, corn silage,
alfalfa-timothy silage, corn grain and vegetables
grown on sludge are being fed, respectively, to
quail, sheep, pregnant goats, swine and rats in long
term studies to assess heavy metal deposition, liver
enzyme changes, mutagenesis and tissue lesions.
Similarly fly ash and fly ash-grown crops have been
fed to cows, steers and chickens to assess selenium
toxicity and nutrition.

PUBLICATIONS: 80/01 TO 80/12
MANDISODZA, D.T., PCND, W.G., LISK, D.J., GUTEMANN,
W.H. and HCGUE, D.E. 1980. Selenium Retention in
Tissues of Swine Fed Carcasses of Pigs Grown on
Diets Containing Sodium Selenite or High Selenium
White Sweet Clover Grown on Fly
FUR R, A.K., PARKINSON, T.F., HACHE, C.A.,
GUTENMANN, W.H., PAKKALA, I.S. and LISK, D.J.
1980. Multielement Absorption by Crops Grown on
Soils Amended with Municipal Sludge Ashes. J.
Agric. Food Chem. 28:660-662.
FURR, A.K., PARKINSON, T.F., WINCE JE., F.E.,
HACHE, C.A., GUTENMANN, W.H., PAKKALA, I.S. and
LISK, D.J. 1980. Elemental Composition of New
York State Maple Syrups Sampled Near Sources of
Air Pollution. Nutr. Rep. International
HOGUE, D.E., REID, J.T., HEFFRON, C. L., GUTENMANN,
W.H. and LISK, D.J. 1980. Soft Coal Fly Ash as a
Source of Selenium in Unpelleted Sheep Rations.
The Cornell Vet. 70:67-71.
LEIN, D.B., MAYLIN, G.A., BRAUND, D.G., GUTENMANN,
W.H., CHASE, L.E. and LISK, D.J. 1980. Increasing
Selenium in Bovine Blood by Feed Supplements or
Selenium Injections. The Cornell Vet. 70:113-124.

004.155 CRIS0071839
QUANTITATIVE AND QUALITATIVE STUDIES OF POLLUTION IN
SELECTED FARM PONDS

MARROW E; BIOLOGY; AGRIC & TECH UNIVERSITY OF N C,
GREENSBORO, NORTH CAROLINA. 27412.
Proj. No.: NC-X-PR-0006-307-086 Project Type: GRANT
Agency ID: CSES Period: 30 JUN 76 To 29 JUN 81

OBJECTIVES: Interpret and evaluate the quantitative
and qualitative data which have been gathered over a
five-year period (1973-78) on pollution in selected
farm ponds. Make an assessment of the effects of this
pollution on the plant and animal life of the ponds
as reflected in changes that occur over the five-year
period.

APPROACH: Plant and animal specimens which have been
collected during the course of this project will be
sorted and identified. Tabular and graphic
interpretation will be made of physical, chemical,
and biological data. Collection of water samples and
chemical examination of same will continue. Data
collected during earlier phases are to be compared
with more recent data.

PROGRESS: 80/03 TO 81/02. Degrees of eutrophication
resulting from pollution have been determined in 10
ponds, based on the following parameters:
concentration of nutrients, numbers and species of
algae, bacterial populations, general conditions and
plankton similarity indexes. Data from four ponds
(Sites 9, 10, 11, 12) not previously treated are
included. With the exception of Site 10 (Bitter's
Lake, a small recreational facility, ca. 10 m (2) in
size, south of the city), these ponds are
characterized by few plankton species and high
bacterial counts and nutrients concentrations.
Eighteen plankton species were counted in samples
from Site 9 (Creekridge Road Pond, southwest of the
city); 7 spp. from Site 10; 13 spp. from Site 11
(Mertin Farm Pond, McLeansville community, ca 12 km
east of city); and 5 spp. from Site 12 (Simmons Farm
Pond, McLeansville). Sites 10 and 11, with 5 plankton
species in common, showed highest degree of species
similarity (S = 0.50), but differed in nutrient
concentrations and bacterial counts (no coliforms or
fecal streptococci were found in Site 10 samples). Site 7
(with 11 spp.) and Site 12 had 3 spp. in common (S =
0.375), and differed greatly in bacterial counts and
nutrient loads. No blue-green algae, fecal coliforms
for fecal streptococci were found in Site 10. This
pond is temporarily classified as oligotrophic,
although low numbers of species suggest eutrophy. The
Plant Materials Pond (Site 2) and the Simmons Pond
(Site 12) are mesotrophic, approaching eutrophy.

PUBLICATIONS: 80/03 TO 81/02
NO PUBLICATIONS REPORTED THIS PERIOD.

004.156 CRIS0074023
A COMPARISON OF THE ACCUMULATION RATES OF P ABSORBED
BY THE VITAL ORGANS OF FISH

VICK A; BIOLOGY; AGRIC & TECH UNIVERSITY OF N C,
GREENSBORO, NORTH CAROLINA. 27412.
Proj. No.: NC-X-PR-0006-20094 Project Type: GRANT
Agency ID: CSES Period: 26 SEP 77 To 25 SEP 82

OBJECTIVES: Note whether solid or dissolved forms of
p³² in the medium vary in absorption rates of the
material in the organs of fish determine the
tolerance level of p³² in Gambusia during different
seasons of the year.

APPROACH: Quantities of minnows will be collected
periodically from nearby farms ponds and streams and
maintained in aquaria for observation and study.
Three ten gallon aquarium tanks will be filled with
pond water from which the specimens are taken. The
tanks will be labeled "experimental liquid"
"experimental solid" "control". A daily record will
be taken of the room temperature and temperature of
each tank. Likewise, the daily pH for each tank and
the concentration of p³² for the "experimental" and
"solid" tanks. (Note: The concentrations of the
liquids in these two tanks should be identical). An

adequate quantity of specimens will be placed in each tank and at three day intervals. Ten specimens from each tank will be sacrificed and dissected to obtain such vital organs as the eye, brain, gills, heart, liver, skin, kidney, body muscle, gonad, and vertebrae. Each of these organs will be thoroughly dehydrated in a drying oven followed by pulverization. Small aliquot portions of each of the samples will be weighed and tested by the use of equipment manufactured by Searle Analytic, Inc.

PROGRESS: 80/03 TO 81/02. This is a summarized statement of the results of an investigation of a comparison of the accumulation rates of radioactive phosphorus absorbed by the vital organs of fish fed treated solid food to the rates of those imbibing the isotope dissolved directly in water. The experimental results obtained to date by the use of model 470 gas flow detector, model 1042 automatic sample changer and model 8703 decade scaler from Searle Analytic, Inc., are as follows: The kidney, heart, and liver respectively absorbed 1.3 times as much radiation as did similar organs of organisms absorbing the isotope dissolved directly in water; The brain, gonad, vertebrae and gills absorbed 1.4 times as much as did the respective organs of specimens receiving the dissolved form; The skin absorbed 1.5 times as much as its counterpart; The eye 1.6 times as much and the muscle 1.3 times the accumulation as its respective counterpart. Hence, on the basis of these results it may be concluded that it is well worthwhile to dissolve waste (32-P) before disposal.

PUBLICATIONS: 80/03 TO 81/02

VICK, A.E. 1978. A Comparison of the Accumulation Rates of Radioactive Phosphorus in Certain Vital Organs of Fish (*Gambusia affinis*): The Research Bulletin Series, Summer, North Carolina Agricultural and State University.

004.157 CRIS00E3126
NITROGEN FIXATION AND ITS EFFECT ON EUTROPHICATION:
IN-POINT AND NON-POINT SOURCE PONDS

REDDY G B; PLANT SCIENCE; AGRIC & TECH UNIVERSITY OF N C, GREENSBORO, NORTH CAROLINA. 27412.
Proj. No.: NC.X-04E-5-80-130-1 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 80 To 30 SEP 82

OBJECTIVES: The objectives are to study the rates of nitrogen fixation by blue-green algae bacteria in sediments; measure the total nitrogen input in ponds; isolate and culture the responsible blue-green algal species and micro-organisms for nitrogen fixation; measure the total biomass present in the system; evaluate the significance of nitrogen fixation and its correlation to other nutrients; and to investigate the primary nutrients cycle in confined water systems and in the laboratory.

APPROACH: Water and sediment samples will be collected from different ponds. All biological, chemical and N(2)-fixation analysis will be performed on these samples. At each sampling time, water temperature, day's temperature and light intensities will be recorded. Nitrogen fixation will be assayed by C(2)H(2) reduction techniques by using gas chromatography. Microorganisms will be isolated and the total biomass will be estimated by determining ATP, and chlorophyll contents.

004.158 CRIS0068208
STRUCTURE AND DEVELOPMENT OF MARGINAL SALT MARSH
SPECIES FROM NORTH CAROLINA

ANDERSON C E; BOTANY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC03518 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 75 To 30 FEB 79

OBJECTIVES: Describe the vegetative development of shrubs growing on the margins of salt marshes; determine seed germination tolerance and growth response to salinity and discover mechanisms for

dealing with salt stress and compare among salt marsh species.

APPROACH: Seeds from marginal salt marsh species such as *Myrica cerifera* and *Iva frutescens* will be collected and their germination tolerances will be studied. Seedlings from the germinated seeds and field specimens will be used to study patterns of development and the influence of various environmental factors, particularly salinity, on the development. Mechanisms of salt tolerance will be investigated using cyto- and histochemical analysis and comparative data from other marsh and dune species.

PROGRESS: 78/07 TO 79/06. Camphor weed growing in North Carolina dune systems has two growth forms and may respond as a biannual. Seeds germinating in the spring produce a rosette form. The following growing season an erect form develops and flowering occurs. If germination occurs in the fall, as it may in North Carolina, the rosette form is essentially bypassed, and the erect form and flowers are produced the following growing season.

PUBLICATIONS: 78/07 TO 79/06
NO PUBLICATIONS REPORTED THIS PERIOD.

004.159 CRIS0063865
EFFECTS OF THE BRUNSWICK NUCLEAR POWER-PLANTS ON THE
PRODUCTIVITY OF SPARTINA ALTERNIFLORA

SENECA E D; STROUD L M; BOTANY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05276 Project Type: STATE
Agency ID: SAES Period: 01 JUL 73 To 31 DEC 79

OBJECTIVES: Determine the effect of the construction and operation of the Brunswick Nuclear Power Plant on the productivity of *Spartina alterniflora* (smooth cordgrass).

APPROACH: In order to fulfill the objectives, environmental analysis of the Oak Island and Dutchman's Creek must be determined. Field studies monitoring environmental parameters, sampling of above and below ground vegetation to determine productivity. After initial gathering of data and vegetation samples, analysis of data, by computer and laboratory tests will be carried out and a model developed for the area.

PROGRESS: 73/07 TO 79/12. A preliminary energy budget was developed for the emergent portion of a *Spartina alterniflora* marsh located in the Cape Fear River Estuary, NC, based on data from this marsh and where needed, values from the literature. Gross primary production was about 1.1% of incident solar energy: of this amount, 32% was respired by the primary producers, mainly *Spartina* and benthic microalgae, leaving a net production of 7518 kcal m⁻² yr⁻¹. The equivalent of 50% of the net production (3957 kcal m⁻² yr⁻¹) was respired by the microbes, but combined meiofaunal and macrofaunal respiration amounted to only 8% (671 kcal m⁻² yr⁻¹). About 42% of the net production was available for export from the marsh to the estuary, with about 1/3 of that amount in the form of dissolved organic carbon and about 2/3 in the form of particulate matter; a portion of the latter was probably lost to the marsh sediment as accretion. Release of DOC from live *Spartina*, decaying litter and sediment or methane release from the sediment surface; together, accounted for 39% of the production remaining after microbial and faunal respiration. A tagging study indicated that mean stem longevity for *Spartina* was 7.9 months, and the experimental turnover rate was 1.5 crops yr⁻¹. Five methods (peak standing crop, Milner and Hughes, Smalley, Wiegert and Evans, and Lomnicki et al.) yielded net aerial primary production estimates ranging from 214 to 1038 g dry wt m⁻² yr⁻¹ in a stand of short *Spartina*.

PUBLICATIONS: 73/07 TO 79/12
MENDELSSOHN, I.A. 1979. Nitrogen metabolism in the height forms of *Spartina alterniflora* in North Carolina. Ecology 60:574-584.

LINTHURST, F.A. 1979. The effect of aeration on the growth of *Spartina alterniflora* Loisel. Amer. J. Bot. 66:685-691.

004.160 CRIS0068035
IMPACTS OF THE CONSTRUCTION AND OPERATION OF COASTAL NUCLEAR POWER PLANTS ON ESTUARINE ECOLOGY

COPELAND B J; HUISE M T; MCNEOE R J; ZCCLCGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05332 Project Type: STATE
Agency ID: SAES Period: 01 JUN 75 To 30 JUN 81

OBJECTIVES: Develop information for evaluating the effects of power plant construction and operation on the ecology of North Carolina estuaries. Specific objectives are to establish baseline populations, diversity and movements of organisms in the intake and outfall areas of the Cape Fear River Estuary and adjacent ocean; determine the effects of construction and operation of the discharge canal on the nursery utilization and productivity of Dutchman Creek; determine the impact of entrainment and impingement on larval fish and crustaceans; and develop information on heat tolerances of organisms.

APPROACH: Sampling stations are established on lower Cape Fear River, offshore and at site of power plant. Regular collections of samples will be examined for changes in phytoplankton, zooplankton, larval fish and crustaceans. Certain physical measurements will be obtained.

PROGRESS: 80/01 TO 80/12. Major analysis of field data was accomplished during the year, resulting in several theses and reports. A major accomplishment was the use of information from the project to prove the premise of power plant cooling without towers. These results enabled the power company to obtain an operating permit and saved the rate-payers about \$800 million over the next 20 years. Scientific significance was underscored by the development of analysis techniques to handle large amounts of field data and provide answers for management questions. Sampling and statistical techniques developed and used during the year will form the base upon which federal agencies will develop guidelines for future studies of potential impact.

PUBLICATIONS: 80/01 TO 80/12

BOBBIE, J.E. and COPELAND, B.J. 1980. Estuarine Ecosystems, pp. 186-197. In: Guthrie, F.E. and Perry, J.J. (Eds.). Introduction to Environmental Toxicology. Elsevier North-Holland, N.Y., 469 pp.
ITCHENS, W.M. and COPELAND, B.J. 1980. Succession in Laboratory Microecosystems Subjected to Thermal and Nutrient Addition Stress, pp. 536-561. In: Giese, J.P. (Ed.), Microcosms in Ecological Research. LCE Symposium.
EINFIELD, E.C. 1980. Differential Responses of Obligate and Facultative Schooling Fishes in Currents. M.S. Thesis, N.C. State Univ., 108 pp.
RULIFSON, R.A. 1980. Assessing the Vulnerability of penaeid Shrimp to
GEAGHAN, J.P. 1980. Distribution and Diversity of Fish and Crustacean Communities in the Cape Fear River Estuary, N.C., 1977-1979. Ph.D. Dissertation, N.C. State Univ., 91 pp.

004.161* CRIS0079631
POSSIBLE CAUSES OF BLUEGILL LEPOMIS MARCOCHIRUS DEFORMITIES

DEMONT D J; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05447 Project Type: STATE
Agency ID: SAES Period: 01 JUN 79 To 31 MAR 80

OBJECTIVES: Examine temperature shock, genetics, and water quality as possible causes of deformities in bluegill sunfish in Lake Robinson, S. C.

APPROACH: Fish will be spawned in the laboratory and the eggs and larvae will be subjected to temperature shock at five stages in development. Tests will be conducted using parental stock from Lake Robinson and another source to detect genetic effects. Lake Robinson water and water from another source will be used in duplicate tests to crudely assess the effects of water quality.

PROGRESS: 79/06 TO 80/03. Work commenced on this project in July after authorization was received. Bluegills chosen from among those which seemed to be approaching spawning condition were stocked into 8 foot diameter fiberglass ponds for "natural spawning." The fish fed poorly and no spawning activity was observed through mid-September. Attempts to strip and fertilize bluegill eggs in the laboratory were also unsuccessful. Even with the injections of Human Chorionic Gonadotropin used late in the summer, eggs obtained were rarely fully developed. Those few eggs which began development died within 24-30 hours. I concluded in early September that further attempts to induce spawning in 1979 were futile and halted work and further spending on the project. This action was communicated to Carolina Power and Light Company officials in a meeting on the 19th of September, 1979. The project will be revised and extended before March 31, 1980 or will be terminated with remaining monies reverting back to Carolina Power and Light Company as per our contractual agreement.

PUBLICATIONS: 79/06 TO 80/03
NO PUBLICATIONS REPORTED THIS PERIOD.

004.162 CRIS0073893
IMPACT OF LAND USE PRACTICES ON POPULATIONS OF WILDLIFE AND FISHERY RESOURCES

HAIR J D; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05398 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 79

OBJECTIVES: Develop data base on habitat requirements of game and non-game species of wildlife and fresh-water fish, research impacts of agriculture/forestry land use practices on population dynamics of wildlife-fisheries resources, develop habitat inventory systems and predictive management alternatives for terrestrial and aquatic ecosystems.

APPROACH: Wildlife and fishery resources are products of terrestrial and aquatic habitats. Effectively document and predict responses to habitat changes, a systems approach to research will be utilized. Initially, this will involve identification of key wildlife-fishery research needs for agricultural, forest and aquatic ecosystems of North Carolina. Subsequently, specific research programs will be developed that will address problems in a systematic manner that will provide both short and long term answers for the wise and sustained management of North Carolina wildlife and inland fishery resources.

PROGRESS: 77/07 TO 79/06. This project provides support for a number of activities associated with the fisheries-wildlife research program. Non-salary budget support included departmental operating expenses, research laboratory utilities, vehicle maintenance, current services and temporary wages. Funds have also been used to support, in part, the following research projects: Behavioral Ecology, Structure and Function of Waterfowl Community During the Winter Period, Winter Habitat Utilization of the Greater Snow Goose Along Coastal North Carolina, Effects of Prescribed Burning of a High Altitude Shrub Bald in North Carolina, Ecology and Management of Furbearers in North Carolina and Impact of Agricultural Practices on Cottontail Rabbit Habitat Selection and Population Dynamics.

PUBLICATIONS: 77/07 TO 79/06
NO PUBLICATIONS REPORTED THIS PERIOD.

004.163 CRIS0081387
STATUS, ABUNDANCE AND EXPLOITATION OF THE STRIPED
BASS IN THE ROANOKE RIVER, NC

HASSLER W W; ZOOLOGY; N CAROLINA STATE UNIVERSITY,
RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05466 Project Type: STATE
Agency ID: SAES Period: 01 JAN 80 To 30 JUN 82

OBJECTIVES: Delineate the status, abundance,
exploitation and ecology of striped bass in the
Roanoke River and Albemarle Sound, N. C.

APPROACH: Tagging and creel census studies will be
conducted in the Roanoke River to determine
exploitation rates, sport and commercial catches and
population size. Egg recovery surveys will be
conducted to determine spawning abundance and egg
viability. Trawling studies will determine relative
success of spawning and survival of young-of-year
striped bass.

PROGRESS: 80/01 TO 80/12. Roanoke River commercial
striped bass catches declined to 20-year low with a
total of 2,286 striped bass landed for a c.u.e. of
0.71 fish per net day. The commercial fishing was
centered in the Williamston area (87.8% of total
catch) and the migration peaked between April 8-28.
The sport catch totaled 13,318 fish of which rod and
reel accounted for 7452 fish and gill nets 5451.
Only 77 fish were tagged because of the poor
commercial catch. A cumulative total of 10,711 fish
have been tagged over a 20-year period. Trawling
studies in the Albemarle sound collected 5885 fish of
which 26 were young-of-year striped bass and the
c.u.e. was 0.46. The Albemarle Sound catch was
dominated by an increase in white perch and the
c.u.e. for this species was 75.54 per trawl. A survey
of motile Aeromonas septicemia indicated a low
incidence of this disease in the Roanoke River and
Albemarle Sound.

PUBLICATIONS: 80/01 TO 80/12
HASSLER, W.W. and HILL, N.L. 1979. A Summary of the
Status, Abundance, and Exploitation of Striped
Bass in the Roanoke River and Albemarle Sound,
North Carolina. 82 pp.

004.164* CRIS0069601
THE STATUS, ABUNDANCE, AND YIELD OF THE STRIPED BASS
IN THE ROANOKE RIVER, NORTH CAROLINA

HASSLER W W; HILL N L; ZOOLOGY; N CAROLINA STATE
UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05352 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 JUN 79

OBJECTIVES: Delineate the status, abundance, and the
ecological factors essential to the perpetuation of
the Striped Bass population in the Roanoke River.

APPROACH: Before the bass migrate upstream a creel
census will provide a base for analysis of subsequent
censuses taken as the bass move upstream. In the
spawning area (Halifax, N. C.) counts of eggs will
provide estimates of productivity. Measurement of
rate of flow, extent of turbidity, temperature and
other factors will indicate factors essential to
perpetuation.

PROGRESS: 75/07 TO 79/06. The commercial catch of
striped bass in the Roanoke River from 1975-79 was
18,989; 7,156; 10,465; 16,253; and 10,000 fish
respectively. Anchor gill nets were the most
successful commercial gear used. The striped bass
sport catch for 1975-79 was 22,219; 40,799; 32,983;
28,016; and 29,419 fish respectively. The CUE for
these years was 3.61, 4.00, 3.27, 2.76, and 3.25
striped bass/boat. Tagging was conducted on striped
bass from 1976-79. The exploitation rates were 22.73,
13.47, 21.24, and 13.0% respectively. Trawling in the
Albemarle Sound nursery area (1975-79) resulted in
catch/trawl of 10.80, 10.52, 3.63, 0.59, and 0.55
young-of-year striped bass. Reduced catches in 1978
and 1979 were associated with high river discharge
flows during the spawning season. Estimates of
striped bass egg production for 1975-78 were 2.19,
1.5, 1.76, 1.69, and 1.61 billion eggs respectively.

The annual estimated striped bass spawning population
was 3.27, 2.78, 3.48, 3.54, and 3.43 x 10⁵
respectively. In 1978 trawling studies in the lower
Roanoke River resulted in the collection of 14,309
fish of which white perch was the dominant species.

PUBLICATIONS: 75/07 TO 79/06
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD

004.165* CRIS0072394
EURASIAN WATERMILFOIL IN CURRITUCK SOUND: ITS CONTROL
AND POTENTIAL USE

HUISSH M T; KERBY J H; ZOOLOGY; N CAROLINA STATE
UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05375 Project Type: STATE
Agency ID: SAES Period: 01 JAN 77 To 31 DEC 78

OBJECTIVES: Obtain fishery relationships to Eurasian
Watermilfoil. Evaluate "edge effect" of Eurasian
Watermilfoil control on recreation and commercial
fishing..

APPROACH: This is a portion of an overall project
with this title. In this portion, age, growth,
feeding habits, and distribution of recreational
fishes will be determined using standard fishery
methods. Sampling will entail the use of various
types of nets, seines, and rotenone. Samples will be
taken at least quarterly and will be designed to
detect differences which can be attributed to the
presence or absence of watermilfoil. Standard water
chemistry data will be taken at least quarterly and
will be designed to detect differences which can be
attributed to the presence or absence of
watermilfoil.

PROGRESS: 77/01 TO 78/12. The effects of
water-milfoil (Myriophyllum spicatum) infestation on
fish populations in Currituck Sound were studied.
Rotenone samples of three coves before (1959-65) and
after (1977) infestation indicated that both weight
and number of fish per hectare increased after
infestation, but that the average weight per
individual decreased from 0.0250 to 0.008 kg. The
population structure changed, with ictalurids and
yellow perch having the greatest increases in numbers
and largemouth bass and white perch the greatest
decreases. Ictalurids and centrarchids (other than
bass) exhibited the greatest increases in weight per
hectare, while largemouth bass and "other" fish
showed the greatest decreases. Numbers of largemouth
bass were not significantly different between pre-and
post water-milfoil samples. A comparison of areas
dense in milfoil with an area of Potamogeton
suggested that no adverse effects on the fish
populations could be attributed to milfoil.

PUBLICATIONS: 77/01 TO 78/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.166* CRIS0078749
ECOLOGY OF JUVENILE FISHES IN NC ESTUARIES

MILLER J M; ZOOLOGY; N CAROLINA STATE UNIVERSITY,
RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05435 Project Type: STATE
Agency ID: SAES Period: 01 JAN 79 To 30 JUN 81

OBJECTIVES: To estimate the seasonal abundance of
juvenile sciaenid fishes in the Pamlico River
estuary. To relate their distribution to certain
environmental factors such as depth and vegetation. To
determine their food habits, local availability of
these food items, and rates of consumption.

APPROACH: Sample juvenile fishes and their food
approximately weekly in the Pamlico River estuary
in relation to major habitat features. Perform
analyses of these data and data from the Department
of Natural Resources and Community Development to
determine the critical features of nursery areas.

PROGRESS: 79/01 TO 81/06. Juvenile fish populations were sampled in Rose Bay, N.C., for a period of two years. They enter the estuary as post-larvae in December and January and grow there for about 8 months before migrating off shore as adults. During this nursery period they eat mainly zooplankton, clam siphons, polychaete worms, as well as a member of min or dietary organisms. Sampling showed reduced abundance in areas subject to salinity depression and variation due to freshwater runoff through canals. Spot and croaker are more or less ubiquitous in Rose Bay, while other species, e.g., specked trout, red drum and silver perch are more restricted to submerged grass beds. There was much dietary overlap among species suggesting the possibility of food competition. Growth rates and mortality schedules are being analyzed now to test this hypothesis. Spot and croaker, the two dominant species, are segregated on the habitat axes of salinity and temperature. Spot have a higher optimum temperature than croaker which is reflected in a higher growth rate for croaker in early Spring and a higher growth rate for spot in summer. The high abundance of food and low mortality rates suggest that the major limiting factors to these juvenile fish populations are reduced habitats owing to salinity variability and the lack of abundance of submerged vegetation. Four Master's theses and one Ph.D. dissertation are in progress on the project.

PUBLICATIONS: 79/01 TO 81/06

MILLER, J.M. and DUNN, M.L. 1980. Feeding strategies and patterns of movement in juvenile estuarine fishes. In V.S. Kennedy, Ed. Estuarine Perspectives Academic Press, N.Y. 533 p.

004.167

CRIS0075647

LIMITS ON PRODUCTION OF ARCTIC CHIRONOMIDAE: A PART OF PROJECT A. L. P. S.

MOZLEY S C; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.

Proj. No.: NC05413

Project Type: STATE

Agency ID: SAES

Period: 01 MAY 78 To 30 APR 81

OBJECTIVES: The Project is designed to test whether food or temperature are limiting the growth and secondary production of Chironomidae (Diptera) larvae in lakes, with specific reference to Toolik Lake along the Alaska Pipeline.

APPROACH: Field observations of energy flow through chironomidae for three years will estimate natural variation of production as a result of year-to-year changes in environment and primary production field experiments with test for production responses to increased food, reduced benthic primary production, elevated temperature and increased competition in replicated, randomized plots of lake bottom.

PROGRESS: 78/05 TO 81/04. Because they grow slowly and have synchronous reproduction, arctic Chironomidae (midges) offer a simplified system in which to test factors that potentially limit invertebrate animal production in lakes. Isolated plots of mud and animals were treated by increasing food (soy flour), raising the temperature, or shading benthic algae to reduce their productivity in 1978, 1979 and 1980. Food became partly limiting in 1978 when chironomid densities were high, but in other years densities were lower and the natural food supply exceeded their needs. No other treatments had a significant effect on production. Predators may have reduced chironomid populations below food-limited levels. Field experiments with carnivorous invertebrates and sculpin (small fish) showed that natural predators can eat large numbers of midge larvae. Both types of predators tended to remove the more active and abundant prey species selectively. The fish preferred larger midge larvae as prey, and indirectly promoted a shift in prey size toward a large proportion of very small larvae. Predation caused significant changes in benthic communities of Toolik Lake. This study indicates that food resources are of secondary importance, but biological controls of benthic community structure and probably production were surprisingly strong in this harsh arctic environment.

PUBLICATIONS: 78/05 TO 81/04

BERSHEY, A.E. 1980. Chironomid Community Structure in an Arctic Lake: The Role of a Predatory Midge. M.S. Thesis, North Carolina State University, 28 pp.

004.168*

CRIS0073132

THE EFFECTS OF ARTIFICIAL STRUCTURES OF GAME FISH IN A BORROW PIT POND

JOHNSON D L; LARSON E; FISHERIES & WILDLIFE; OHIO AGRIC RES AND DEVL P CENTER, WCOSTER, OHIO. 44691.

Proj. No.: OBO00609

Project Type: BATCB

Agency ID: CSRS

Period: 01 JUL 77 To 30 SEP 80

OBJECTIVES: Develop and evaluate a new device called a pop net for sampling various types of artificial cover. Also to chronicle the development of the arthropods and fish communities associated with both tire and stake structures at various depths. Also to determine the use made by various species and sizes of game fish.

APPROACH: Construct 12 reefs about 25 meters long each made up of 5 separate units each about 1.5 meters high. The reefs will extend into the lake from the north shore. Six of those reefs will be made up of tire structures and the other six of verticle stake beds. Half of the tire reefs will be kept food-free with bi-weekly scrubbing while the remaining reefs will develop attached communities normally. A new net device, SCUBA, and angling will all be used to evaluate the effect of depth, cover type, and food availability on fish community development and fish behavior.

PROGRESS: 77/01 TO 80/09. The pop net has been developed to sample artificial structure. The floor of the cylindrical, open-ended net is placed on the lake bottom, the 4 m diameter circular wall collapsed, and secured around the floor's perimeter. Structure to be sampled is placed on the net floor. The net released mechanism is triggered remotely. The net wall with floats rises, enclosing the structure and associated fish. Eighteen tests were conducted in clear water to determine pop net efficiency. Escapement rates were 0.5% and 2.1% respectively for bluegills (*Lepomis macrochirus*) 75-130 mm and large-mouth bass (*Micropterus salmoides*) 180-230 mm in total length. No bluegill greater than 160 mm and bass greater than 315 mm escaped. A total of 671 fish were susceptible to capture. Of these, 4 escaped resulting in a net efficiency of 99.4%. Initial examination of data suggests that number of bluegill captured, regardless of size, is inverse to the percentage of small bass associated with structure. Also, number of small bass captured is inverse to the percentage of small bluegill associated with structure. An inverse relationship is also suggested for water temperature and the percentages of small bluegill and all fish associated with structure.

PUBLICATIONS: 77/01 TO 80/09

NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

004.169

CRIS0084520

THE EFFECT OF STRUCTURE ON FISH BEHAVIOR

JOHNSON D L; TRIPLETT J R; FISHERIES & WILDLIFE; OHIO AGRIC RES AND DEVL P CENTER, WCOSTER, OHIO. 44691.

Proj. No.: OBO00490-S

Project Type: STATE

Agency ID: SAES

Period: 01 JUL 78 To 30 JUN 83

OBJECTIVES: To define the relationships of structure type and placement to behavior and harvest of selected fish species, which will serve as a basis for altering the habitat and improving the fishery of C. J. Brown Reservoir.

APPROACH: Batching ponds will be used to determine preference for a size-range of bluegill, white crappie and largemouth bass for structures of various interstitial sizes and configurations. C. J. Brown Reservoir will be sampled to determine fish community composition and artificial structure installed to determine preference of fish for a variety of

structure types. Anglers will be surveyed to determine fishing pressure and harvest success.

004.170 CRIS0077992
ALGAL METABOLISM IN THE PRESENCE OF HERBICIDES

HAWXBY K W; LANGSTON UNIVERSITY, LANGSTON, OKLAHOMA. 73050.
Proj. No.: OKLX-7984-15-4 Project Type: 1890/T
Agency ID: CSRS Period: 04 JUN 69 To 03 JUN 84

OBJECTIVES: Determine cellular and sub-cellular effects of triazine, dinitroaniline, urea and phenoxy acetic acid herbicides on algae with use of an electron microscope. Compare the effects and interactions of herbicides in algal photosynthetic lamellae, polyhedral bodies, pigment proteins and cell structure with effects on cell metabolism. Determine the interaction of various levels of minerals and climatic factors in metabolism of algae in the presence of the above herbicides.

APPROACH: Standard EM techniques will be used to determine morphological and cytological changes in algae due to herbicide treatment. Labeled herbicides will be used; polyhedral bodies will be separated by centrifugation and studied under the EM; standard analysis will be used in the analysis of algae treated with minerals.

PROGRESS: 80/01 TO 80/12. Electron microscopic and biochemical studies were carried out on the blue-green algae *Anacystis nidulans* and *Lynbya birgei* treated with 10 - 5 M dinoseb. Preliminary observations suggest that photosynthetic lamellae in *Anacystis* were affected more than those of *Lynbya*. Work on algal pigment separation and absorption spectrum analysis of *Anacystis* grown under day-light type fluorescent light was done. The results are now being compiled for possible publication. Estimation of total protein by the Lowry method and phycobiliprotein separation by sucrose gradient techniques are being utilized. Column chromatography was also used to analyze algal pigments. Work on the effects of *Xanthomonas malvacearum* on cotton plant was also begun. TEM and SEM pictures of the infected cotton leaf cells were obtained and remain to be analyzed.

PUBLICATIONS: 80/01 TO 80/12

HAWXBY, K. 1980. Participated in Symposium on "Algae as Biomass and Solar Energy Collector" at the E. M. Society of America Meeting Reno, Nevada, Aug. 1-8.
MEHTA, R.S. and HAWXBY, K.W. 1980. The Electron Microscopy of the Blue-Green Alga *Anacystis nidulans*. Association of Research Director Symposium, Atlanta, GA, November 12, 15.

004.171 CRIS0065961
ACCUMULATION AND DEGRADATION OF SOME HERBICIDES BY ALGAE

HAWXBY K W; MEHTA R S; LANGSTON UNIVERSITY, LANGSTON, OKLAHOMA. 73050.
Proj. No.: OKLX-PR-0007-404 Project Type: GRANT
Agency ID: CSRS Period: 12 FEB 74 To 11 FEB 79

OBJECTIVES: Determine the extent and rate of removal of phenoxyacetic acid, dinitrophenol and dinitroaniline herbicides from aqueous solutions by cultures of algae common to Oklahoma lake waters. Determine the extent and rate of breakdown of the herbicides by algae. Determine whether algae may be induced to breakdown the herbicides by substrate enrichment technique as has been shown for bacteria.

APPROACH: The algae will be cultured in sterile, defined nutrient media by methods as described by Erickson et al. (29) or Schiff (30). Preparation of sterile media, the harvesting of algae and the determination of algae wet and dry weight will be carried out by methods described by Curl and Rodriguez-Kabana (31).

PROGRESS: 79/01 TO 79/12. Under experimental conditions, simazine at 10 - 5M concentration is effective by disrupting photosynthetic functions. Whether the presence of simazine affected the thylakoids (photosynthetic lamellae) and polyhedral bodies (storage granules) directly or not has not been determined. Simazine apparently caused death in algal cells by imbalancing the function of thylakoids and in turn making polyhedral bodies incapable of performing their functions. What these functions are, remains to be understood. The estimation of protein in whole and mechanically disrupted *Anacystis* cells was done by the Lowry method. Pigment and cellular protein values in control and herbicide treated cells were evaluated. Phycobilisomes have been separated using sucrose gradients, and protein content will be determined. Preliminary observation of 100 ml. *Anacystis* aliquots (O.D. = 0.6) showed 1.5 times more protein in ruptured cells than in whole cells.

PUBLICATIONS: 79/01 TO 79/12

MEHTA, R.S. and HAWXBY, K.W. (1979) Effects of simazine on the blue-green alga *Anacystis nidulans* Hull, Environ. Contam. Toxicol 23:319-326.
MEHTA, R.S. (1979) An electron microscopic study of the blue green algae: Oklahoma Academy of Science.
MEHTA, R.S. (1979) Structure of phycobilisome in the blue-green algae. Poeter session at the E.M.S.A. annual meeting, San Antonio, TX.

004.172 CRIS0070155
ACCUMULATION AND DEGRADATION OF SOME HERBICIDES BY ALGAE

HAWXBY K W; MEHTA R S; LANGSTON UNIVERSITY, LANGSTON, OKLAHOMA. 73050.
Proj. No.: OKLX-PR-0007-616-36 Project Type: GRANT
Agency ID: CSRS Period: 16 JAN 76 To 15 JAN 81

OBJECTIVES: Determine whether algae may be induced to breakdown the herbicides by substrate enrichment techniques as has been shown for bacteria.

APPROACH: Algae will be grown through several cultures in the presence of low levels of the herbicides. This data will then be compared to data taken before prolonged exposures to the herbicides. Such studies should reveal whether algae can be induced to accumulate or detoxify herbicides.

PROGRESS: 80/01 TO 80/12. Aliquots of *Anacystis nidulans*, *Chlorella pyrenoidosa*, *Scenedesmus quadricauda*, *Lynbya birgei*, and *Anabaena variabilis* were treated with 10 - 5 M alachlor, Aquazine, dinoseb, fluometuron, glyphosate, methazole, prometryn, trifluralin, or 2,4,5-T. Algal samples were taken after 1, 2, 3, and 4 days and the optical density was measured. The Lowry method was used to determine protein content of the samples. Ten ml samples of *A. variabilis*, *L. birgei*, or *C. pyrenoidosa* were treated with 1 ml 14C-simazine, 14C-trifluralin, 14C-2,4-D, or 14C-2,4,5-T. After one hr, the samples were centrifuged and filtered. Pellets obtained were placed in scintillation cocktail and counted. Half of the treatments contained 10 - 5 M dinitrophenol (DNP). Treated samples were compared with controls to determine uptake. After 4 days the growth of algae in the fluometuron, prometryn, Aquazine, and methazole treatments was greatly reduced when compared to controls. The reduction of protein in these treatments was not as pronounced, indicating the herbicides had a greater effect on photosynthesis than on protein synthesis. Herbicide uptake by the algae was recorded as follows; trifluralin in greater than simazine greater than 2,4,5-T=2,4-D. DNP treatment had little effect on herbicide uptake of most algae tested. However, simazine, 2,4,5-T and trifluralin uptake by *A. variabilis* and 2,4,5-T uptake by *L. birgei* was greatly reduced after 1 hr.

PUBLICATIONS: 80/01 TO 80/12

HAWXBY, K.W. and MEHTA, R. 1980. Uptake of Herbicides by Algae and Herbicidal Effects on Algal Metabolism. Association of Research Directors Symposium. Atlanta, GA, November 12-15.

004.173 CRIS0079845
FEASIBILITY OF CAGED FISH CULTURE IN NORTH CENTRAL
OKLAHOMA FARM PONDS

MAUGHAN O E; BOWMAN D E; LANGSTON UNIVERSITY,
LANGSTON, OKLAHOMA. 73050.
Proj. No.: OKLX-8085-15-5 Project Type: 1890/T
Agency ID: CS4S Period: 01 OCT 79 To 30 SEP 84

OBJECTIVES: Study production and cost of caged fish in small ponds in Central Oklahoma, investigate and test the feasibility of caged fish in a normal farm or ranch operation.

APPROACH: Channel catfish will be grown in cages and fed pellets containing 30-35% protein, and Tilapia will be grown in cages and fed pellets containing 25-30% protein. Oxygen and temperature will be measured daily at feeding time to develop a profile as if they relate to growth. Record as to marketing and home consumptions and cost will be kept to determine return on investment.

PROGRESS: 80/01 TO 80/12. Cage culture appears to be economically feasible in small (less than 2.0 ha) farm ponds and has potential for generating a small additional source of income (estimated to be \$744.00/ha) and/or producing low cost food for the farm family. Ponds that are clear (depth of visibility greater than 1.0 m) and shallow (depth less than 1.0 m over half of the pond) should probably not be used for cage fish culture unless aquatic vegetation control is implemented. Channel catfish fingerlings should be 150 to 200 mm in total length when stocked if a large proportion of marketable size fish are to be produced in one year in Oklahoma. Tilapia appear to stimulate channel catfish feeding and therefore increase production. The optimum ratio appears to be a very high ratio of catfish to tilapia. The optimum density of fish per cage appears to be about 400 fish per cubic meter with an anticipated harvest weight of 0.45 kg.

PUBLICATIONS: 80/01 TO 80/12
GEBHART, G.E. and MAUGHAN, O.E. 1980. Feasibility of Mixed Cage Culture of Tilapia and Channel Catfish. Inland Commercial Fisheries Association. 14 March 1980, Nashville, TN.
GEBHART, G.E. and MAUGHAN, C.E. 1980. Cage Fish Culture in Small Farm Ponds in Oklahoma. Oklahoma Academy of Science, November 14, 1980. Norman, Oklahoma.

004.174 CRIS0068774
ACCUMULATION AND DEGRADATION OF SOME HERBICIDES BY
ALGAE

HAWKBY K W; LANGSTON UNIVERSITY; LANGSTON UNIVERSITY,
LANGSTON, OKLAHOMA. 73050.
Proj. No.: OKLX-PR-0007 Project Type: GRANT
Agency ID: CS4S Period: 21 MAY 75 To 20 MAY 80

OBJECTIVES: Determine the extent and rate of breakdown of the herbicides by algae.

APPROACH: Herbicides will be labeled with ¹⁴C and uptake in algae and disappearance in the nutrient media will be followed by assaying for radioactivity.

PROGRESS: 79/01 TO 79/12. Previous work in our laboratory indicated different reactions when phosphate levels changed in the presence of herbicides. Aliquots of *Chlorella pyrenoidosa* were cultured in high (0.023 mg/l) or low (.003 mg/l) concentrations of ortho or polyphosphate along with different concentrations of herbicides. Phosphate hydrolyzed by algal cells was determined by the method of Eray. High concentrations of polyphosphate appeared to be toxic to algal growth. Prometryn inhibited algal growth more than fluometuron at the concentrations tested. Orthophosphate was more conducive to growth than polyphosphate. Greater hydrolysis by algal cells was observed with high concentrations of ortho and polyphosphates. Different levels of phosphate and herbicides were also added to aliquots of various algae. Oxygen evolution and respiration were measured with an oxygen monitor. No significant difference in photosynthesis or

respiration were found due to phosphorus levels in the treatments. Higher concentrations of the herbicides tested reduced photosynthesis but had little effect on respiration.

PUBLICATIONS: 79/01 TO 79/12
TUBEA, B. and HAWKBY, K. Interaction of phosphates and herbicides with *Chlorella pyrenoidosa*. 1979 Oklahoma Academy of Science; Southern Weed Science Society.

004.175 CRIS0022032
RELEASE OF ADSORBED PESTICIDES INTO WATER

MENZEL R G; S PLAINS WATERSHED & WATER QUALITY LAB, DURANT,
OKLAHOMA. 74701.
Proj. No.: 7320-20790-002 Project Type: INHOUSE
Agency ID: ARS Period: 16 JUN 71 To 30 SEP 79

OBJECTIVES: We will relate the movement of herbicides in surface runoff, and their persistence and effects in farm ponds, to the degree of their adsorption on soils.

APPROACH: Arsenical herbicides which vary widely in degree of adsorption on soils will be used in laboratory and model pond studies. Methylation or demethylation of the various forms of these herbicides will be investigated. Effects on pond microorganisms and transformations by pond microorganisms will be related to the persistence of these herbicides in farm ponds. In cooperation with runoff studies at other locations, the relationship of adsorption characteristics to movement of herbicides in interflow, surface runoff, and sediment transport, will be incorporated into an agricultural chemical transport model.

PROGRESS: 80/01 TO 80/12. Microbial transformations of arsenical herbicides were studied in pond microcosms containing about 500 g of sediment and 6 l of water. About 20% of cacodylic acid demethylated after 9 months, but methylation of arsenate was undetectable. Numerous types of bacteria were isolated that were adapted to high concentrations of arsenic. These isolates were tested in groups or individually for their ability to transform arsenic compounds by methylation, demethylation, or gaseous evolution. No arsenic transformations were detected. A method was developed for separating arsenate, monomethylarsenate, and dimethylarsinite on an ion exchange column. The method performed satisfactorily on runoff samples containing arsenic at environmental concentrations.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.176 CRIS0045905
EFFECTS OF WATER QUALITY PARAMETERS ON FARM POND
VEGETATION AND THEIR INTERACTIONS

WILLIAMS R D; MENZEL R G; MCHENRY J R; S PLAINS
WATERSHED & WATER QUALITY LAB, DURANT, OKLAHOMA. 74701.
Proj. No.: 7320-20790-006 Project Type: INHOUSE
Agency ID: ARS Period: 12 DEC 79 To 12 DEC 82

OBJECTIVES: Assess the ecology of aquatic vegetation (macrophytes, algae, and bacteria) in farm ponds in relation to water quality and the development of management practices to optimize these systems.

APPROACH: Conduct laboratory, growth chamber, and field experiments designed to investigate the influence of water quality parameters (temperature, nutrient level, light penetration, and sediment) of farm ponds on associated plant growth and succession; investigate the effect of aquatic vegetation on the nutrient flow into and nutrient cycling within the impoundment; and manage plant species associated with waterways and impoundments to reduce the impact of non-point pollution.

PROGRESS: 80/01 TO 80/12. The physiology and growth of various amphibious and aquatic plants are being studied in relation to sediment and nutrient influxes that typify farm ponds. Transpiration rates of maidencain (*Panicum hemitomon*), marshbay cordgrass (*Spartina patens*), and narrowleaf cattail (*Typha angustifolia*) were measured during moisture stress cycles, and are being evaluated for significance. With yellow nutsedge (*Cyperus esculentus*), significant reductions in tuber weight occurred from shading at a low level of N fertilization, but not at two higher levels. Diatom (*Nitzschia* sp.) growth rates in solution culture did not vary at different N concentrations, indicating that this species can store N for later use. Sediment deposition averaged 32 and 175 g/m² per day in two farm ponds near Chickasha, OK. Although the sediment composition was similar, one of the sediments released much more soluble P and NH(4)-N to water than the other sediment did.

PUBLICATIONS: 80/01 TO 80/12

- LEHMAN, C.F. 1980. Oxygen Exchange Between a "Model" Pond and the Atmosphere Advances in Water Resources 3:87-90.
- MENZEL, R.G. 1980. Review of Book, "A Perspective of Environmental Pollution," by Holdgate, M.W. J. Environ. Qual. 9:332.
- MENZEL, R.G. 1980. Enrichment Ratios for Water Quality Modeling. In: "CREAMS - Field Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems" Knisel W.G. (Editor), USDA-SEA Conservation Research Report
- TROEGER, W.W. and OLNESS, A. 1980. Plant Development and Sequence in Artificial Ponds With or Without Phosphorus- Enriched Sediments. Southwest. Nat. 25:441-423.
- WAUCHOPE, F.D. and YAMAMOTO, M. 1980. Extraction, Speciation, and Analysis of Arsenic and Arsenical Herbicides in Runoff: Evaluation of Simple Methods at the ppb Level. J. Environ. Qual. 9:497-601.

004.177 CRIS0011762
ECOLOGY AND SYSTEMATICS OF AQUATIC INSECTS

ANDERSON N H; HAWKINS G P; DUDLEY T L; ENTOMOLOGY;
OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00578 Project Type: HATCH
Agency ID: CSRS Period: 02 JUN 67 To 30 JUN 85

OBJECTIVES: To increase the knowledge of occurrence and distribution of aquatic insects in Oregon, and to obtain basic life history information on selected species; To investigate the role of food quality in life history strategies of aquatic insects through both laboratory and field studies; To investigate the interrelationships between wood debris and stream invertebrates; and To compare the effects of canopy modification and sediment input due to logging on stream invertebrate communities.

APPROACH: The work proposed with aquatic insects includes both field and laboratory studies. In the field, emphasis will be on faunal surveys, larvae-adult associations, population estimates in relation to sediment input, and densities of insects on submerged wood of known age. Under laboratory conditions work will be on impact of aquatic insects on their food resources. Feeding experiments will be conducted with shredders and grazer-scrappers. The experiments include determination of food preferences, growth rate studies, and calculation of ingestion, egestion and assimilation.

PROGRESS: 80/01 TO 80/12. The mayfly community on wood was investigated as part of long-term studies on invertebrates associated with wood debris in streams. Of 9 genera encountered, only *Cinygma* showed a predilection for wood. *Cinygma* and *Ironodes* have mouthparts adapted for scraping the aufwuchs film and ingest wood fibers along with the fungal and bacterial flora. Mycophagy in wood-associated mayflies makes a contribution to wood processing and related to emergence and mineralization estimated at over 1g/m²/yr. Benefits accrued by mayflies from wood are related to emergence and shelter in addition to feeding. The effects of fine sediments on stream

communities was studied by comparing logged and forested sections of streams in the Oregon Cascades. The open clearcut sites had greater biomass of invertebrates and trout than did the shaded forested sections regardless of sediment composition. The changes in trophic status and increased primary production resulting from shade removal may mask or override the effects of sedimentation in these small streams. Study of stream recovery following the Mt. St. Helens eruption was initiated in 1980. Sites were established to compare channel condition and stream communities: across a range of impacts (blast deposits, heavy ash and pumice, moderate ash, light ash deposit), and along a continuum in a system receiving blast deposits and debris flows in the headwater reaches.

PUBLICATIONS: 80/01 TO 80/12

- PEREIRA, C.R.D. 1980. Life History Studied of *Glyngma integrum* Eaton (Ephemeroptera: Heptageniidae) and Other Mayflies Associated with Wood Substrates in Oregon Streams. MS thesis, 52 pp.
- GRAFIUS, E. and ANDERSON, N.H. 1980. Population Dynamics and Role of Two Species of *Lepidostoma* (Trichoptera: Lepidostomatidae) in an Oregon Coniferous Stream. Ecology 61:808-816.
- WINTERBOURN, M.J. and ANDERSON, N.H. 1980. The Life History of *Philanisus plebeius* (Trichoptera: Chathamidae), a Gaddisfly Whose Eggs Were Found in a Starfish. Ecol. Ent. 5:293-303.

004.178 CRIS0069960
BIOLOGICAL FEASIBILITY OF INTENSIFIED OYSTER CULTURE

BRESE W P; FISHERIES & WILDLIFE; GREGG STATE
UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00338 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 JUN 81

OBJECTIVES: Out-bay culture will investigate the biological and economic feasibility of pond or raceway culture under controlled conditions. This will yield data on the influence of parameters such as water volumes, currents and seeding density on oyster growth. Efforts will also be made to correlate changes in available natural food, as measured by dissolved and particulate organic carbon and nitrogen, with changes in oyster growth. These studies may also encourage investors by demonstrating the reduced threat to culture facilities from floods, winds and storms.

APPROACH: Hatchery-produced seed oysters will be placed on the bottom of commercial oyster growing grounds, on oyster growing trays and on experimental rafts. The growth and survival of these oysters will be monitored over a two-year period beginning in the spring of 1975. These data will provide a means of evaluating the relative efficiency and productivity of the various culture methods. Concurrent with the placement of seed oysters in the field, oysters from the same brood group will be held in an existing out-bay rearing pond provided with pumped seawater. The growth and survival of these oysters will be monitored for comparison with other rearing methods. Refinement of the out-bay culture method will be a continuing process.

PROGRESS: 80/01 TO 80/12. Cultchless seed was again planted in Tillamook Bay. As we have had no ice or adverse weather to date, growth and survival data should be collected in the Spring of 1981. *Crassostrea rivularis* has been accepted by some of the growers and eyed larvae and seed are available from two commercial hatcheries. Monthly sampling of the Kumamoto oyster is complete. Three years of data shows this oyster to mature later in the year. As this oyster is a warm water spawner (25 degrees C), this data agrees with our laboratory data which says low temperature delays sexual maturation but does not affect the rate of maturation. For the second year we have successfully spawned this oyster in late summer. Eyed larvae as a seed source is gaining popularity. A failure of domestic wild seed has increased the interests in hatchery seed. Techniques for handling eyed larvae are being perfected. Four hatcheries are now producing eyed larvae for sale. Communication.

Held a workshop in Astoria for Oregon and Washington growers to explain the eyed larvae technique for obtaining oyster seed. Visited the interested growers and helped them with the technique of setting eyed larvae.

PUBLICATIONS: 80/01 TO 80/12

- LANNAN, J.E. 1980. Broodstock Management of *Crassostrea gigas* I. Genetic and Environmental Variation in the Larval Rearing System. *Aquaculture* 21:323-336.
- LANNAN, J.E., ROBINSON, A.M. and ERESE, W.P. 1980. Broodstock Management of *Crassostrea gigas* II. Broodstock Conditioning to Maximize Larval Survival. *Aquaculture* 21:337-345.
- LANNAN, J.E. 1980. Broodstock Management of *Crassostrea gigas* III. Selective Breeding for Improved Larval Survival. *Aquaculture* 21:347-351.
- LANNAN, J.E. 1980. Broodstock Management of *Crassostrea gigas* IV. Inbreeding and Larval Survival. *Aquaculture* 21:353-356.
- MURANANKA, M.S. 1980. Broodstock Management of the Pacific Cyster *Crassostrea gigas* (Thunberg), M.S. Thesis. Cre. State Univ., 55 pp.

004.179 CRIS0084309
TEMPERATURE EFFECTS ON XENOBIOTIC ELIMINATION BY FISHES

CURTIS L R; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: OEE00911 Project Type: STATE
Agency ID: SAES Period: 01 JUL 81 To 30 JUN 86

OBJECTIVES: Increased understanding of and enhanced ability to explain the cellular events underlying hepatic elimination of xenobiotics will be sought. The influence of environmental factors on hepatic metabolism and biliary excretion of selected chemicals by salmonids will be investigated in an attempt to characterize the capacities of these fishes to eliminate "prototype" environmental contaminants.

APPROACH: Pharmacological/toxicological approaches will be employed to investigate the effects of acclimation under various regimens of temperature and caloric intake on the elimination of 2,4-toluenediamine, phenolphthalein and benzo(a) pyrene by salmonids. Standard pharmacokinetic indices will be applied to trace movement of administered agents from plasma to bile and/or urine. Examination of biochemical processes associated with hepatic elimination of xenobiotics will be incorporated into the research project so that mechanistic explanations of the actions of xenobiotics may be approached. The roles of conjugative metabolism and adenosine triphosphatase activity in hepatobiliary function are of particular interest.

004.180 CRIS0084308
ACUTE AND CHRONIC EFFECTS ON FISH EXPOSED CONTINUOUSLY AND INTERMITTENTLY TO TOXICANTS

CURTIS L R; WARREN C B; SEIM W K; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: OEE00910 Project Type: STATE
Agency ID: SAES Period: 01 JUL 81 To 30 JUN 86

OBJECTIVES: The potential for environmental contaminants to produce adverse effects on natural populations is not easily extrapolated from laboratory data. Expanded knowledge of how temporal factors contribute to tolerance of fishes to toxic substances is necessary for development of environmental policy. The influence of manipulation of schedules of toxicant exposure on salmonid survival, growth and development will be studied.

APPROACH: The toxicity of copper and an additional agent to salmonids following continuous and intermittent exposure will be assessed. Juvenile rainbow trout will be utilized for determination of

LC50 values, the results being coupled with 21 day growth studies. Embryo-larval tests will be conducted to ascertain the responses of another stage in the life history of rainbow trout to variation in exposure regimens of toxic substances. Tissue residue analysis will be utilized to gain insight into how dispositional factors may influence differential toxicity attributable to temporal aspects of exposure.

004.181 CRIS0004421
EFFECTS OF WATERSHED PRACTICES ON STREAM HABITAT AND FISH POPULATIONS

BALL J D; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: OEE00526 Project Type: STATE
Agency ID: SAES Period: To 30 JUN 84

OBJECTIVES: To assess impacts of forest practices on fish populations and their habitat in streams of the Coast and Cascade ranges in Oregon. To develop improved methods of evaluating fish habitat, especially those characteristics impacted by forest practices. To evaluate measures taken to rehabilitate and enhance fish habitat in streams impacted by forest practices.

APPROACH: Cooperative with ongoing studies of watershed management and stream ecology on H. J. Andrews Experimental Forest and other locations in Oregon for extensive analysis of watersheds in a variety of geomorphic settings. Develop specific process studies to define detailed aspects of fish habitat, impacts on that habitat, and means to rehabilitate damaged or degraded streams.

PROGRESS: 80/01 TO 80/12. A review of natural variation in abundance of salmonid populations in streams was completed during the year. The work was based on literature and unpublished data. A major objective was to use the information to make recommendations for design of studies of watershed management impacts on streams. The standing stock biomass of salmonid fishes in streams was found to vary greatly in both time and space, from 0 to 60 g/m² or more. This variation is sufficient to mask large-scale perturbations caused by land management practices. Among the approaches we suggest to minimize the masking effect, the most important are further development of habitat quality ratings and improved systems of watershed and stream classification. Study designs employing paired comparisons are advocated as an additional improvement. In one study that incorporated this design, the effects of small clearcuts on fish and their habitats in the Cascade Mountains of Oregon were found to vary depending on stream gradient and time after logging. Clearcut sections where the stream was still exposed to sunlight (5-17 yrs. after logging) had greater trout biomass than old-growth (450 yrs) forested sections. Second-growth logged sections (12-35 yrs after logging), reshaded by forest canopy, had lower biomass of trout and fewer predator taxa than old-growth sites. Work began during the year on a new subproject involving impacts of sedimentation.

PUBLICATIONS: 80/01 TO 80/12

- MURPHY, M.L. and BALL, J.D. 1981. Varied Effects of Clear-cut Logging on Predators and Their Habitat in Small Streams of the Cascade Mountains, Oregon. *Can. J. Fish. Aquat. Sci.* 38:137-145.
- GREGORY, S.V. 1980. Effects of Light, Nutrients, and Grazing on Periphyton Communities in Streams. Ph.D. Thesis. Oregon State Univ., Corvallis, 151 pp.
- KNIGHT, N.J. 1980. Factors Affecting the Smolt Yield of Coho Salmon (*Oncorhynchus kisutch*) in Three Oregon Streams. M.S. Thesis. Oregon State Univ., Corvallis, 105 pp.
- FAUDKESAR, J.D. 1980. Ecology of Underyearling Summer Steelhead Trout in Intermittent Streams Tributary to the Rogue River, Oregon. M.S. Thesis. Oregon State Univ., Corvallis, 85 pp.

004.182 CRIS0084307
MICROCOSM MODELING OF THE RESPONSE OF PERSISTENT
AQUATIC COMMUNITIES TO A TOXICANT

LISS W J; WARREN C E; FISHERIES & WILDLIFE; OREGON
STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00081 Project Type: STATE
Agency ID: SAES Period: 01 APR 80 To 31 MAR 83

OBJECTIVES: The objectives of this research are 1) to evaluate and explain the influence of population exploitation, invertebrate habitat availability, and energy input rate on the structure and organization of laboratory aquatic communities, 2) evaluate and explain the response of these communities to introduction of a toxic substance and their recovery from toxicant perturbation as influenced by exploitation, habitat availability, and energy input.

APPROACH: Laboratory communities composed of persistent populations of guppies, amphipods, snails, planaria, and various microinvertebrates are being maintained at Oak Creek Laboratory of Biology. The guppies are exploited at different rates to simulate fishing. Two levels of energy input, in the form of an alfalfa ration, and invertebrate habitat availability are maintained. When the behavior of the communities at each exploitation and energy input rate has been well-documented and the systems have established near steady-states, dieldrin, an organochlorine insecticide, is introduced. The response of the systems to dieldrin, as influenced by exploitation and energy input rate, is determined and explained.

004.183* CRIS0028750
FISH GENETICS

SCHRECK C E; FISHERIES & WILDLIFE; OREGON STATE
UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00846 Project Type: STATE
Agency ID: SAES Period: 20 JUL 66 To 01 JUL 80

OBJECTIVES: Conduct original research in fish genetics and ecology. Apply findings of research toward clarification of existing problems of race identification, hatchery improvement, evolution of fishes, and genetic tolerance to heavy metal poisoning for fishes. Incorporate graduate instruction and research into each of the above objectives.

APPROACH: Population genetics, DNA homology studies, cytogenetic and Mendelian genetics studies, toxicity studies, and graduate level instruction in fish genetics and fish culture.

PROGRESS: 80/01 TO 80/12. Objectives include facilitating salmon and trout culture by determining phenotypic control of development, particularly stages during emoltification. Experiments on effects of transportation of coho and chinook indicated that post-release performance could be affected. Wild cut-throat tend to dominate hatchery coho salmon. Detection of imprinting odorants may vary during emoltification. Hormone therapy can be used to induce spawning in coho salmon in both fresh and saltwater.

PUBLICATIONS: 80/01 TO 80/12

DELAHUNTY, G., SCHRECK, C.E., SPECKER, J., OLCESE, J., VODICNIK, M.J. and DEVLAMING, V. 1979. The Effects of Light Reception on Circulating Estrogen Levels in Female Goldfish, *Carassius auratus*: Importance of Retinal Pathways

DELAHUNTY, G., SCHRECK, C.E. and DEVLAMING, V.L. 1980. Effects of Photoperiod on Plasma Corticoid Levels in the Goldfish, *Carassius auratus*: Role of the Pineal. *Comp. Biochem. Physiol.* 65A: 355-358.

EJLIKE, C. and SCHRECK, C.E. 1980. Stress and Social Hierarchy Rank in Coho Salmon. *Trans. Am. Fish. Soc.* 109:423-426.

REDDING, J.M. and SCHRECK, C.E. 1979. Adaptive Significance of Certain Enzyme Polymorphisms in Steelhead Trout (*Salmo gairdneri*). *J. Fish. Res. Board Can.* 36(5):544-551.

SPECKER, J.L. and SCHRECK, C.E. 1980. Stress Responses to Transportation and Fitness for Marine Survival in Coho Salmon (*Oncorhynchus kisutch*) Smolts. *Can. J. Fish. Aquatic Sci.* 37(5):765-769.

004.184* CRIS0075513
CHRONIC TURBIDITY AND STRESS IN JUVENILE COHO SALMON
AND STEELHEAD TROUT

SCHRECK C E; FISHERIES & WILDLIFE; OREGON STATE
UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00401 Project Type: STATE
Agency ID: SAES Period: 25 APR 78 To 31 DEC 80

OBJECTIVES: Objectives will be met by answering: Is there a generalized, physiological response to stress in juvenile salmonids; are the physiological responses to stress correlated or related to reduced fitness; does stress produce predictable physiological responses?

APPROACH: Juvenile coho salmon and steelhead trout will be exposed to siltation and their resistance to other stresses determined. Clinical chemistries involving primary aspects of the general adaptation syndrome of stress, such as cortisol, will be monitored.

PROGRESS: 80/01 TO 80/12. Juvenile coho salmon and steelhead trout exposed to suspended topsoil, clay or Mt. St. Helens volcanic ash had elevated plasma cortisol, suggesting that exposure to high levels of suspended solids is a moderately stressful condition. Although cortisol returned to pre-stress levels and osmoregulatory performance of the fish was not affected by exposure to sediment, topsoil significantly reduced the fish's tolerance to the pathogen *Vibrio anguillarum*. The absence of light during imposition of stress may mitigate in part the reaction to the stress.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.185 CRIS0084302
ACCOUNTING FOR VARIABILITY IN PRODUCTIVITY OF OCEAN
FISH IN YIELD ESTIMATION

TYLER A V; FISHERIES & WILDLIFE; OREGON STATE
UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00912 Project Type: STATE
Agency ID: SAES Period: 01 JUL 81 To 30 JUN 86

OBJECTIVES: Provide new mathematical approaches to estimating yields that account for variability in natural production of ocean fishes.

APPROACH: Develop multi-factor statistical analyses of the effects of physical oceanographic processes, fishing effort and stock size on trends of selected continental shelf fishes in the eastern Pacific. Develop mathematical models that explore how to estimate fishery yields in the face of variability in productivity due to density-dependent population processes and also variability brought about by hydrographic trends and fluctuations. Consideration will be given to food-web structure and multi-species fisheries.

004.186 CRIS0014167
TOXICOLOGICAL AND ECOLOGICAL EFFECTS OF TOXICANTS

WARREN C E; WEBER I J; LISS W J; FISHERIES &
WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON.
97331.
Proj. No.: ORE00693 Project Type: HATCH
Agency ID: CSRS Period: 31 DEC 64 To 31 DEC 80

OBJECTIVES: Develop an understanding of mechanisms of toxicity to aid in developing standards for toxicants which are adequate to protect freshwater organisms. The research will be designed to predict effects from multiple toxicants found in aquatic environment; effects of acute and chronic administration; and physiological treatment of toxicants by aquatic organisms.

APPROACH: Toxicological and pharmacological approaches will be used to determine the effects of multiple toxicant; toxicological and bioenergetic approaches will be used in specific toxicant studies; and physiological, pharmacological, and biochemical approaches will be used in relation to the organism elimination of a toxicant.

PROGRESS: 80/01 TO 80/12. Investigation of acute copper toxicity to juvenile rainbow trout following either continuous or intermittent exposure has been conducted. The 96-hr LC 50's appear to markedly differ (in terms of total mg/lb of toxicant exposure) between treatment schedules. In addition, when a daily ration is provided to fish in our bioassay system the 96-hr LC 50 is approximately twice that of unfed trout. Analysis of studies of structure-toxicity relationships of substituted benzenes has been completed. Increase in the degree of chlorine substitution, with subsequent enhanced lipophilicity, was found to result in increased acute toxicity of these agents to fishes. Laboratory ecosystems composed of persistent populations of guppies, snails, amphipods, planaria, and various microinvertebrates are being maintained. The guppies are exploited at different rates to simulate fishing and two levels of energy input are maintained. Near steady-state community structure and organization of the systems was determined by the rate of exploitation of their guppy population and by the rate of input of energy. Continuous introduction of 1 ppb of dieldrin into four ecosystems, one at each exploitation rate, at the low level of energy input brought about alteration of community structure and organization rate. Response ranged from initial reduction in density and subsequent recovery of the unexploited guppy population to extinction of the most heavily exploited guppy population.

PUBLICATIONS: 80/01 TO 80/12

- FINGER, S.E. 1980. Effects of Perturbation on Community Structure and Organization of Aquatic Microcosms. M.S. Thesis, Oregon State University, Corvallis.
- KULBICKI, M.L. 1980. Effects of Dieldrin and Different Food Levels on Life History Tactics of the Guppy (*Poecilia reticulata* Peters). M.S. Thesis, Oregon State University, Corvallis.
- WELTERING, D.M. 1981. Organization and the Adaptation of Aquatic Laboratory Ecosystems to Resource Availability, Exploitation, and a Toxicant. Ph.D. Thesis, Oregon State University, Corvallis.

004.187*

CRIS0076338

MICROBIOLOGICAL ASSESSMENT OF RIVER WATER CONTAMINATION

LEONG J A; MICROBIOLOGY; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.

Proj. No.: ORE00402

Project Type: HATCH

Agency ID: CSFS

Period: 01 APR 78 To 31 DEC 82

OBJECTIVES: Since 1973, there has been at least one major viral epizootic in Oregon fish hatcheries each year. This research proposal is concerned with the microbiological quality of the water released into the Oregon watershed after a viral epizootic and the potential impact of releasing this virus-containing water on the wildlife fed by this water.

APPROACH: Determine the rate of virus survival in the field after an epizootic using the following methods: Hatchery effluent sampling and virus concentration by membrane filtration. Assay for virus infectivity in tissue culture. Develop more sensitive assays for infectious virus using known chemical enhancers of viral infectivity. Determine whether IBNV and IPNV can infect animals other than Salmonid fishes and

produce a disease state. Determine whether fish viruses may interact with other viruses to yield an attenuated viral strain or a strain which is now more infectious for other animals.

PROGRESS: 80/01 TO 80/12. This project is concerned with the microbiological quality of the water released into the Oregon watershed from fish hatcheries during a viral epizootic and the impact of releasing this virus-containing water on the wildlife fed by this water. In the grant period 10-1-79 to 9-30-80 we made the following progress: We have extended our observations that infectious hematopoietic necrosis virus of salmonid fish can also grow in insect cells. The virus produces no change in the insect cell but large quantities of virus are released by the infected cell line. Thus, a possible insect reservoir for the virus may exist. We have also found that the virus that is produced by the insect cell line is altered in three of the five virion proteins. We are currently determining if the alteration in viral protein is due to a difference in the way the insect cell processes the viral protein or in the way the insect host selects for the replicating viral strain. The sensitivity of the assay for virus detection in tissue samples from diseased fish is dependent upon the cell line used in the assay. (See paper attached, submitted to J. Fish. Res. Bd. Can., 1980.) We have determined that UV-irradiation of water can be used to reduce the titer of virus in that water by 1,000 fold.

PUBLICATIONS: 80/01 TO 80/12

- SCOTT, J., FENDRICK, J., and LECNG, J. 1980. Growth of Infectious Hematopoietic Necrosis Virus in Mosquito and Fish Cell Lines. *Wasmann J. of Biology* 38(1,2):21-29.
- HEDRICK, R.P., LEONG, J.C. and FRYER, J.L. 1981. Establishment and Maintenance of the Carrier State in Salmonids with Infectious Pancreatic Necrosis Virus in the Sixth FDA Symposium on Aquaculture. Human Services Publication. Ed. FRYER, J.L., MCCAIN, B.E. and LECNG, J.C. 1980. A Cell Line Derived from Rainbow Trout (*Salmo gairdneri*) Hepatoma. *Proc. Jap. Soc. Fish Pathol.* Tokyo.
- LEONG, J. and FRYER, J.L. 1980. Microbiological Assessment of River Water Contamination by Fish Hatchery Effluent. Office of Water Research and Technology Publication. WERI 66, 43 pp.

004.188

CRIS0031226

BACTERIAL SURVIVAL AND RECOVERY MECHANISMS: SIGNIFICANCE IN MARINE ENVIRONMENT

MORITA R Y; MICROBIOLOGY; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.

Proj. No.: ORE00895

Project Type: STATE

Agency ID: SAES

Period: 01 APR 68 To 30 SEP 86

OBJECTIVES: To determine the physiological mechanism that permits bacteria to survive for long period of time without the presence of an energy-yielding substrate as well as to determine the mechanism of recovery from the starvation-survival state.

APPROACH: *Vibrio* (Ant-300), a pseudomonad, and a few nitrifiers will be monitored as to their survival in the absence of energy-yielding substrates for periods of days and months. During this period the size of the cells, formation or decrease in the macromolecules (protein, DNA, and RNA) will be followed and analyzed on the basis of the total cell count, viable cell count, and the respiring cell count. Endogenous metabolism, if any, EC (energy charge), and the cryptic growth will also be determined. In the recovery of the bacterial cells, the ability to utilize an energy-yielding substrate will be monitored. In both the survival and recovery processes, the protein patterns will be determined by the O'Farrell gel technique so that the possible changes in protein patterns (including enzymes) can be analyzed.

PROGRESS: 80/01 TO 80/12. The ability of psychrophilic bacterial cells (Ant-300) to undergo starvation survival over long periods of time lies in their ability to capture, bind, transport and utilize

substrate when available. Under prolonged starvation the cells maintain their binding proteins and an energized membrane. The starvation survival forms are in a state of "ready and waiting", capable of maintaining itself in nutrient deprived environment only to take advantage in any favorable shift in the nutrients available in the organism's environment. During the first 1.5 to 14 days of starvation under hydrostatic pressure Ant-300 cells are apparently more pressure sensitive than cells of Ant-300 starved for long periods of time. The data obtained indicates that Ant-300 may well adapt to survival at increased pressure under extended starvation but not capable of growth under pressure unless sufficient energy is available.

PUBLICATIONS: 80/01 TO 80/12

- MCRITA, F.Y. 1980. Microbiology of the Deep-sea. Can. J. Microbiol. 26:1375-1385.
MCRITA, R.Y. 1980. Calcite Precipitation by Marine Bacteria. Geomicrobiol. J. 2:63-82.
MORITA, F.Y. 1980. Biological Limits of Low Temperature and Pressure. Origins of Life 10:215-222.
MCRITA, F.Y. 1980. Low Temperature, Energy, Survival and Time in Microbial Ecology. pp. 323-324. In Schleissinger, D. (Ed.), Microbiology. Amer. Soc. Microbiol., Washington, D.C.
YORGEY, F.S. 1980. The Synergetic Effect of Starvation and Hydrostatic Pressure on Uptake of Alpha-aminoisobutyric Acid by a Psychrophilic Marine Vibrio. M.S. Thesis. Oregon State Univ., Corvallis. 81 pp.

004.189* CRIS0069126
HISTOPATHOLOGIC AND HISTOCHEMICAL INDICES OF
SUBLETHAL PESTICIDE TOXICATION IN FISH

ANTHONY A; NEFF W H; BIOLOGY; PENNSYLVANIA STATE UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA. 16802.
Proj. No.: PEN02211 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 76 To 30 JUN 81

OBJECTIVES: Develop histochemical bioassay methods of sublethal pesticide toxication in fish; investigate biochemical and physiological correlates of sublethal pesticide toxication in fish in relation to course of pathogenesis, survival potential and toxicant resistance.

APPROACH: Fish will be exposed to sublethal concentration of four pesticides. Atrazine, Carbaryl, 2,4-D and Parathion. Acid and formalin exposure will serve as "stress toxicant" reference standards. Tissues from major organ systems will be analyzed using differential and histochemical staining procedures. Cytometric and analytical cytophotometric indices will be used as text parameters in evaluating the utility and sensitivity of histochemical methods for detecting sublethal pesticide toxication. Supplemental biochemical and physiological studies will also be undertaken to validate histochemical assays of pesticides and elucidate their mode of action.

PROGRESS: 80/01 TO 80/12. Laboratory tests were conducted to investigate histopathologic and histochemical changes in various tissues of brook trout ('Salvelinus' 'fontinalis') exposed to sub-lethal dosages of the pesticides: atrazine, carbaryl, parathion and 2,4-dichlorophenoxyacetic acid. Analytical histochemical methods were employed to provide measures of regulatory aspects of metabolism as well as end products of synthesis. Among the important contributions of the study was the demonstration that quantification of nucleic acid responses in specific brain, liver, kidney and endocrine tissue compartments permits the detection of incipient stages of toxication and provides information on the pharmacological basis of toxicant induced pathogenesis. For example, it was found that with carbaryl toxication neuronal RNA levels were evaluated in the optic tectum and depressed in cerebellar Purkinje cells. With parathion toxication RNA was elevated in both cerebrocortical and cerebellar compartments. Thus, the higher toxicity of parathion stems from a generalized increase in

excitability of brain neurons, whereas carbaryl appears to be more site-specific with respect to toxin-mediated impairment of neuronal functioning.

PUBLICATIONS: 80/01 TO 80/12

- KOBULARIK M. G. 1980. Comparative incidence of histopathology in white perch ('Roccus americanus') and Atlantic tomcod ('Microgadus' 'tomcod') collected from water intake screens of Hudson river nuclear reactor plants. M.S.
ANTHONY A., et al. 1980. Microspectrophotometric analyses of water toxicant induced changes in nucleic acid and mucopolysaccharide levels of Stannius corpuscle cells of brook trout. Proc. Pa. Acad. Sci. 54(1):109.

004.190* CRIS0069189
ZOOGEOGRAPHY AND ECOLOGY OF FISHES IN PENNSYLVANIA

COOPER E L; BIOLOGY; PENNSYLVANIA STATE UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA. 16802.
Proj. No.: PEN02276 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 77 To 30 JUN 81

OBJECTIVES: Measure the impact of environmental disturbance on patterns of distribution of fish species; investigate the phylogeny of selected fish groups in order to assess the validity of species nomenclature.

APPROACH: The severity of environmental degradation due to acid mine drainage, soil erosion, industrial pollution or other disturbances to aquatic habits will be correlated with the presence or absence of species of fishes known to be sensitive to these forms of pollution. Predictions of the level of pollution permissible to maintain diverse fish populations are then possible. Studies will be continued to better understand the diversity of taxa and the geographic distribution of fishes in northeastern United States.

PROGRESS: 80/01 TO 80/12. Work is continuing on a manuscript "Fishes of Pennsylvania" which is in Press. The phylogeny of the sculpins (Teleostei: Cottidae) of eastern North America has been revised by detailed electrophoretic and meristic analysis of many Appalachian species and populations. An acceptable thesis is now being prepared for publication.

PUBLICATIONS: 80/01 TO 80/12

- STRUASS, R. E. 1980. Geographic variation and the intra- and interspecific relationships of eastern North American freshwater sculpins (Teleostei: Cottidae). The Graduate School, Penn State Univ., Ph.D. Thesis, 210 p.

004.191 CRIS0082236
ECOLOGY OF RARE AND ENDANGERED FISHES OF PENNSYLVANIA

COOPER E L; BRENNEMAN W M; BIOLOGY; PENNSYLVANIA STATE UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA. 16802.
Proj. No.: PEN02534 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 81 To 30 JUN 82

OBJECTIVES: Determine the status of rare or endangered fish species in Pennsylvania; to determine the role of the banded darter, Etheostoma oreade, in fish communities on stream riffles.

APPROACH: The distribution of most common fishes in Pennsylvania has been well defined by collections. Effort now is needed to describe the distribution and ecology of the rare and endangered species by collections in specific areas. The banded darter recently expanded its normal range by invading the colonizing nose of the Susquehanna River drainage. Several riffle communities of fishes, including this darter, will be selected within the original range of this darter and from the Susquehanna drainage. On these riffles, the ecological role of the darter will be compared to answer how this species successfully colonized a new riffle already supporting an abundant fish community.

004.192 CRIS0076818
NATURAL PRODUCTION OF TROUT IN INFERTILE MOUNTAIN
STREAMS OF PENNSYLVANIA

ARNCLD D E; FISBERIES & WILDLIFE; PENNSYLVANIA STATE
UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA. 16802.
Proj. No.: PEN02408 Project Type: STATE
Agency ID: SAES Period: 01 MAY 79 To 30 JUN 83

OBJECTIVES: Determine factors which limit natural
reproduction and growth of trout in infertile
streams; develop methods to manipulate the limiting
factors.

APPROACH: Compare fertile and infertile streams with
regard to number and size of fish produced, effects of
rainfall chemistry, and other factors. Test methods
of managing and controlling the factors identified.

PROGRESS: 80/01 TO 80/12. Over six years of data on
sensitive streams and their biota have been collected
on the Quehanna Wilderness Area. Several
precipitation chemistry stations have also been
maintained. During this period emphasis was shifted
to biology. A thesis on the effect of low dissolved
minerals on trout is in the writing stage. Most
chemical analyses of rain and stream samples have
been completed. New thesis studies on feeding of
brook trout and on insect populations as affected by
acidification of poorly-buffered, infertile streams
were begun. Several streams which show severe effects
of acidification have been identified. Rainfall pH
continues to average 4.0 or below.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.193 CRIS0064010
FISH MORBIDITY AND MORTALITY RELATED TO ENVIRONMENTAL
CHANGES AND/OR INTENSIVE CULTURE METHODS

ROTBENBACHER H; VETERINARY SCIENCE; PENNSYLVANIA
STATE UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA.
16802.
Proj. No.: PEN02099 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 74 To 31 DEC 79

OBJECTIVES: Determine major causes of fish morbidity
and mortality in Pennsylvania and examine the role of
man-made environmental stress conditions on incidence
of disease in fish. Attempt duplication of stressed
stream or lake conditions in the laboratory to study
pathogenesis.

APPROACH: Case reports of fish disease or mortality
will be investigated and classified into physical,
chemical, viral, bacterial, parasitic, neoplastic or
nutritional pathology. Physical, chemical and
microbiologic water determinations will be made at
sites of major disease incidence and correlated to
man-made environmental change. Laboratory studies are
aimed at duplication of stressed stream or lake
situations in order to study pathogenesis by
precipitating disease. Combinations of various
stresses will be applied.

PROGRESS: 79/01 TO 79/12. A 3 year experiment of
mixed culture between native bluegills 'epomis'
'macrochirus' and Israeli mirror carp 'Cyprinus'
'carpio' in 2-1000 m² ponds prevented reproduction of
the carp and resulted in overgrowth of bluegills.
Interbreeding and reproduction between recently
imported high-bred Israeli Mirror Carp and native
(1890 imports) Allegheny River mirror carp continued
for the 6th year in an irrigation reservoir.
Consultation agreements on pond-and intensive fish
culture continued with the Penna. Fish Commission
research hatchery and with 2 private foundations.
Experiments to recycle dried sewage sludge into fish
feed are in progress at the Benner Spring research
hatchery. Diagnostic examinations were made on 14
saltwater fish from a local aquarium and 2 freshwater
aquarium fish. Gill and internal parasites (flukes),
nutritional pathology and tuberculosis were main
findings in the saltwater fish. The freshwater fish
had 'Aeromonas' septicemia.

PUBLICATIONS: 79/01 TO 79/12
ROTBENBACHER, H., SHANNON, EARLY. 1979. Deaths
among brook trout traced to polluted water.
Science in Agr. XXVI, No. 2, p.3.

004.194* CRIS0073855
IDENTIFICATION OF SUB-OPTIMAL ENVIRONMENTAL
PARAMETERS AFFECTING AQUACULTURE

WOLKE R E; DUNN J L; MEADE T L; ANIMAL PATHOLOGY;
UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND.
02881.

Proj. No.: RI00412 Project Type: HATCH
Agency ID: CSRS Period: 07 NOV 77 To 01 OCT 81

OBJECTIVES: Mount a multidisciplinary approach to the
elucidation of sub-optimal environmental parameters
responsible for inefficient growth, poor reproduction
and increased disease incidence in aquaculture
production systems. Identification and clarification
of these critical parameters will be followed by
appropriate investigation of remedial measures.

APPROACH: Initial effort will be restrictive and
designed to develop tests capable of indicating early
stress in the fish, develop tests capable of
measuring early suppression of piscine immune
response, and investigate the actual effect of
altered water and nutritional factors thought to be
protective or advantageous to fish in closed systems.

PROGRESS: 80/01 TO 80/12. The cellular and humoral
components of the fishes immune system are well
developed and reflect environmental alterations.
Further, they are probable sensitive indicators of
sub-optimal parameters affecting fish culture. To
this end, during 1980, we expanded our testing
battery by developing the methodology and
capabilities to measure the following immune
indicators of stress and increased susceptibility in
finfish: Cellulose electrophoresis, Gel
electrophoresis, Agglutination, Precipitation,
Serumlysozymes, Hemolytic plaque, MIF, Macrophage
Phagocytic index, Serum Fe and Fe binding capacity,
Immuno fluorescence, Immuno electrophoresis.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.195 CRIS0064402
ABATEMENT OF EUTROPHICATION RESULTING FROM INTENSIVE
ANIMAL PRODUCTION

MEADE T L; ANIMAL SCIENCE; UNIVERSITY OF RHODE
ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: RI00822 Project Type: STATE
Agency ID: SAES Period: 01 JUL 73 To 30 SEP 80

OBJECTIVES: Develop practical methods for: Removal of
metabolites from fish culture water that render it
unsuitable for re-use. Treatment of fish culture
water to meet existing and projected standards for
discharge. Removal and treatment of suspended solid
wastes in fish culture water. Adaptation and/or
modification of processes for treatment of fish
culture water and solid waste in treatment of waste
from intensive livestock and poultry production.

APPROACH: Primary treatment will involve physical
screening and aerobic digestion. Secondary treatment
will involve aerobic digestion of solids,
denitrification by continuous microbial reduction and
re-oxygenation of effluent.

PROGRESS: 77/06 TO 80/09. Solids removal is one of
the more difficult unit processes involved in water
reuse systems for the culture of salmonids.
Traditional settling basins effectively remove
settleable solids but suspended solids are normally
entrained in the associated biological filter where
their buildup impairs nitrification efficiency and
necessitates periodic cleaning. Alternate methods of
solids removal were evaluated. Studies with a pulsed
rapid sand filter indicated that a 12 cm. atracite
coal bed over a 7.5 cm. sand bed resulted in a 66
percent removal of suspended solids at acceptable

hydraulic loading rates. Studies with an inclined 40 mesh stainless steel static screen indicated that up to 38 percent of the suspended solids could be removed at a hydraulic loading rate of 122 liters/m²/minute. Combining a plate settler with an 80 mesh stainless steel screen resulted in a 71 percent removal rate when the influent contained 77 mg/l of suspended solids. The relatively poor results obtained lead to investigation of "in situ" solids digestion in a system using 10 o/oo salinity water. Solids concentration was reduced 97 percent. This work will be continued in freshwater systems.

PUBLICATIONS: 77/06 TO 80/09

LLOYD, S.W. 1980. Solids removal from fish culture systems. M.S. Thesis, University of Rhode Island, Kingston, RI 50 p.

004.196

CRIS0071719

FISH BARRIER SYSTEMS FOR POWER STATIONS

MOTTE G A; BILLIER A J; FISHERIES & MARINE TECH;
UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND.
02881.

Proj. No.: RI00751 Project Type: STATE
Agency ID: SAES Period: 01 OCT 76 To 01 OCT 81

OBJECTIVES: The ingress of fish into the cooling outlet canals of large power stations present serious mechanical & environmental problems. Fish attracted by the high temperature are sometimes killed in great numbers by the toxic gases in the warm water outlet plume. Such fish kills are of environmental concern & can interfere with powerplant efficiency. Study materials, design & effectiveness of fish net barrier systems presently installed in power station outlet canals; propose modifications of design & installation based on above study.

APPROACH: Conduct laboratory tests on precise scale models of installed fish barrier nets; conduct minor adjustments, based on above tests, on installed barrier nets; monitor stress factors in the installed net systems.

PROGRESS: 79/01 TO 79/12. Work conducted during the report period was limited to analyzing data collected earlier.

PUBLICATIONS: 79/01 TO 79/12

NO PUBLICATIONS REPORTED THIS PERIOD.

004.197

CRIS0065375

THE PHYSIOLOGICAL BASIS FOR MANAGING TIDAL MARSH VEGETATION

BULL E J; PLANT & SOIL SCIENCE; UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.

Proj. No.: RI00527 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 74 To 30 SEP 80

OBJECTIVES: The impact of tidal marsh management practices on the physiological condition of marsh vegetation will be measured. Harvesting salt marsh hay, altering flood water salinity and solute content, changing drainage patterns will be evaluated for their effects on the stability of salt marsh grasslands.

APPROACH: Sound grassland management is based on knowledge of the seasonal energy flow through component species. Management practices will be evaluated for their effect on annual photosynthetic patterns, carbohydrate mobilization and storage, root rhizome and tiller growth, mineral uptake and transport. Most studies will be conducted on *Spartina alterniflora* and *S. patens* growing under marsh conditions.

PROGRESS: 74/07 TO 80/09. Seasonal energy relations and mineral nutrient absorption by tidal salt marsh vegetation were studied in order to formulate management programs which would enhance the productivity and stability of these fragile estuarine grasslands. Carbohydrates in rhizomes of *Spartina alterniflora* were depleted during spring shoot growth

and were not replenished until late summer. This cycle in carbohydrate status was of lesser magnitude in the short ecophene than in the tall form. Substantial amounts of photosynthate were partitioned to vegetative reproduction throughout the growing season even during grain filling. Energy overwintering in rhizome and crown tissues was utilized in the spring to support growth and in the summer to regenerate the rhizome system. Soluble nitrogen and phosphorus applied to the marsh surface rapidly penetrated the sediment and were readily absorbed by *S. alterniflora* roots resulting in stimulated shoot growth. The presence of NaCl in the nutrient solution stimulated ammonium absorption by roots of *S. alterniflora* and *S. patens* while reduced oxygen tension had no effect on root function. Both ammonium and nitrate were utilized by *S. alterniflora* although the reduced nitrogen source was preferred. The cordgrasses are well adapted to growth under tidal salt marsh conditions and to absorption of nutrients introduced to the marsh in the tidal flood waters.

PUBLICATIONS: 74/07 TO 80/09

WRONA, A. 1976. Nutrient Uptake and Growth of *Spartina patens* as a Function of Salinity and Oxygen Concentration. M.S. Thesis, University of Rhode Island, Kingston, 59 pp.

004.198

CRIS0071761

FRESHWATER FOOD ANIMALS

FOLTZ J W; EVERSOLE A G; FOLTZ J W; ENTOMLOGY & ECONOMIC ZOOLOGY; CLEMSON UNIVERSITY, CLEMSON, SOUTH CAROLINA. 29631.

Proj. No.: SC00241 Project Type: HATCH
Agency ID: CS&S Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals cultured for food. Nutrition, water quality, diseases and culture systems. Evaluate the economics of production processing and marketing of freshwater food animals.

APPROACH: Parasites, nutrition and growth of American eels will be investigated in natural and cultured populations. Tolerance of eels to chemicals commonly used in fish culture will be studied. Nutritional requirements and growth of tilapia and basses will be investigated by feeding diets containing varying percentages of protein and different amino acid mixtures. Effects of waterborne quantities of insecticides (Mirex) on production of freshwater prawns will also be investigated. Economics of a state-operated hatchery for *Macrobrachium rosenbergii* will be investigated. Cooperate involvement in freshwater shrimp culture is not anticipated in South Carolina, but a cottage industry may be assisted by receiving post larvae or juveniles from the state.

PROGRESS: 80/01 TO 80/12. A feeding regime for channel catfish, which takes into account water temperature and body size was tested again during 1980. Results described herein represent data from 1571 channel catfish weighed individually. Average final weight after 174 feeding days was 280 g, representing a 270 g net gain. Conversion (5) averaged 1.20. Catfish continued to feed regularly until harvest, at which time water temperature was 10 degrees C. Final weights and conversions observed in this study represent substantial improvements over previously reported values. The assumption of linearity in daily growth in length was tested in a separate experiment. When water temperature exceeds 25 C, daily growth is essentially linear, averaging 1.27 mm/day (0.05 in/day). Work on the identification and confirmation of parasites found on 21 7 subadult American eels (*Anguilla rostrata*) trapped in Cooper River, S.C. is continuing. New host records were identified for the protozoan *Trypansoma granulorum*; monogenean *Gyrodactylus anguillae*; trematodes *Stephanostomum imparaspine*, *Opecoeloides fibriatus* and *O. vitellosus*; cestode, *Bothriomonus sturionus*; and crustacean *Ergasilus cerastes*. New distribution records for parasites found in the southeastern region of United States include the protozoans *T. granulorum* and *Myxidium giardi*; monogenean *G. anguillae*; cestode *B. sturionus*; acanthocephalan

Fessitentis friedi and crustacean E. celestis

PUBLICATIONS: 80/01 TO 80/12

HINTON, M.J. and EVERSCIE, A.G. 1980. Toxicity and Tolerance Studies with Yellow-phase Eels: Five Chemicals. Prog. Fish-Cult. 42(4):201-203.
HANSEN, E.A. 1979. Age, Growth, and Sex Ratio of the American Eel, Anguilla rostrata (LeSueur), in Brackish Water Portions of Cooper Fiver, South Carolina. M.S. Thesis. Clemson Univ., Clemson, South Carolina, 45 pp.

004.199 CFIS0073560
THE QUALITY OF SEAFOOD CONSUMED BY THE PEOPLE OF SOUTH CAROLINA

KOLI A; SOUTE CAROLINA STATE CCLL, CWANGEBURG, SCUTE CARCLINA. 29115.
Proj. No.: SC.X-PR-0001-BN-21 Project Type: GRANT
Agency ID: CSRS Period: 02 MAR 77 To 01 SEP 82

OBJECTIVES: Determine mercury levels of Sea and Freshwater fish consumed by the people of South Carolina, determine the effect of fish species on the accumulation and distribution of mercury in their tissues, and compare levels of mercury found by geographic location and relate to environmental factors.

APPROACH: Determine the availability of knowledge on the quality of seafood consumed by the people of South Carolina. The fish samples will be collected from the Atlantic Coast of South Carolina for determination of mercury content. To accomplish this the state's coastline will be divided into 30 sections of ten miles apart. The fish samples will be frozen on dry ice and stored in a freezer. The fish tissue will be analyzed for mercury contents by flameless atomic absorption spectroscopy--Mercury Analyzer.

PROGRESS: 80/01 TO 80/12. A survey of mercury and other toxic trace element residues in saltwater fish from the Atlantic Coast of South Carolina was conducted to see if the problem of the magnitude of toxic trace elements contamination was evident in the South Carolina Fishery. Samples of fish and shellfish from the Atlantic Coast of South Carolina were collected during 1978 and 1979. The fish collected were Spot, Whiting, Silver Snapper, Red Snapper, Flounder, Shrimp, Sea Bass, Squid, Grouper, Bluefish, Clam, Crab, Scallop, Speckled Trout, Croaker, Mullet, etc. The whole fresh fish were placed in plastic bags and frozen in a freezer. Triplicate samples of fish tissues were analyzed by wet digestion method. Sample flasks were incubated in reagent grade sulfuric acid and nitric acid mixture using a constant temperature shaking-water bath at 58 degrees C. Digests were analyzed using atomic absorption spectrophotometry procedures outlined by Hatch and Ott, and Utbe et al, as modified for use with a Perkin-Elmer, Coleman Mass-50 Mercury Analyzer and Flame atomic absorption spectrophotometer, Perkin-Elmer Model 306 and 5000. Thirteen trace metal elements were determined by atomic absorption spectrophotometry analysis of fish tissues. Trace elements determined were Mercury, Cadmium, Copper, Zinc, Arsenic, Lead, Iron, Magnesium, Chromium, Nickel, Aluminum, Manganese and Cobalt. A significant finding of this report are that larger fish had higher trace element contents than smaller fish of the same species.

PUBLICATIONS: 80/01 TO 80/12

KOLI, A.K. and CANTY, W.T. 1979. Determination of Methylmercury in Fish of South Carolina. Oceanic Abstract 16:472.
KOLI, A.K., SANDHU, S.S., CANTY, W.T., FELIX, K.L., REED, R.J. and WHITMORE, R. 1979. Trace Metals in Some Fish Species of South Carolina. Oceanic Abstract 16:884.

004.200 CRIS0075108
EFFECT OF SEDIMENT CONTROL DAMS ON THE WATER QUALITY OF A PRAIRIE LAKE

HALKTEL L; BOTANY & BIOLOGY; S DAKOTA STATE UNIVERSITY, BROOKINGS, SOUTH DAKOTA. 57007.
Proj. No.: SD00873 Project Type: STATE
Agency ID: SAES Period: 01 JUL 78 To 01 SEP 80

OBJECTIVES: Evaluate the effect of perimeter record sediment control dams on the water quality of a prairie lake.

APPROACH: Lake Cochrane (Deuel County, S. D.) has been extensively sampled for water quality through previous agricultural experiment station projects (SD 668, 590). Sediment control dams were constructed on inflowing tributaries to Lake Cochrane in 1976. This study would sample algal density, algal production rates and water clarity using replicate samples at two sites in the lake. In addition, concentrations of limiting algal nutrients (NO(3), NH(3), total N, ortho PO(4) and total PO(4)) would be sampled both at the intake stations and above the sediment control structures. Data would be analyzed by multiple regression and analyses of variance to evaluate present limiting factors and compare present lake level concentrations with those present in the lake prior to sediment dam construction, respectively.

PROGRESS: 78/07 TO 80/09. Secchi disc transparency, algal density (chlorophyll and cell counts) and nutrient chemistry (NH(3), NO(3), Org. N, Crtho PC(4) and Total PO(4)) were sampled on Lake Cochrane, S.D. from 1976-1979 during and after sediment dam construction. These data were compared by ANOVA with previous data from Lake Cochrane 1970-1975. Nutrient levels were significantly highest in 1977 and 1978, probably as a result of erosion caused in construction of the sediment control dam. However, chlorophyll a data indicated that 1978 and 1979 were not significantly different from 1970, the year of lowest algal concentrations and best water transparency measured, suggesting a trend toward improved water quality after sediment dam construction. Water transparency readings from 1971 to 1979, were significantly poorer than in 1970. Algal species composition also indicated more eutrophic conditions from 1971-1979 than existed in 1970. Since the disturbance of water quality from the construction process apparently persisted through the 1978 open water season, and this study terminated sampling midway through the 1979 open water season, more data needs to be taken to properly evaluate the long-term effects of the sediment-control dams on Lake Cochrane water quality.

PUBLICATIONS: 78/07 TO 80/09
HAERTEL, L. 1980. Effect of Sediment Control Dams on the Water Quality of a Prairie Lake. USDI-CWRT Completion Report A-061 SDAK.

004.201 CRIS0028152
FISHERIES UNIT

APPLEGATE R L; WILDLIFE MANAGEMENT; S DAKOTA STATE UNIVERSITY, BROOKINGS, SOUTH DAKOTA. 57007.
Proj. No.: SD00914 Project Type: STATE
Agency ID: SAES Period: 17 JAN 67 To 01 JAN 89

OBJECTIVES: Research various problems of fish and aquatic habitats in South Dakota.

APPROACH: Partial contribution by University to M/U between U and Cooperative Fishery Unit between U. S. Sport Fisheries and Wildlife and S. D. Department of Game, Fish, & Parks. Work program varies according to the annual agreement of the coordinating committee.

PROGRESS: 80/01 TO 80/12. The study concerning fish interactions in a power plant cooling reservoir continued. The estimated standing crop of the 4 major forage fish species was 28.1 kg/ha. The forage fish population was dominated by age-groups I and II. Impingement of forage fishes was primarily restricted to young-of-the-year and highest impingement rates usually occurred in the evening. Muskellunge (Esox masquinongy) were most vulnerable to impingement during the first 2 months after their introduction. The growth rate of muskellunge in the reservoir (Age-II, 753 mm average; Age-I, 465 mm average) was higher than all reports for the species in North

America. Alimentary canal development of muskellunge was studied with relation to invertebrate food sources. The most selected for food organism during both day and night was *Moina brachiata*. *Cyclops vernalis* was also selected for during night. Muskellunge selected against *Asplanchna sieboldi*, *Potamocypis* sp., and *Daphnia* sp. Food organisms collected from the foregut of fry collected at 2300 hours were significantly larger, but not more numerous, than those in the foregut of fry collected at 1300 hours. As the fry grew and the mouth diameter increased, the sizes of food organisms increased. Fry initially selected for the first and second instars of *M. brachiata* and against the later instars and adults; by day 23 they selected for adults and against immature instars.

PUBLICATIONS: 80/01 TO 80/12

BENDA, R.S. 1979. Analysis of Catch Data for 1968 Through 1976 for Nine Fish Landings in Kenya Waters of Lake Victoria. *J. Fish Biol.* 15:385-387.

BENDA, R.S. 1979. Occurrence of *Argulus appendiculatus* Wilson, 1907 (*Branchiura*) in Indiana. *Indiana Acad. Sci.* 89:344.

RCSSEN, R.A. and BALES, D.C. 1980. Occurrence of Scarred Faddlefish in the Missouri River, South Dakota-Nebraska. *Prog. Fish-Cult.* 40(2):82-85.

WAHL, J.F. 1980. Forage Fish Populations and Growth of Muskellunge in a South Dakota Power Plant Cooling Reservoir. M.S. Thesis. South Dakota State University, Brookings. 71 p.

SLOANE, G.E. 1980. Macroscopic Benthos Populations in a South Dakota Power Plant Cooling Reservoir. M.S. Thesis. South Dakota State University, Brookings. 67 p.

004.202 CRIS0080247
APPLIED PHYSIOLOGY OF ECONOMICALLY IMPORTANT FISHES

STRANGE R J; FCRESTRY & WILDLIFE; UNIVERSITY OF TENNESSEE, KNOXVILLE, TENNESSEE. 37916.

Proj. No.: TEN00599 Project Type: HATCH
Agency ID: CSRS Period: 17 OCT 79 To 30 SEP 84

OBJECTIVES: Use plasma cortisol and glucose concentrations to measure acute stress during management and culture procedures and to develop ways of reducing stress; develop enzyme assays as indicators of chronic stress caused by pollution or other adverse environmental conditions.

APPROACH: Important sport and commercial fish species will be subjected to various management and culture routines used in fisheries. Plasma cortisol and glucose concentration will be determined. If cortisol and glucose levels indicate that a given management or culture routine subjects a fish to substantial stress the routine will be modified and tested again to see if the modification results in less stress. Important sport and cultural fish species will be taken from either natural environments where adverse conditions are suspected or experimental tanks where such conditions are created. Various tissues from these stressed fish and controls will be tested for activity of several enzymes. When differences in enzyme activity occur between stressed and control fish, the enzymes will be characterized and developed, if possible, into indicators of chronic stress.

PROGRESS: 80/01 TO 80/12. Investigation showed that basal concentrations of plasma cortisol (near 50 ng/ml) and plasma glucose (near 0.50 mg/ml) were significantly greater in yearling channel catfish (*Ictalurus punctatus*) acclimated to 10 C than in fish adapted to 20 or 30 C; the latter groups had similar basal levels of cortisol (near 25 ng/ml) and glucose (near 0.30 mg/ml). Fish at 10 C had a slower and less marked increase in cortisol and glucose over minutes, hours, and days in response to the stress of severe confinement than fish at 20 or 30 C which were again similar. No mortality occurred in the fish stressed at 10 C during 3 days of confinement, while 89% died in the 20 C group by day 3 and all fish at 30 C were dead by day 2. Glucose concentrations initially rose more slowly than those of cortisol, but continued to increase between 3 and 12 hours after confinement.

Also, glucose returned to near basal levels in dying fish while cortisol at that time was at its highest level. Channel catfish, even at warm temperatures, have a slower and less extensive cortisol response to stress, taking 3 days to reach 225 ng/ml, than other fish that have been investigated. This is significant in that it helps define usefulness of plasma cortisol and glucose as indicators of acute stress in fish. In addition to the progress on cortisol and glucose, work continues on the refinement of assays of enzyme activities (e.g. MDH) to be tested as indicators of chronic stress.

PUBLICATIONS: 80/01 TO 80/12

STRANGE, R.J. 1980. Acclimation Temperature Influences Cortisol and Glucose Concentrations in Stressed Channel Catfish. *Transactions of the American Fisheries Society* 108:298-303.

004.203* CRIS0074335
CULTURE AND MANAGEMENT OF SELECTED GAME FISHES

WILSON J I; FCRESTRY & WILDLIFE; UNIVERSITY OF TENNESSEE, KNOXVILLE, TENNESSEE. 37916.

Proj. No.: TEN00521 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 77 To 30 SEP 81

OBJECTIVES: Develop new management techniques and cultural methods for improving yields of game fishes in Tennessee waters by: Evaluating the feasibility of using selected non-native (exotic) species and/or hybrid fishes, and improved fish habitat management practices.

APPROACH: Ponds, raceways, and other holding facilities will be constructed to evaluate the potential of such fish as grass carp, mirror or other carps, tilapia, striped bass, hybrid sunfish, hybrid catfish, and other non-native species. Monospecific culture of selected fishes will be compared to polycultural techniques to determine production (kg/hectare). The use of different stocking rates, fertilization practices, and supplemental feeds will be evaluated as management practices. Culture techniques for hybrid sunfish and other selected species will be determined and their potential for use in pond environments will be assessed. New management techniques for improving yields in game fish populations by habitat manipulation will be assessed. Research problems would include the evaluation of the effects of aquatic vegetation control on fish production; the effects of aquatic pesticides on yield of game fishes in ponds, streams, and reservoirs; the identification and control of fish parasites and diseases in game fishes; and the evaluation of biological agents as biofilters of waste materials in aquatic systems.

PROGRESS: 80/01 TO 80/12. Data collection for two pond studies were completed and the data are being analyzed. In one study, over 250 Florida largemouth bass have been tagged and released in two different impoundments. All were weighed and measured; scales were removed to determine age composition of the population. In the second study, fingerling striped bass were stocked in two small impoundments to determine survival and growth. To date, 47 young-of-year and yearlings have been collected; indications are that survival is directly related to fingerling size and data of stocking. In a two-year investigation to determine food habits, movements, and general life history of striped bass, approximately 400 fish have been collected. Preliminary analyses indicate young-of-year striped bass utilize zoo plankton, principally midge larvae, as the primary source of food for some time subsequent to stocking. There is evidence of similar food habits for white bass, leading to the assumption of interspecific competition. A study has been initiated to evaluate the effects of fish attractors in Norris Lake.

PUBLICATIONS: 80/01 TO 80/12

MINTON, J.W. 1980. Bioenergetics of Sauger in Watts Bar Reservoir, Tennessee. M.S. Thesis. The University of Tennessee, Knoxville. 75 pp.

WADDLE, H.E., COUTANT, C.C. and WILSON, J.L. 1980. Summer Habitat Selection by Striped Bass, *Morone saxatilis*, in Cherokee Reservoir, Tennessee, 1977. *Crrl Env. Sci. Publ. No. 1360*. 195 pp.

004.204* CRIS0070519
ADAPTATION FACTORS AND CONTROL OF AQUATIC WEEDS

NEWTON R J; MARIYN R D; PLANT SCIENCE; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06225 Project Type: STATE
Agency ID: SAES Period: 30 APR 77 To 05 APR 81

OBJECTIVES: Investigate environment stress factors on the growth and development of aquatic weeds. Determine biomass production, distribution, and life cycles of aquatic weeds. Determine adaptation characters (morphological and physiological) of aquatic weeds to wet-dry, cold-hot and photoperiodic cycles. Determine effectiveness and mode of action of herbicides and growth regulators for aquatic weed control.

APPROACH: Aerial photographs of lakes Livingston and Conroe will be taken monthly by the Remote Sensing Center to monitor growth and distribution of aquatic weeds. Measurement of temperature, oxygen content, light intensity, nutrient levels will be determined the day after photographs are taken. Perennating organ development effected by environmental stress factors will be monitored quantitatively, and roles of light, temperature, nutrients, herbicides, and growth regulators on development will be investigated under laboratory conditions.

PROGRESS: 79/01 TO 79/12. Research has been conducted along 3 avenues this past year. First, the separation and concentration of phenol storing cells (phe) from waterhyacinth leaves and the chromatographic identification of the phenolic acids (pa) within. We believe these cells are responsible, in part, for the high degree of disease resistances found in waterhyacinth. The second major avenue has been in the use of remote sensing data for mapping the aquatic vegetation in Lake Conroe Reservoir. The base line vegetation map has been made and the vegetation levels will be monitored quarterly over the next two years in an effort to determine the efficiency of the grass carp as a biological control agent. The third line of research has involved the interaction of sugars and dormancy in duckweed. Differences in the levels of the trisaccharide, raffinose were associated with the breaking of dormancy with cold treatments.

PUBLICATIONS: 79/01 TO 79/12
CODY, Y.S. 1979. Separation of intact phenol cells from waterhyacinth leaves, characterization of their phenolic content and the effect of some phenolic acid on two potential biocontrol agents. M.S. Thesis, Texas A and M Univ., College Station
CODY, Y.S. and MARIYN, R.D. 1979. Separation of phenol cells from waterhyacinths and the effect of some phenolic acids on the growth of two potential biocontrol agents. *Phytopathology* 69:1025.
SHEITCN, D.F. 1979. The effect of sugars on turion germination and growth of *Spirodela polyrhiza* (L.) Schleiden. M.S. Thesis, Texas A and M Univ., College Station. 86 p.

004.205 CRIS0064257
FRESHWATER SHRIMP OF THE GENUS *MACROBRACHIUM* WITH SPECIAL EMPHASIS ON CULTURE

BRICK R W; WILDLIFE & FISHERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06052 Project Type: HATCH
Agency ID: CSRS Period: 13 JUL 73 To 31 DEC 80

OBJECTIVES: Develop & improve production & management systems for freshwater shrimp cultured for food & bait in Texas. Conduct field studies on natural history and ecology of freshwater shrimp to better understand their nutritional and environmental requirements.

APPROACH: Laboratory and field observations will be coordinated in studying nutritional and environmental requirements of *Macrobrachium* under culture conditions. Survival and growth will be indices most considered in evaluating treatments.

PROGRESS: 80/01 TO 80/12. Studies undertaken within this project were highly varied in nature, in part because very little information on the culture of freshwater shrimp has been developed. Electrophoretic patterns of several species of freshwater shrimp were elaborated and the genetic implications of them addressed in one study. The basic nutritional requirements and nutritional physiology of *Macrobrachium rosenbergii* with respect to protein were outlined, giving rise to information on the protein-energy requirements of that species. The feasibility of rearing freshwater shrimp with tilapia was demonstrated. The responses of freshwater shrimp to degraded water quality was also addressed in an attempt to determine the limits within which this organism can live and grow.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.206 CRIS0074338
LIMNOLOGICAL BASIS FOR THE PRODUCTIVITY OF INLAND WATERS

CLARK W J; WILDLIFE & FISHERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06259 Project Type: HATCH
Agency ID: CSRS Period: 09 JAN 78 To 08 JAN 83

OBJECTIVES: Evaluate the limnology of the inland waters of Texas on a regional basis by: Inventorying the resource, establishing the basic regional limnological characteristics, identifying those characteristics in each region which are of major importance in determining productivity or are otherwise of critical importance in management of the waters.

APPROACH: Divide the state into limnological regions, working first with ponds, later with streams and reservoirs; inventory the resource, review available data, study representative bodies of water in each region and establish regional limnological patterns, determine critical productivity or management parameters.

PROGRESS: 80/01 TO 80/12. Current research is directed at developing the ability to predict the ionic composition of pond waters from the watershed soil chemistry. Conservative ions are being studied using ion exchange characteristics. Field studies are still underway and collections and analyses have been completed for 6 out of a projected 14 total sites in representative areas of Texas. It is now clear that standard soil science techniques for determining the quantity/intensity relationship can also be used successfully to characterize the ion exchange complex of pond muds as well as watershed soils, and that the characteristics of the watershed soil are closely related to lake water composition. Preliminary data indicate that quantity/intensity analysis of watershed soils can predict the order of dominance of the cations in lakes that trap water running over the soils, and that for many systems the activity ratios of the cations may be predicted with some precision. Equilibrium concentrations of phosphorous indicated by adsorption isotherms of watershed soils have been found to be poorly related to oxidized pond mud equilibrium phosphorous concentrations, which have been uniformly too low to measure by standard methods.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.207* CRIS0072931
EXPERIMENTAL FISH ECOLOGY

NEILL W H; WILDLIFE & FISHERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06295 Project Type: BATCH
Agency ID: CSRS Period: 17 JUN 77 To 16 JUN 82

OBJECTIVES: Experimentally determine biophysical, physiological, and behavioral responses of fishes to environmental variation; evaluate energetic costs and benefits of such responses; generate and evaluate hypotheses relating such responses and their energetic costs/benefits to ecology of wild cultured fishes; develop from these relations generic models for within-habitat distributions of fishes.

APPROACH: Mathematical and computer simulation models to provide conceptual framework within which environment-fish relationships are hypothesized, tested by behavioral-physiological experiment, then used in turn to improve models; final validation of models in field, using such techniques as telemetry.

PROGRESS: 80/01 TO 80/12. Experimental Fish Ecology project is directed towards understanding how fishes' behavioral and physiological responses to environment are integrated in an ecological context; project successes enhance the capability for predicting ecological responses under both natural and aquacultural conditions. Realistic patterns of fish movement in temperature gradients have been simulated with a generalized mechanistic model that seems potentially valid for species as diverse as carp, Atlantic salmon, and albacore tuna; the model invokes stochastic increases in turning rate whenever physiological comparisons of ambient and body-core temperature imply worsening thermal conditions. The major obstacle to an experimental test of the model's underlying hypothesis has now been overcome: Experiments with bluegill (sunfish) and Tilapia spp. have resulted in a highly accurate model, derived from Newton's law of cooling, for predicting core temperature (± 0.2 degrees C) of fish under conditions of continuously fluctuating ambient temperature (± 10 degrees C); thus, the need for stressful telemetry of core temperature in thermoregulating fish has been obviated. An apparatus for evaluating environmental responses of fish in multivariate situations has been constructed and will be put into service during early 1981.

PUBLICATIONS: 80/01 TO 80/12
CHAMBERLAIN, G.W., NEILL, W.B., ROMANOWSKY, P.A. and STRAWN, K. 1980. Vertical Responses of Atlantic Croaker to Gas Supersaturation and Temperature Change. Trans. Amer. Fish. Soc. 109:737-750.

004.208 CRIS0071939
FISH POPULATION AND PRODUCTION IN POND AND LAKE IMPOUNDMENTS

NOBLE R L; TEER J G; WILDLIFE & FISHERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06206 Project Type: STATE
Agency ID: SAES Period: 01 DEC 76 To 31 DEC 80

OBJECTIVES: Determine variations in fish population parameters in existing and planned floodwater retarding structures. Relate variations in fish population parameters to variations in management practices and biological, limnological and structural differences among reservoirs. Test and evaluate selected structural modifications and periodic management practices which will enhance fish production in floodwater retarding structure reservoirs.

APPROACH: Fish population characteristics of selected reservoirs will be measured and correlated with physical, chemical and biological characteristics of the reservoirs. Selected management techniques will be experimentally evaluated.

PROGRESS: 80/01 TO 80/12. Farm and ranch ponds provide the potential for substantial food production and recreation close to rural residences. Florida largemouth bass have been widely stocked into Texas waters, with little known of their ecological requirements and interactions with native northern

largemouth bass. Research on these two subspecies indicated that Florida bass were more susceptible to cold shock, which can occur at the time of stocking, than are northern bass. Intergradation between the subspecies occurs when stocked together, but rates of intergradation vary with pond characteristics, particularly water clarity. Intergradation has occurred within several hatchery stocks in Texas and the genetic integrity of fish stocked throughout the state likely has frequently been mistaken. Studies of floodwater retarding structures indicated that channel catfish populations were largely related to physical conditions, whereas biological conditions were most important to largemouth bass. Summer drawdown of floodwater retarding structures can be used to increase water clarity of turbid lakes without long-lasting direct effects on fish populations. Two new studies on larger impoundments were initiated during 1980. In Lake Conroe, baseline data were collected for evaluation of effects of vegetation control to be initiated in early 1981.

PUBLICATIONS: 80/01 TO 80/12
PATE, M.W. 1980. Intergradation Between Two Subspecies of Largemouth Bass, *Micropterus salmoides*, in Texas. M.S. Thesis, Texas A and M University, College Station, 64 pp.

004.209 CRIS0084198
PRE-IMPOUNDMENT ENVIRONMENTAL STUDIES OF AQUILLA LAKE

SLACK R D; NOBLE R L; CLARK W J; WILDLIFE & FISHERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06533 Project Type: STATE
Agency ID: SAES Period: 24 MAR 81 To 30 JUN 82

OBJECTIVES: Document fish and wildlife resources of the Aquilla Lake project area. Evaluate current aquatic and terrestrial habitats of the Aquilla Lake project area. Determine land use changes and associated impacts of dam construction on aquatic and wildlife resources.

APPROACH: Aquatic habitats and fish resources will be sampled quarterly during the period 1 January 1980 through 30 August 1981. Terrestrial habitats and wildlife will be sampled and evaluated monthly. Infrared aerial photography will be used to determine land uses and the area extent of identified habitat types. Final aerial photography will be taken at dam closure in early 1983.

004.210 CRIS0060593
EFFECTS ON SELECTED ORGANISMS OF WATER PASSING THROUGH THE CEDAR BAYOU GENERATING STATION

STRAWN K; ALDRICH D V; NEILL W H; WILDLIFE & FISHERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX01869 Project Type: STATE
Agency ID: SAES Period: 01 APR 71 To 01 JUN 80

OBJECTIVES: Determine the suitability of electric power plant cooling water for growth, food conversion, and survival of selected species of crustaceans and fishes in cages, ponds, and temperature-controlled tanks.

APPROACH: Animals will be held in cages in front of the plant intake and in the discharge canal; in fish ponds located near the start of the discharge canal; and in aquaria in a laboratory to be built near the fish ponds. After the construction of the cooling pond, animals will be kept in cages in its first and last compartments and occurrence and distribution of selected organisms in the cooling pond will be determined. Temperatures in the aquaria will span the range of temperatures usually occurring in Trinity Bay. The influence of the effluent on phytoplankters both in the field and in culture will also be determined.

PROGRESS: 78/01 TO 78/12. Species most suited for commercial production in the vast quantities of water pumped by the Cedar Bayou Generating Station are being identified and raised to evaluate their potential. Blue shrimp (*Penaeus stylirostris*) survived low salinities (2% or less for over half of the culture period) associated with heavy rain falls during the Summer of 1978, but survival and production were down. Quality of harvested shrimp was excellent. Staggered stocking of postlarvae appeared superior to a single stocking. Mud minnows (*Fundulus grandis*) were raised for marine live bait. Local fish performed better than a pond-raised stock from Alabama. Some spawning occurred all summer. Polyculture of black drum (*Pogonias chromis*) and striped mullet (*Mugil cephalus*) was superior to monoculture. New pens are better than cages for black drum culture, because they are cheaper to construct and less labor intensive.

PUBLICATIONS: 79/01 TO 79/12

BRANCH, M. and STRAWN, K. 1979. Analysis of feeding relationships among estuarine fishes raised in polyculture in ponds receiving thermal effluents. Power Plant Waste Heat Utilization in Aquaculture Workshop II. Allanheld, Osmun and Co.

CHUNG, K.S. and STRAWN, K. 1979. Heat tolerance of free-living estuarine animals to predict their survival in heated effluents. Proc. 31st Ann. Conf. Southeastern Assoc. Wildlife Agencies. pp. 514-518.

GIBBEARD, G.L. 1979. Report on survival, growth, and behavior of selected estuarine organisms cultured in tanks receiving heated effluent from a power plant near Baytown, Texas. M.S. Thesis. Texas A and M Univ. College Station

HUFF, M.E. 1979. Growth and survival of selected marine and estuarine organisms employed as water quality monitors and cultured at various temperatures and light intensities in flow-through systems utilizing power-plant effluent.

004.211

CRIS0072283

FISH PHYSIOLOGY IN RESPONSE TO WATER QUALITY AND CHEMISTRY

STRAWN K; NEILL W B; STICKNEY R R; WILDLIFE & FISHERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.

Proj. No.: TEX06260
Agency ID: CSRS

Project Type: HATCH
Period: 10 FEB 77 To 30 OCT 80

OBJECTIVES: Determine physiological changes, particularly in blood pH, due to water pH, water temperatures, ions and ion concentrations, and other aquatic environmental factors. Establish minimal and optimal water quality parameters for fish survival, as influenced by acid-base stress factors, flesh wounds, feed and other factors.

APPROACH: Fishes will be subjected to water containing various levels of ABPS factor under controlled laboratory conditions. Temperature, blood and water pH, buffering ions and observations on the well being of the fish will be recorded on a regular basis.

PROGRESS: 80/01 TO 80/12. Each species of fish is adapted to its own set of hydrological conditions. Intensive culture adds stress and intensifies our need to delineate ranges and optimums. A species either should be cultured in natural water that fully meet its requirements or in water that is cheap to modify. The buffering system and resulting pH controls both the loss of ammonia to air and its toxicity. The objectives of our research are as follows 1) the ability of channel catfish to withstand exposure to acid-base stress in various solutions of CaCl₂ will be examined, 2) the relationship between blood pH and the salt solution will be assessed to determine the physicochemical buffering capacity, 3) other hematological characteristics will also be examined to determine their relationship with blood pH and the salt solution. Project goals have been completed up to conducting the experimental phase.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

004.212

CRIS0077316

ECOLOGY AND TAXONOMY OF TWO MAJOR ORDERS OF AQUATIC INSECTS, EPHEMEROPTERA AND TRICHOPTERA, IN VA

VOSHELL J R JR; ENTOMOLOGY; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.

Proj. No.: VA-0612317

Project Type: HATCH

Agency ID: CSRS

Period: 01 NOV 78 To 31 OCT 83

OBJECTIVES: Determine the function of selected species of Ephemeroptera and Trichoptera in aquatic ecosystems. Analyze the downstream effects of impoundment upon a river ecosystem. Prepare identification manuals for the Ephemeroptera and Trichoptera occurring in Virginia.

APPROACH: Field and laboratory studies with basic and applied aspects aimed at understanding the taxonomy and ecology of aquatic insects, with special emphasis on determining the downstream effects produced by impounding rivers.

PROGRESS: 80/01 TO 80/12. A comparative study of the secondary production of filter-feeding Trichoptera in an impounded and a free-flowing river was completed. Total production was extremely high immediately below the dam (318,416 mgDW/m²/yr), but farther downstream production in the impounded river (11,221 mgDW/m²/yr) was considerably less than that at a similar location in a free-flowing river (50,116 mgDW/m²/yr). Seston analysis showed that the release of nutritious plankton, particularly zooplankton, from the reservoir was the primary factor responsible for the high production below the dam. However, the amount of available energy in the seston decreased downstream, because the abnormally high densities of filter-feeders immediately below the dam lowered the food quality of the seston. Further analyses of the effects of impoundment on the life history of *Heterocleonus curiosus* (Ephemeroptera) indicated that surface-release reservoirs may have subtle, but significant, adverse effects on benthic macroinvertebrates. A 50% reduction in the density of *H. curiosus* in the impounded river, as compared to the free-flowing river, was attributed to reduced fecundity brought about by an altered thermal regime.

PUBLICATIONS: 80/01 TO 80/12

PARKER, C.R. 1980. Production of Filter-feeding Trichoptera in an Impounded and a Free-flowing River. Ph.D. Dissertation, Va. Polytech. Inst. and St. Univ., Blacksburg, 220 pp.

PARKER, C.R. and VOSHELL JR., J.R. 1980. *Ochrotrichia graysoni*, A New Species of Caddisfly From Virginia (Trichoptera: Hydroptilidae). Ann. Entomol. Soc. Am. 73:368-371.

VOSHELL JR., J.R. and PARKER, C.F. 1980. Quantity and Quality of Seston in an Impounded and a Free-flowing River. (Abstract). In: Titles and Abstracts of 28th Annual Meeting North American Benthological Society, p. 45. Mar. 26-28,

004.213*

CRIS0081384

AN EVALUATION OF ENDANGERED MOLLUSKS IN VIRGINIA

NEVES R J; PARDUE G B; BENFIELD E F; FISHERIES & WILDLIFE; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.

Proj. No.: VA-1111111
Agency ID: SAES

Project Type: STATE
Period: 01 JUL 80 To 30 JUN 83

OBJECTIVES: Develop a literature review, species range and relative distribution maps for the nine endangered species; develop habitat characterization for the nine species; determine and life histories of two common mussels; summarize components 1 and 2 and prepare final report.

APPROACH: Survey mussel populations in the Clinch, Powell and Holston River; determine water quality, substrate composition and species associations at sites with endangered mussels; artificially infect various species of fish in the laboratory to

determine the required fish hosts; apply appropriate statistical analyses to data and write final report.

PROGRESS: 80/01 TO 80/12. The final report on the first phase of this project was submitted to the Virginia Commission of Game and Inland Fisheries in October, 1980. Based on recently completed mussel surveys in southwestern Virginia, the following 7 endangered species reside in the Clinch, Powell, and Holston Rivers: *Fusconaia edgariana*, *Fusconaia cuneolus*, *Drems dromas*, *Conradilla caelata*, *Quadrula intermedia*, *Quadrula sparsa*, and *Dysnonia walkeri*. Three of these species occur only in the lower Powell River, an area influenced by upstream coal mining operations. Two of the species are relatively widespread, and approximately 59 river kilometers in Virginia are considered of utmost importance for the continued survival of 5 of the 7 species. Mussel surveys at 2 bridge construction locations on the Clinch River recorded 3 endangered species near these sites. Recommendations were made to the U.S. Fish and Wildlife Service and the Virginia Department of Highways and Transportation for mitigating disturbance of the habitat of these endangered species.

PUBLICATIONS: 80/01 TO 80/12

ZALE, A.V. 1980. The Life Histories of Four Freshwater Lampshell Mussels (Mollusca: Unionidae) in Big Moccasin Creek, Russell County, Virginia. M.S. Thesis. Va. Poly. Inst. and State Univ., Blacksburg. 256 pp.

004.214 CRIS0090686
BIOACCUMULATION AND IMPACT OF HIGHWAY-GENERATED HEAVY METALS ON STREAM FISHERY RESOURCES IN VIRGINIA

NEY J J; GARLING D L; FISHERIES & WILDLIFE; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.
Proj. No.: VA-0612367 Project Type: BATCH
Agency ID: CSRS Period: 01 JAN 80 To 30 DEC 84

OBJECTIVES: Determine lead, cadmium, nickel, and zinc levels in water, sediments, invertebrate animals and fish associated with highways of different traffic densities. Determine if lead, cadmium, nickel, and zinc move upward in aquatic food chains. Determine if seasonal changes in contamination occur. Assess the relationship of metal accumulation with age and size of fish. Assess impact of heavy metal contamination on fish and invertebrate animal populations as a function of traffic density and period of exposure. Profile hematological parameters to determine their utility as indicators of stress associated with heavy metal toxification.

APPROACH: Collect quarterly samples of water, sediment, and aquatic plants and animals from streams which are crossed or paralleled by established highways. Collect quarterly samples of water, sediment, and aquatic plants and animals from streams of pre- and post- construction of new highways. Analyze samples for heavy metals using standard clean-lab atomic absorption spectrophotometric methods. Construct fish hematological profiles. Validation through additional lab work.

PROGRESS: 80/01 TO 80/12. All field collections have been completed on the sub-project to evaluate activity of selected enzymes as indicators of chronic lead contamination in trout from roadside streams. Enzyme levels in blood and lead concentrations in bone and liver are being analyzed to determine relationships and effects of traffic density. Pre-traffic data were collected during the autumn on lead, zinc, nickel and cadmium in the biota of streams which flow under I295. Population estimates were made for fish and benthos. Study sites include upstream, highway, and downstream locations on two streams.

PUBLICATIONS: 80/01 TO 80/12

VAN HASSEL, J.E. NEY, J.J. and GARLING JR., D.L. 1980. Heavy Metals in a Stream Ecosystem at Sites Near Highways. Trans. Amer. Fish. Soc. 109:656-663.

004.215 CRIS0078829
TEE USE OF FISHING TOURNAMENT RECORDS TO ESTIMATE ABUNDANCE OF BASS POPULATIONS

NIELSEN L A; FISHERIES & WILDLIFE; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.
Proj. No.: VA-0612338 Project Type: BATCH
Agency ID: CSRS Period: 01 MAR 79 To 28 FEB 82

OBJECTIVES: The abundance of largemouth bass in a lake will be estimated from various types of data available from fishing tournaments. Decline in catch per unit effort in several tournaments, on Back Bay, Virginia, in one year will be evaluated as a practical method of estimating population abundance for management purposes.

APPROACH: During spring of 1979 and 1980, large mouth bass will be collected by electrofishing and marked with distinctive fin clips. During fishing tournaments throughout the year, all captured fish will be observed for marks and catch per unit of effort will be calculated. Ongoing creel census or Back Bay will provide data on total harvest. Procedures for population estimation developed for Back Bay will be applied to data for other reservoirs in the southeastern U.S.

PROGRESS: 80/01 TO 80/12. During 1980, 12 bass fishing tournaments and general fishing use were monitored on Back Bay, Virginia to develop methods for estimating largemouth bass abundance. Population estimates were made by mark-recapture, fishing success using tournaments, and fishing success using all fishermen. All estimates are comparable and indicate a population of approximately 160,000 largemouth bass 300-mm or longer. The method using fishing success and creel census data may be useful because the necessary data are collected for other management purposes on many major fisheries. Data have been collected for another lake in Virginia, two lakes in West Virginia, and a lake in Oklahoma.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

004.216 CRIS0081385
IMPACTS OF RESOURCE DEVELOPMENT AND EXPLOITATION ON NATURAL RESOURCES

NIELSEN L A; FISHERIES & WILDLIFE; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.
Proj. No.: VA-1111112 Project Type: STATE
Agency ID: SAES Period: 01 JUL 80 To 30 JUN 83

OBJECTIVES: The effects of various environmental changes and exploitation activities on fish populations will be investigated by literature review and field sampling. Environmental changes, such as road construction, reservoir construction, water quality alterations, and forest management will be used to create generalizations regarding the impact on fish populations in streams, rivers and impoundments. Exploitation of fish populations for commercial and recreational purposes will be analyzed to determine potential benefits and effects of exploitation of resident and introduced species.

APPROACH: Surveys of fish populations and fishery users will be made in areas destined for habitat or population alteration. Based on descriptions of the existing environment and analysis of relevant literature, changes in the affected ecosystems will be predicted. Post-alteration surveys will be conducted to determine the accuracy and precision of predictions and formulate general principles.

PROGRESS: 80/01 TO 80/12. Progress on this project has occurred under a variety of separate analyses of the relationship between resource use and fisheries. Re-routing of an access road to the Gathright Dam area in western Virginia was predicted to have no permanent impact on the adjacent stream, and recommendations for minimum impact on the stream and watershed were made to the U.S. Army Corps of Engineers. Extensive inventory of fish fauna and censusing of fishing on Brumley Creek and Hidden Valley Lake in southwest Virginia indicated that

construction of a pumped-stored hydroelectric project on the stream might impact both stream fishes and fishing. However, comparison of fauna and fishing use to other similar locations indicated that the fauna was typical of other streams and could be re-introduced and that fishing in the effected areas was of comparable or lower quality than other areas. Assessment of the potential for establishing a commercial bait minnow fishery on the Ohio River in West Virginia indicated that both Ohio and West Virginia bait dealers would utilize the minnows if they could be caught, transported, maintained, and sold readily. Sampling of sport and commercial fishes in the Ohio River indicated that only seuger utilize minnow species extensively as prey

PUBLICATIONS: 80/01 TO 80/12

NIELSEN, L.A. 1980. Fisheries Component. In: A Preliminary Environmental Assessment of a Potential Site for an Appalachian Power Company Pumped Storage Hydroelectric Facility. Center for Environmental Studies, Va. Poly. Inst.

HAIN, M.E. 1980. The Relationship of Parental Care, Fish Predation, and Larval Bluegill Survival During Nesting. M.S. Thesis. Va. Poly. Inst. and State Univ., Blacksburg. 75 pp.

004.217* CRIS0081386
FACTORS INFLUENCING TROUT PRODUCTION IN VIRGINIA STREAMS

PARCUE G B; BENFIELD E F; WEBSTER J R; FISHERIES & WILDLIFE; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.

Proj. No.: VA-111114 Project Type: STATE
Agency ID: SAES Period: 01 JUL 80 To 30 JUN 83

OBJECTIVES: Examine links between the food production base and brook trout production, develop the work on brook trout competition with other age classes or trout and with nongame fish to include competition, determine rainbow trout production and gonadal energetics during the year.

APPROACH: Collect monthly quantitative samples of macroinvertebrates to determine trophic structure, biomass, production and feeding rates; collect quarterly depletion samples of fishes to determine trophic structure, biomass, production and food habits, compare food habits of trout with nongame fishes and examine longitudinal zonation of fishes in the stream, conduct quarterly mark-recapture sampling, collect length-weight data and use bomb calorimetry on somatic and reproductive tissues during the year.

PROGRESS: 80/01 TO 80/12. Macroinvertebrate identification and enumeration from quarterly drift samples is largely completed and is being used to relate to food habits of trout and nongame fishes to determine trophic relationships and feeding overlaps. One hundred sixty taxa of benthic invertebrates have been identified from Guys Run. Measurements of primary and secondary production have been collected and are in the process of analysis. Behavioral observations of spatial distribution and feeding activities have been conducted for brook trout and five nongame species in laboratory experiments. A conceptual model of energy flow dynamics is being developed for Guys Run, a second order native brook trout stream. Collections of rainbow trout for reproductive biology, gonad energetics and annual production have been completed and are being analyzed using multivariate statistics and Ricker's cohort production formula ($P = GE$).

PUBLICATIONS: 80/01 TO 80/12

KENDALL, W.T. 1980. The Dispersion of Hatchery-reared Rainbow Trout (*Salmo gairdneri*) Stocked in Big Stony Creek, Giles County, Virginia. M.S. Thesis. Va. Poly. Inst. and State Univ., Blacksburg. 96 pp.

GARMAN, G.C. 1980. Impacts of Stocked Brown Trout (*Salmo trutta*) on the Native Fish Fauna of Bottom Creek, Virginia. M.S. Thesis. Va. Poly. Inst. and State Univ., Blacksburg. 81 pp.

004.218* CRIS0070377
MODE OF ACTION AND INFLUENCE OF ENVIRONMENTAL FACTORS ON THE TOXICITY OF SEVERAL AQUATIC HERBICIDES

HATZIOS K K; HATZIOS K K; PLANT PATHOLOGY & PHYSIOLOGY; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.

Proj. No.: VA-0612269 Project Type: HATCH
Agency ID: CSWS Period: 01 JUL 76 To 30 JUN 81

OBJECTIVES: The effects of temperature, pH, light, bicarbonate ions and algal cell densities on the performance of chelated cupric ions, diquat, diuron, simazine, and combinations of these aquatic herbicides will be examined. The mode of action of the herbicides at cellular and sub-cellular levels will be studied to facilitate comprehension of aberrations in physiological functions of plants exposed to the compounds.

APPROACH: Since these compounds are inhibitors of photosynthesis, photosynthesis and growth of *Chlorella sorokiniana* and electron transport in isolated chloroplasts will be used to determine toxicity. The possibility of chlorophyll degradation by these herbicides and the role of photosensitized reactions in this destruction will be examined. Attempts will be made to determine active and non-active site binding of the herbicide molecules and their influence on lipid peroxidation.

PROGRESS: 80/01 TO 80/12. The work on the mode of action of the 1,3,4-thiadiazolyl herbicidal derivatives was completed and a summary of that work was presented in the fifth international congress on photosynthesis during last summer. From that work it was concluded that photosynthesis is the main metabolic process inhibited by these herbicides in plants. R-25788 (N, N-diallyl-2,2-dichloroacetamide) is a chemical used commercially to protect corn (*Zea mays* L.) from injury caused by the thiocarbamate herbicides EPTC and butylate. Our knowledge on the mode of action of the antidote R-25788 is limited. It has been proposed that R-25788 increases the rate of metabolism of these herbicides in corn. Indirect evidence to support this hypothesis was obtained in our studies initiated this past summer in the greenhouse. The herbicide tebuthuron resembles structurally a group of chemicals known as 1,2,3-benzothiadiazoles, which are strong inhibitors of metabolic enzymes called mixed-function oxidases. Mixed-function oxidases have been implicated in catalyzing the oxidation of the sulfur atom of the thiocarbamate herbicides in corn. Growth responses of corn seedlings treated with combinations of tebuthuron and EPTC or Butylate in the presence of the antidote R-25788, were indicative of synergistic interactions of these chemicals. Thus, it appeared that R-25788 may act by increasing the activity of the mixed function oxidase system that sulfoxidizes EPTC and butylate in corn.

PUBLICATIONS: 80/01 TO 80/12

HATZIOS, K.K. 1981. Synergistic Interactions of Tebuthuron with Eredicene (EPTC + R-25788) and Sutan + (Butylate + R-25788) and Its Implications on the Mode of Action of the Herbicide Antidote R-25788. Abstracts Weed Sci. Soc. of

004.219 CRIS0033237
NITROGEN FIXATION IN METHANE-OXIDIZING BACTERIA

O'CONNOR M L; MICROBIOLOGY; UNIVERSITY OF WASHINGTON, SEATTLE, WASHINGTON. 98105.

Proj. No.: 7801086 Project Type: GRANT
Agency ID: CRGC Period: 22 SEP 78 To 31 SEP 81

OBJECTIVES: Isolate and characterize new strains of nitrogen-fixing methane-oxidizing bacteria. Determine the influence of various chemical and physical parameters on nitrogen fixation in one of these new isolates. Determine the relative importance of nitrogen fixation by methane-oxidizers in five different aquatic environments.

APPROACH: Five distinct aquatic environments will be sampled. Various chemical and physical determinations will be made on these samples and they will also be used for enrichment culture. Isolates will be characterized and regulatory studies will be carried out on one isolate with the use of continuous culture techniques.

PROGRESS: 79/10 TO 80/09. Two new facultative methane-oxidizing bacteria have been isolated from lake water enrichments and characterized. One of these, named *Methylobacterium ethanolicum* has been used for further studies. Nitrogen fixation has been found to be regulated by oxygen in both *M. ethanolicum* and *Methylobacterium organophilum* R6, with the optimum in sulfate-limited continuous culture ($D = 0.03$) at 25 μM . The structural genes for nitrogen fixation have been located in *M. organophilum* R6 onto an 11.5 kb EcoRI chromosomal fragment and in *M. ethanolicum* onto a 12.1 kb EcoRI chromosomal fragment, using the probe PSA30 containing the *nif* region of *Klebsiella pneumoniae*. A seasonal ecological study has been initiated and has shown that nitrogen fixing methane oxidizers predominate in lakes where oxygen tensions are low but methane is in the μM range. In Lake Washington and Soap Lake, it appears unlikely that nitrogen fixation is being carried out by methane oxidizers.

PUBLICATIONS: 79/10 TO 80/09

MCNERNEY, T. and OCONNOR, M.L. 1980. Regulation of Enzymes Associated with C-1 Metabolism in Three Facultative Methylophiles. *Appl. Env. Micro.* 40:370-375.

LYNCE, M.J., WOPAT, A.E. and OCONNOR, M.L. 1980. Characterization of Two New Facultative Methanotrophs. *Appl. Micro.* 40:400-407.

OCONNOR, M.L. In press. Extension of the Model Concerning Linkage of Genes Coding for C-1 Related Functions in *Methylobacterium organophilum*. *Appl. Env. Micro.*

004.220 CRIS0066854
MICROBIAL ECOLOGY OF METHANE PRODUCTION IN AQUATIC ENVIRONMENTS

ZEIKUS J G; BACTERIOLOGY; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.
Proj. No.: WIS02110 Project Type: STATE
Agency ID: SAES Period: 01 MAR 74 To 30 AUG 81

OBJECTIVES: Characterization of the microbial anaerobic niche, as it occurs in aquatic sediments, in terms of: environmental parameters affecting bacterial methane formation; quantitative enumeration and kinds of methane bacteria present; determination of the in situ rates of methane production and decomposition of organic matter; determination of the preferred substrates employed by methane-producing bacteria present. Isolation of bacterial species responsible for methane formation in aquatic sediments and specification of their important properties, in terms of: determination of general properties, nutritional requirements and growth rates; determination of the rates of methane production and factors which influence this process; establishment of taxonomic identity and characterization of new species.

APPROACH: Characterization of bacterial methane formation as it occurs in nature by employing in situ experiments. Quantitative enumeration of methane-producing bacteria present in sample sediments. Isolation of pertinent bacterial species and characterization of their morphological, nutritional and physiological properties.

PROGRESS: 80/01 TO 80/12. Microbial methanogenesis was characterized in situ in thermal, volcanic environments in Yellowstone National Park, wetwoods in living trees and lake sediments in Wisconsin lakes. The organisms responsible for methanogenesis in these ecosystems and source rock from oil fields in U.S.S.R. were isolated and, their general growth and metabolic features were examined. Methanol was shown to be an important end product of pectin metabolism. Methanol metabolism by acidogenic and methanogenic bacteria was examined in more detail. A

new species was described, *Eutyritacterium methylophilicum*, that produced organic acids from growth on methanol, H_2/CO_2 or carbon monoxide as energy sources. The involvement of vitamin E(12) in methanol metabolism by anaerobes was established by quantification of high amounts of corrinoids in methanogens or acetogens specifically grown on methanol.

PUBLICATIONS: 80/01 TO 80/12

ZEIKUS, J.G. 1980. Microbial Populations in Digestors. In *Proc. First International Symposium on Anaerobic Digestion*. Stafford, D.A. (ed), pp. 75-103. A.D. Scientific Press, Cardiff.

KRZYCKI, J. and ZEIKUS, J.G. 1980. Quantification of Corrinoids in Methanogenic Bacteria. *Current Microbiology* 3:243-245.

ZEIKUS, J.G., BEN-BASSAT, A. and HEGGE, P.W. 1980. Microbiology of Methanogenesis in Thermal Volcanic Environments. *J. Bacteriol.* 143:432-440.

SCHINK, B. and ZEIKUS, J.G. 1980. Microbial Methanol Formation: A Major End Product of Pectin Metabolism. *Current Microbiology* 4:387-390.

004.221 CRIS0057149
BIOLOGY, ECOLOGY, TAXONOMY AND DISTRIBUTION OF AQUATIC INSECTS IN WISCONSIN

HILSENHOFF W L; ENTOMOLOGY; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.
Proj. No.: WIS01564 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 85

OBJECTIVES: Provide illustrated keys to the genera and species of aquatic insects found in Wisconsin. Determine the life cycles and distribution of aquatic insects in Wisconsin. Evaluate extrinsic bioregulatory mechanisms in aquatic beetles.

APPROACH: Aquatic insects will be collected from all types of habitats throughout Wisconsin and identified to species whenever possible. When sufficient knowledge is gained about a family, group of families, or order within Wisconsin, species keys and notes on biology and distribution will be published. A study of aquatic beetles will be continued to determine factors that cause emergence, flight, swimming and hiding behavior, and hibernation. Methods for quantitatively evaluating beetle populations will be developed.

PROGRESS: 80/01 TO 80/12. Aquatic Insects of Wisconsin was revised. All keys were modified, some extensively, and plates were expanded with about 100 additional illustrations. Other figures were redrawn, and information on biology and ecology was updated. Studies of bioregulatory mechanisms in water beetles were greatly expanded. We developed a new technique for quantitatively sampling shallow ponds, which involves enclosing a measured area in a cylinder and adding an irritant to force beetles to the surface where they can be easily collected. Life cycles of several species were studied and it was found that low soil moisture levels prevented some species from emerging from their pupal chamber. Larvae of several species were described for the first time. Movements of beetles within and into and out of a pond were studied. Most species congregated in shallow water with a heavy vegetative cover, but a few preferred the deeper areas. Beetles entered wintering sites in October, either in or out of the pond. Those that hibernated within the pond became active in early spring before the ice melted from the pond. A study of the distribution, abundance, and life cycles of the abundance, and life cycles of the abundant caddisfly fauna of Otter Creek was initiated in April, with collections being made at 2-week intervals from five sites in the stream. During the warm months, adult caddisflies were collected with a blacklight in alternate weeks.

PUBLICATIONS: 80/01 TO 80/12

HILSENHOFF, W.L. 1980. *Coptotomus* (Coleoptera: Dytiscidae) in Eastern North America with Descriptions of Two New Species. *Trans. Amer. Entomol. Soc.* 105:461-471.

KARL, T.S. and HILSENHOFF, W.L. 1980. The Caddisflies (Trichoptera) of Parfrey's Glen Creek, Wisconsin. Trans. Wis. Acad. Sci. Arts and Let. 67:31-42.

004.222² CRIS0072335
EFFECTS OF ANTIMYCIN ON STREAM INSECTS

HILSENHOFF W L; ENTOMOLOGY; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.
Proj. No.: WIS02303 Project Type: STATE
Agency ID: SAES Period: 01 JUL 74 To 31 DEC 78

OBJECTIVES: Determine acute toxicity of antimycin to about 50 common species of stream insects. Determine effects of pH and temperature on rates of mortality caused by antimycin. Determine chronic effects of antimycin on emergence of stoneflies, mayflies, and caddisflies. Study effects of antimycin in a stream treated by Department of Natural Resources personnel to eliminate rough fish.

APPROACH: Initial toxicity experiments will be carried out at concentrations of 1, 10, 100, and 1000 parts per billion (ppb) in 5 liter polyethylene containers and compared to a control. Final replicated tests will be run at twofold dilutions within the range of 0 to 100% mortality. Tests will be conducted at 2°C or 20°C at pH 8.0 or pH 7.0 with mortality recorded over a 5-day period. Effects of treatment of the Rock River will be studied by sampling benthos in treated and untreated sections before and after treatment. Drift samples in treated and untreated sections will be compared.

PROGRESS: 78/01 TO 78/12. The toxicity of antimycin to 38 species of Wisconsin stream insects was evaluated in static, aerated bioassays utilizing antimycin exposures typical of stream treatments used to kill fish. Several species of Trichoptera, Ephemeroptera and Plecoptera were very sensitive to fish killing concentrations of antimycin (EC-50 less than 50 ppb). Beetles (*Psephenus herricki*, *Optioservus fastiditus*, *Stenelmis crenata*, *Helichus striatus*), dragonfly nymphs (*Neurocordula molesta*, *Gomphurus vastus*), damselfly nymphs (*Argia apicalis*), fishfly larvae (*Nigronia serricornis*), and snipe fly larvae (*Atherix variegata*) were relatively unaffected by antimycin (EC-50 greater than 1,000 ppb). Early instars of *Tipula* spp. and *Ephemerella* sp. were more sensitive to antimycin than later instars. Exposure to antimycin produced greater mortality at 18 degrees C than at lower temperatures in several species, even though exposure times were reduced at the higher temperature. Post-exposure observations indicated mortality may be delayed more than five days, particularly at reduced temperatures. Large differences in antimycin sensitivity were found for different species belonging to the same family (hydracarina caddisflies, perlid stoneflies). Emergence of several species of stream insects was reduced or prevented by exposure of the mature larvae or nymphs to sublethal concentrations of antimycin.

PUBLICATIONS: 78/01 TO 78/12
ECTILLA, F.M. 1978. Effect of antimycin on stream insects in field and laboratory trials. Ph.D. Thesis, Univ. of Wisconsin-Madison. 107pp.
ECTILLA, P.M. and HILSENHOFF, W.L. 1978. Effects of antimycin on stream insects. Wis. Water Resources Center Tech. Rep. 78-05, 55pp.

004.223 CRIS0073469
EFFECTS OF LIVESTOCK GRAZING PRACTICES ON THE WATER QUALITY OF STREAMS

HILSENHOFF W L; ENTOMOLOGY; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.
Proj. No.: WIS02338 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 77 To 30 SEP 80

OBJECTIVES: Document effects of pasturing cattle on the fauna and water quality of streams. Determine factors associated with the congregation of cattle in streams. Determine relationships of cattle weight, stream flow, cattle access, and water quality.

APPROACH: Replicated laboratory tests will be carried out in artificial streams at various temperatures and current velocities to determine effects of different amounts of cattle manure in the water on selected aquatic insects known to be sensitive to organic pollution. The arthropod fauna of a stream from which cattle have been fenced will be compared before and after fencing and with a control stream. Other streams will be observed to determine how many cattle can be pastured and under what conditions before the ecosystem of a stream is altered.

PROGRESS: 79/01 TO 79/12. Tests of the effects of manure on water quality and aquatic insects were carried out in two pairs of 8-foot fiberglassed streams channels. In this system we can control water temperature, discharge rate, depth of riffles and pools, current velocity and photoperiod. A 5-day EOD test showed a 10g/l suspension of manure to have a EOD 59mg/l, nearly twice the effluent standard of 30mg/l required by law. Effects of manure were tested for 2-week periods at concentrations of 2, 4, 8, 16 and 32g/l, with the manure confined in a mesh bag. At the two highest concentrations, dissolved oxygen levels dropped to 5mg/l and there was significant mortality of *Acroperia lycorica* and *Symphitopsyche riola*, a stonefly and a caddisfly. Large amounts of nutrients were released into the stream from the manure, causing considerable growths of periphyton. This in turn resulted in diel dissolved oxygen fluctuations as great as 1.5mg/l. Total organic nitrogen increased 2 to 26 fold and total phosphorous 2 to 134 fold over the range of manure concentrations tested. Color, conductivity and alkalinity all increased substantially upon addition of manure. All initial tests were carried out with soft water from Otter Creek in Sauk County, but similar results were achieved with water from Trout Creek, a hard water stream. In additional tests, manure was thoroughly mixed with the water instead of being enclosed in a mesh bag.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

5. Feeding and Nutrition

005.001 CRIS0067635
EVALUATION OF A CLOSED SYSTEM FOR THE CULTURE OF FISH, SHELLFISH AND AQUATIC PLANTS

ALLISON R; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
Proj. No.: ALA00399 Project Type: HATCH
Agency ID: CSRS Period: 14 APR 75 To 30 JUN 80

OBJECTIVES: Maximize animal protein production from a fed fish population in a closed system through the use of aquatic plants, fish and shellfish grown in the effluent. Develop management plan for growing fish from recently hatched fry to harvestable size in a closed system. Determine the carrying capacity of closed systems for various sizes of food fish fingerlings.

APPROACH: Food fish populations will be grown in tanks and fed a complete diet. The effluent will be reconditioned by circulation through tanks containing populations of filter feeding fish and shellfish. It will be further reconditioned with the removal of dissolved nutrients by aquatic plants. Reconditioned water will be aerated by air blower and returned to the food fish population.

PROGRESS: 75/04 TO 80/06. During 1980 all data for the year 1979 were summarized and recorded in a doctoral dissertation and two technical papers. Data collected during the five-year period of the project were summarized and the various modifications of the systems used were compared. This project was initiated 14 April 1975 and terminated 30 June 1980. Initial experiments were conducted in dual tanks, one for production and one for filtration. In this system

dense populations of unicellular algae developed and was not adequately removed by the filter or filter feeding fish. Maximum production of channel catfish was 2.65 kg/m³ and tilapia was 4.54 kg/m³. A system of one production and three filtration tanks was developed. Aquatic macrophytes were used to control unicellular algae. Maximum production of Tilapia was 38.9 kg/m³.

PUBLICATIONS: 75/04 TO 80/06

RAKOCY, J.E. 1980. Evaluation of a Closed Recirculating System for Tilapia Culture. Ph.D. Dissertation. Auburn Univ. Auburn 119 pp.

005.002 CRIS0066917
MANAGEMENT OF AQUATIC PLANTS FOR SPORT FISH PRODUCTION IN PONDS

BOYD C E; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
Proj. No.: AIA00398 Project Type: BATCH
Agency ID: CSRS Period: 01 JAN 75 To 30 JUN 79

OBJECTIVES: Determine the most effective fertilization rate for high levels of fish production in ponds. Determine the amount of fertilizer needed for moderate fish production and adequate control of aquatic weeds in ponds. Develop better methods for applying fertilizers to ponds.

APPROACH: Influence of different rates of fertilization on production of bluegill sunfish and growth of aquatic weeds will be evaluated in ponds. Need for trace elements in fertilizer mixtures will be investigated by nutrient bioassay experiments. Two methods of application, broadcasting and underwater platforms, will be compared. Detention time of water for effective fertilization will be determined in ponds with known flushing rates.

PROGRESS: 80/01 TO 80/12. No progress report.

PUBLICATIONS: 80/01 TO 80/12

BOYD, C.E. and CUENCO, M.L. 1980. Refinements of the Lime Requirement Procedure for Fish Ponds. Aquaculture 21:293-298.
ACRE, R.G. and BOYD, C.E. 1980. Water Chemistry of Alabama Ponds. Agr. Exp. Sta., Auburn Univ., Auburn, Bull. 522. 35 pp.

005.003* CRIS0078980
POND FERTILIZATION AND LIMING

BOYD C E; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
Proj. No.: ALA00497 Project Type: BATCH
Agency ID: CSRS Period: 02 APR 79 To 30 SEP 84

OBJECTIVES: Determine the solubilities of different phosphorus fertilizers in pond waters. Evaluate fluid fertilizers for use in sport fish ponds. Investigate use of low rates of calcium hydroxide for liming ponds which have excessive overflow during winter and spring.

APPROACH: Solubilities of phosphorus compounds will be determined by measuring the loss of phosphorus from samples of these compounds placed on fertilizer platforms in ponds. Compounds will be tested in ponds representing a range of water quality. Effects of different ratios and rates of application of fluid fertilizer on bluegill production will be evaluated in ponds. Effects of calcium hydroxide applications on total hardness and total alkalinity will be tested in ponds which have excessive overflow during winter and spring.

PROGRESS: 80/01 TO 80/12. Dissolution rates for phosphate fertilizers settling through 1.8m of water at 29 degrees F were: superphosphate, 4.6%; triple superphosphate, 5.1%; monoammonium phosphate, 7.1%; mixed 8-8-8 fertilizer, 11.4%; mixed 20-20-5 fertilizer, 11.9%; diammonium phosphate, 16.8%. Nitrogen was highly soluble (61.7 to 98.8%) from settling granules of sodium nitrate, calcium nitrate, ammonium nitrate, ammonium sulfate, and two mixed

fertilizers, but not (5.1 to 11.7%) from ammonium phosphates. Five pond fertilization programs (44.8 kg/ha per application of 20-20-5 mixed fertilizer, 20.2 kg/ha per application of triple superphosphate, 10.1 kg/ha per application of triple superphosphate, 10.1 kg/ha per application of diammonium phosphate, and 7.3 kg/ha of a liquid fertilizer with a grade of 13-25-0) all resulted in similar sunfish yields. The cost of fertilization may be greatly reduced by using the low triple superphosphate treatment 10.1 kg/ha, diammonium phosphate, or liquid fertilizer.

PUBLICATIONS: 80/01 TO 80/12

BUNT, E. and BOYD, C.E. 1980. Alkalinity Losses Resulting from Ammonium Fertilizers Used in Fish Ponds. Trans. Amer. Fish. Soc. 110:81-85.
METZGER, R.J. and BOYD, C.E. 1980. Liquid Ammonium Polyphosphate as a Fish Pond Fertilizer. Trans. Amer. Fish. Soc. 109:563-570.
MUSIG, Y. and BOYD, C.E. 1980. Comparison of Orthophosphate and Polyphosphate as Fertilizers for Fish Ponds. Aquaculture 20:135-138.

005.004 CRIS0060956
FRESHWATER FOOD ANIMALS

LOVELL R T; PRATHER E B; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
Proj. No.: ALA00339 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 71 To 30 SEP 81

OBJECTIVES: Develop production and management systems for freshwater food animals - Nutrition.

APPROACH: Winter feeding regimes for catfish in ponds will be studied. Mineral and vitamin requirements for catfish will be determined. Energy requirements and digestibility from various food sources will be determined for catfish.

PROGRESS: 80/01 TO 80/12. Channel catfish fed rations of 15% extruded (floating) and 85% pelleted (sinking) diets in ponds grew as well and had the same feed conversion rate as fish fed 50:50, 100:0, or 0:100 ratios of extruded to pelleted diets. Extruded diets cost 20% more. A small percentage of the extruded diet in the ration gave the same management benefits but was 17% cheaper than feeding an all-extruded diet. Channel catfish synthesized as much as 1.9ng/g body wt/day of vitamin B₁₂ by intestinal bacteria. Addition of an antibiotic or emission of cobalt from the diet suppressed vitamin synthesis. Intestinally synthesized vitamin B₁₂ was absorbed directly from the gut and utilized by the fish. Fish fed diets without B₁₂ showed deficiency signs. A nutritionally-complete meal-type diet for feeding ornamental fishes was developed which would not lose any water-soluble nutrients to leaching when the feed was placed in the water. Vitamin C was most susceptible to leaching. By suspending powdered vitamin C in oil and spraying on, it adhered well to feed particles when put in water.

PUBLICATIONS: 80/01 TO 80/12

LOVELL, R.T. 1980. Fish Cultures in the United States. Science 206:1368.
LOVELL, R.T. 1980. Combination Feeding of Extruded and Pelleted Diets for Catfish. Highlights of Agric. Res., Auburn Univ. Agric. Exp. Sta. 27:3.
LOVELL, R.T. 1980. Computer Formulation of Fish Feeds. Aquaculture 6(4):36.
LOVELL, R.T. 1980. Nutrient Requirements of Tilapia. Aquaculture 7(1):42.
LOVELL, R.T. 1980. Feeding Extruded and Pelleted Fish Diets. Aquaculture 6(2):38.

005.005 CRIS0066476
INSECTS ATTRACTED BY LIGHT AS A SOURCE OF FOOD FOR CATFISH

NEWTON S B; MERKOWSKY A; AGRICULTURE; UNIVERSITY OF ARKANSAS, PINE BLUFF, ARKANSAS. 71601.

OBJECTIVES: Evaluate the effectiveness of different light sources in attracting (making available for fish) insects and zooplankton over fish ponds. Determine most advantageous time to run the light during the crepuscular and diurnal periods. Determine cost-benefit ratio of insect and fish meal fed fish along with weight gain and survival per acre. Determine the feeding efficiency of small fingerlings on aquatic insects and zooplankton that are attracted to the lights. Determine species and life stages of insects attracted.

APPROACH: Channel catfish fingerlings will be stocked at the rate of 1,500 to 2,000 per acre in eight (8) 1/10 acre ponds. The treatments will consist of feeding the fish a formula similar to Auburn Number 2, while a diet with reduced protein will be fed to fish which are utilizing attracted insects. The tenth acre ponds will have a controlled water supply.

PROGRESS: 74/06 TO 79/06. Attraction of aerial insects to supplement channel catfish production was insignificant economically for both cage and pond production methods. Additional growth benefits were not achieved by catfish during three seasons of study which involved at least four experiments. A nutritional profile of attracted insects suggested that they were dietarily adequate; but data collections revealed that neither sufficient volumes of insects were made available, nor were insects utilized by the catfish. Therefore, with light-attraction units, costs of production were doubled in cages and nearly tripled in ponds compared to production units receiving artificial feed alone. Light units do concentrate catfish for harvest either by recreational or commercial methods. Aerial insects may be reduced around living areas, gardens, and livestock by light-attraction units and some may be cycled through fish rather than wasted entirely. There is a need for additional research with light attraction of insects for other fish species. Greater utilization may be anticipated with sunfishes, and possibly even with catfish fry during the first year of their development.

PUBLICATIONS: 74/06 TO 79/06

NEWTON, S. F. AND A. J. MEREKOWSKY. 1976. Use of Aerial Insects to Supplement the Artificial Feeding of Channel Catfish in Ponds and Cages. (Abstract)

005.006 CRIS0080218
CRUSTACEAN NUTRITION AND FEED DEVELOPMENT

CONKLIN D E; ANIMAL SCIENCE; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ASC-3891-E Project Type: BATCB
Agency ID: CSRS Period: 01 OCT 79 To 30 SEP 83

OBJECTIVES: Define the nutritional requirements of crustaceans; define other important nutritional parameter (i.e., consumption assimilation, food conversion) for use in the economic evaluation of crustacean aquaculture; design appropriate nutrient delivery systems (i.e., stable, nonleaching microparticles for water-soluble nutrients, binding systems for particulate portion of pelleted rations, etc.) for aquatic crustaceans.

APPROACH: Various deficiency syndromes will be established for the lobster, *Homarus americanus* and other crustaceans by using a series of defined diets. Addition of a various feed ingredients and specific nutrients to the diets will allow for the definition of qualitative requirements which eliminate the various deficiency syndromes. A range of microencapsulation techniques will be evaluated as to their ability to prevent leaching of required nutrients which are water-soluble and as to their acceptability to cultured crustaceans. Quantitative studies will be carried out in order to maximize growth and health of intensively cultured crustaceans. Feeding trials will be used to define the interaction of dietary and environmental influences on consumption. Assimilation and

conversion values for the lobster will be established using an input-output balance approach and used along with the other data in the economic evaluation of lobster aquaculture.

PROGRESS: 80/01 TO 80/12. Development of practical and economical formulated rations for use in the commercial cultivation of lobsters (*Homarus americanus* and *B. gammarus*) as well as other decapod crustaceans. This development requires for crustaceans the definition of minimal, qualitative requirements along with the delineation of optimum quantities of both essential and growth promoting nutrients. In addition to identifying these nutrient requirements, other parameters such as consumption, assimilation and food conversion need to be quantified. Significant progress has been made in the attempt to provide an efficient pelleted ration which will promote rapid growth and high survival. Inclusion of soy lecithin (approximately 10% dry weight) into the formulated purified diet has been found to be critical and eliminates mortalities associated with a "molt death syndrome". This syndrome is characterized by the lobster's inability to extricate itself successfully from its exoskeleton during ecdysis. We have now demonstrated the phosphatidylcholine is the active component of the soy lecithin. Preliminary information suggests that the phosphatidylcholine is an important component of a lipoprotein complex that effectively transfers cholesterol, an essential nutrient for lobsters, from the hepatopancreas to the hemolymph.

PUBLICATIONS: 80/01 TO 80/12

BORDNER, C.E., D'ABRAMO, L.F. and CONKLIN, D.E. 1980. Progress in Lobster Nutrition Research. Feedstuffs 52(13):23-25.
GOLDBLATT, M.J., CONKLIN, D.E. and ECKWA, W.D. 1980. Nutrient Leaching from Coated Crustacean Rations. Aquaculture 19(4):383-388.
CONKLIN, D.E. 1980. Recent Progress in Lobster Nutrition at the Bodega Marine Laboratory. Lobster Nutrition Workshop Proceedings. Main Sea Grant Publications Technical Report 58.
CONKLIN, D.E., D'ABRAMO, L.F., ECKNER, C.E. and BAUM, N.A. 1980. A Successful Purified Diet for the Culture of Juvenile Lobsters: The Effect of Lecithin. Aquaculture 21:243-249.
CONKLIN, D.E. 1980. Nutrition. IN: The Biology and Management of Lobsters. Editors, Cobb, S.J. and Phillips, E., Academic Press. Inc., 1:277-300.

005.007 CRIS0066365
NUTRITIONAL ASPECTS OF AQUACULTURE SYSTEMS

BROWN W D; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-FST-3010-H Project Type: BATCH
Agency ID: CSRS Period: 10 SEP 74 To 30 SEP 82

OBJECTIVES: Learn more of nutrient requirements of crustacea, including such things as optimal dietary level of protein and the interrelationship of energy and protein in diets for juvenile and adult crustacea; develop the technology of better feed delivery systems, including encapsulation and other means of preventing nutrient loss by leaching.

APPROACH: A system for holding several hundred juvenile crustacea (or other aquatic animals) has been designed and built and will be installed in the Ecology Institute of the University of California at Davis. Experimental animals will be housed in this system with controlled water quality, temperature, light etc. Feeding experiments will be conducted according to established protocol, and will be based on our earlier work in this area.

PROGRESS: 80/01 TO 80/12. Delivery of essential nutrients is the primary purpose of any animal ration. We have been able to demonstrate the failure of conventional shrimp and lobster in water soluble nutrients for periods long enough to assure effective delivery to the target animal. The loss due to leaching of riboflavin choline, vitamin C, free amino acids and potassium was found to be rapid and independent of a ration's physical stability, regardless of the binding agent used in the diet.

Losses of total nitrogen and trace minerals were found to be negligible when examined on a per gram ration recovered basis. We have investigated the use of ethyl cellulose as a coating agent to retain water soluble nutrients in pelleted feeds. When the entire ration pellet was coated, minimal nutrient leaching occurred, even after 6 hours. Inclusion of individually coated micronutrients was less effective than total pellet coating for nutrient retention, but did help prevent losses due to leaching.

PUBLICATIONS: 80/01 TO 80/12

GOLDBLATT, M.J., CCNKLIN, D.E. and BROWN, W.D.
1980. Nutrient Leaching from Coated Crustacean Rations. *Aquaculture* 19(4):383-388.

005.008* CRIS0066814
THE USE OF SELECTED AQUATIC ORGANISMS FOR PURPOSES OF AQUACULTURE (FOOD PRODUCTION)

KNIGHT A W; LAND, AIR & WATER RESOURCES; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-LAW-3350-B Project Type: BATCH
Agency ID: CSRS Period: 05 NOV 74 To 30 SEP 80

OBJECTIVES: Determine the tolerances, growth dynamics, food preference, egg hatchability of selected pest organisms. Utilize existing pest organisms such as tadpole shrimp and cladophora algae for beneficial purposes such as low cost protein source.

APPROACH: Initially information will be obtained relating to the environmental needs of the organisms under consideration. Later we will manage environmental factors in order to maximize the production of the potential protein material for purposes of either a domestic animal food (i.e., chicken or catfish food) or a protein supplement for humans.

PROGRESS: 80/01 TO 80/12. Preparation of manuscripts resulting from our work with the Malaysian prawn (*Macrobrachium rosenbergii*) continues. These manuscripts focus on physiological aspects of our research and will be submitted to scientific journals in the near future. Research to better understand the laboratory culture of the grass shrimp (*Cragson*) is progressing well. This shrimp is a key food item for striped bass and sturgeon. Those culturing the sturgeon in the laboratory have indicated a need for food that is also under culture and therefore readily available to feed fish. Our research to determine the environmental needs of the shrimp has increased our capabilities to successfully culture this shrimp in the laboratory. Recently we have included the Asiatic clam (*Corbicula*) in our culture operations. This clam exhibits potential as a filter feeder to remove undesirable particulate matter from aquaculture systems. In addition, the clam has demonstrated an ability to accumulate toxic materials such as heavy metals and organic materials. Clams, it is felt, will serve as excellent monitoring organisms in aquaculture systems. We are experimenting with methods of placing the clams in aquatic systems and their retrieval for tissue burden determination.

PUBLICATIONS: 80/01 TO 80/12

STEPHENSON, M.J. and KNIGHT, A.W. 1980. Growth, Respiration and Caloric Content of Larvae of the Prawn *Macrobrachium rosenbergii*. *Comparative Biochemistry and Physiology* 66A(3):385-381.
NAGAMINE, C., KNIGHT, A.W., NAGAMINE, C., KNIGHT, A.W., MAGGENTI, A. AND PAXMAN, G. 1980. Effects of Androgenic Gland Ablation on Male Primary and Secondary Sexual Characteristics in the Malaysian Prawn, *Macrobrachium rosenbergii* with First Evident of Induced

005.009* CRIS0064485
DIETARY FACTORS IN WHITE FISH MEAL RESPONSIBLE FOR CATARACT FORMATION IN TROUT

AZARI P; BIOCHEMISTRY; COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO. 80523.
Proj. No.: COL00032 Project Type: STATE
Agency ID: SAES Period: 01 JUL 73 To 30 JUN 80

OBJECTIVES: Investigate some of the nutritional factors in white fish meal responsible for growth retardation and high incidence of cataract in trout. Modify the white fish meal by addition of necessary factors or deletion of injurious substances so that it could be effectively used as a supplement to trout feed.

APPROACH: Feeding experiments: Long-range feeding of trout on a complete white fish feed will be performed in order to determine the incidence and time factor involved in the formation of cataract. The effect of lipid-free and heavy-metal-free diets will also be studied. Organic solvents will be used to extract lipid components, and specific chelating agents will be employed to remove heavy elements. The compositional analysis of white fish meal will be aimed at determining the amino acid content of proteins, free and bound carbohydrates and heavy trace elements. Automated amino acid analysis, gas chromatography and atomic absorption procedures will be used, respectively to accomplish these. Compositional analysis of lens proteins from normal and cataractous fish will be done after solubilization and separation of lens proteins by conventional procedures, followed by acid hydrolysis or proteins to liberate amino acids. The levels of cysteine, cystine and tryptophan will be particularly of interest.

PROGRESS: 79/01 TO 79/12. Inclusion of white fish meal at a 20% level into the trout diet was found to cause cataract (67% at 140 days) and higher incidence of mortality (48%) as compared to herring-meal diet. No significant difference in the amino acid composition was found between herring and white fish meals. Fortification of the white-fish diet with tryptophan, histidine, tyrosine, phenylalanine, cystine, lysine or combination of all showed no significant decrease in the incidence of cataract. Fortification of diet with vitamins, A, D, E, B(12) or niacin did not alleviate the problem. Mineral analysis of the white fish and herring meals revealed significantly lower content of Fe, Zn, Se and Mn and a higher content of Ca and P for the white-fish, as compared to herring meal. Incorporation of commercially available mineral mix (protein-mineral chelates) into the white fish diet at 5-10% levels abolished the incidence of cataract and reduced the mortality by 90%. The ratio of calcium to available phosphate was found to be approximately 1.5 times higher for white-fish diet as compared to herring. Inclusion of additional phosphate into the white-fish diet to produce a Ca/P ratio close that of herring diet, reduced the incidence of cataract to 1%. The Na-K ATPase activity of cataractous lens was decreased by about 50%, as compared to normal lens. Fortification of white-fish diet with the mineral mix caused an increase of Na-KATPase activity to 84% of the normal diet.

PUBLICATIONS: 79/01 TO 79/12

NO PUBLICATIONS REPORTED THIS PERIOD.

005.010* CRIS0075815
RELATIONSHIPS BETWEEN SALT MARSH AND ESTUARINE ANIMAL COMMUNITIES AND ENERGY EXCHANGE

SUBRAHMANYAM C B; BIOLOGY; FLORIDA AGRIC & MECH UNIVERSITY, TALLAHASSEE, FLORIDA. 32307.
Proj. No.: FLAX-PR-0002-4232-1 Project Type: GRANT
Agency ID: CSRS Period: 21 APR 78 To 20 APR 88

OBJECTIVES: Conclude the study of benthic and pelagic animals in St. Marks estuary. Assess metabolic requirements of estuarine and marsh animals. Determine caloric values of marsh and estuarine animals and plants. Initiate study of seasonal composition of estuarine and inshore plankton.

APPROACH: A Lentic dredge will be used to sample a known volume of sediments, and a 14-ft balloon trawl for collecting nektonic and benthic species. The rate of oxygen uptake of young and mature specimens of invertebrates and fish will be determined in a static system in 2-hr experiments. Caloric values of dried specimens of plants, invertebrates and fish will be determined in a Parr Oxygen Bomb Calorimeter using standard procedure. A No. 3 net and a No. 20 net will be used to sample phyto- and zooplankton in the estuary and in inshore waters. After taking the settling volumes qualitative analysis of the species will be carried out in the laboratory.

PROGRESS: 77/10 TO 79/09. The study of the infaunal invertebrates and fish of St. Marks River estuary and shallow inshore was continued and completed. The soils of the same localities contained 80 to 92% sand, 2 to 13% clay, and 0.2 to 2% organic matter. The density of invertebrates was higher than in marsh, and amphipods were more abundant. Fish numbers declined from about 80-2000/catch at inshore station to 5-10/catch at river station. Black bass and spinbox fish were common in trawl samples. Estuarine fish, such as *Leiostomus xanthurus*, *Anchoa*, flounders and blue crabs and shrimps enter marshes as juveniles. The fish production was estimated at 1.68 g/m²/yr at St. Marks and 3.13 g/m²/yr at Wakulla. Fish catch in Florida amounts to 18 million dollars per hour. A Master's Thesis was developed on the economic value of salt marshes, and an estimate of 56 to 69 dollars per acre was arrived at based upon blue crab fishery. The distribution patterns of invertebrates show that *Cyathura* is ubiquitous, certain polychaetes are restricted to either marsh zones or tidal creeks, and molluscs such as *Polymesoda* are restricted to marsh zones. Among fishes killifishes occur more abundantly in marsh creeks than in estuaries. Energy exchange between estuaries and marshes is via tidal creeks. Preliminary experiments on metabolic needs of fish species indicate that migratory fish species need basically more oxygen per gm of body weight than resident fish, and both types are metabolically dependent on external oxygen.

PUBLICATIONS: 77/10 TO 79/09

SUBRAHMANYAM, C.B. 1980. The role of salt marshes in the production of fish. Florida A and M University Research Bulletin. In Press.
SUBRAHMANYAM, C.B. 1980. Oxygen consumption of estuarine fish in relation to external oxygen tension. Comparative Biochemistry and Physiology. In Press.

005.011* CRIS0076759
ECOLOGICAL OF SALT MARSHES IN RELATION TO ESTUARIES AND ENERGY FLOW

SUBRAHMANYAM C B; BIOLOGY; FLORIDA AGRIC & MECH UNIVERSITY, TALLAHASSEE, FLORIDA. 32307.
Proj. No.: FAX79004 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 78 To 30 SEP 83

OBJECTIVES: Study community structure and seasonal variations in marsh and estuaries; study breeding cycles of individual species; study nutritional needs of species in terms caloric intake study energy utilization of species in terms of oxygen consumption; determine the energy content of species in terms of caloric values and study activity patterns in field and laboratory to understand movements of species.

APPROACH: Collect animals with trawl, plankton nets, corer and grabs. Sort and identify species. Follow the seasonal distribution of larvae in plankton to assess breeding patterns. Conduct feeding experiments in laboratory, and evaluate food intake and assimilation. Study the oxygen consumption rates by continuous flow techniques, and determine diurnal and tidal rhythms of metabolism by 24-hr experiments. Burn the organisms in Oxygen bomb calorimeter and determine caloric values. Tag fish species in field and follow movements by recapture. Release tagged fish in enclosures and follow activity. Perform laboratory experiments.

PROGRESS: 79/09 TO 80/09. The abundance patterns of fish and invertebrates in St. Marks coastal estuarine-marsh system were summarized in a published paper. Preliminary experiments on the metabolism of estuarine fish showed that the two resident species, *Fundulus grandis* and *F. sizilis* consumed 0.036 - 0.047 mlO₂/gm/hr, which was lower than 0.071 - 0.112 mlO₂/gm/hr consumed by the migratory species *Leiostomus xanthurus* and *Lagodon rhomboides*. All the four species showed metabolism dependent on ambient oxygen tension in the range of 20 - 90 mmHg. Plankton collections and water quality study in St. Marks estuary and Apalachee Bay were started in April 1979 and will be completed in May 1981. Differences between surface and bottom salinity in one tidal cycle were as high as 5-8 p.p.t., but between surface and bottom oxygen (0.5-1.0 ml/l) and temperature (1-2 degrees C) were negligible. Summer temperatures were higher in contrast to salinities because of rainfall. Plankton volume varied from 5ml/tow (8 minutes) to 300 ml/tow between cool and warm months. Phytoplankton maxima were observed in fall and early winter, and zooplankton peaks in late spring and late summer. When stations are compared, Apalachee Bay stations generally showed larger volume of plankton, and mesohaline estuarine stations showed less. Crustacean larvae such as crab zoea and megalopa, peneid postlarvae, and fish larvae were abundant from spring through fall.

PUBLICATIONS: 79/09 TO 80/08

SUBRAHMANYAM, C.B. Oxygen Consumption of Estuarine Fish in Relation to External Tension. Comparative Biochemistry and Physiology 67A:129-133.
SUBRAHMANYAM, C.B. Studies on the Animal Communities in Two North Florida Salt Marshes. Pt. III. Seasonal Fluctuations of Fish and Macroinvertebrates. Bulletin of Marine Science 30:790-818.

005.012 CRIS0064913
UTILIZATION OF KRAFT MILL EFFLUENT FOR FISH PRODUCTION

SHIREMAN J V; JUUL R B; FOR RES & CONSERV; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-FY-01671 Project Type: HATCH
Agency ID: CSRS Period: 06 FEB 74 To 30 JUN 79

OBJECTIVES: Determine the suitability of secondarily treated kraft mill effluent for fish growth and production. Establish the feasibility of utilizing pulp mill effluent as a medium for fish production systems. Determine the effects of intensive fish culture on the environmental quality of effluent waters.

APPROACH: Field and laboratory studies will be conducted to determine the effects of kraft mill effluent on warm water fish populations. An effluent channel coming from four oxidation ponds at the Hudson Pulp and Paper Corporation Secondary Wastewater Facility will be surveyed for biological and chemical parameters. Studies pertaining to the influence of kraft effluents on fish growth, movement, distribution, food consumption, and food preference will be conducted in the effluent channel. Measurements obtained from populations inhabiting the channel will be compared to those obtained from naturally occurring populations. Fish will be contained within cages in order that growth and other measurements can be obtained from known individuals. This study should provide information as to the fitness of kraft effluents for warm water fish production.

PROGRESS: 79/01 TO 79/06. Terminated 30 Jun 1979.

PUBLICATIONS: 79/01 TO 79/06
NO PUBLICATIONS REPORTED THIS PERIOD.

005.013 CRIS0066524
FRESHWATER FOOD ANIMALS

ANDREWS J W JR; ENTOMOLOGY-FISHERIES; GEORGIA COASTAL
PLAIN EXPT STA, TIFTON, GEORGIA. 31794.
Proj. No.: GEO00254 Project Type: HATCH
Agency ID: CS&S Period: 05 SEP 74 To 30 SEP 81

OBJECTIVES: Develop and improve production and
management systems for freshwater animals cultured
for food. Nutrition; culture systems.

APPROACH: Studies will be conducted to determine
protein, amino acid, energy, vitamin and mineral
requirements of catfish and relate these requirements
to environmental and cultural conditions and
least-cost feed formulations. Polyculture studies
will be conducted with species which can utilize
effluent waste products from catfish tanks.

PROGRESS: 76/09 TO 78/12. Studies were conducted on
the dietary protein, lipid, carbohydrate, thiamin,
riboflavin, niacin, pyridoxine pantothenic acid,
vitamin D, vitamin E, vitamin C, potassium and copper
requirements of catfish and culture techniques for
catfish, bait minnows, goldfish *Macrobachium* shrimp
and American shad. Results indicated free amino acids
and simple sugar were poorly utilized by channel
catfish. High dietary levels of linoleic acid (4% of
diet) had a growth depressing effect when compared to
saturated fats. Studies were conducted on the
relative values of various animal and plant protein
sources in catfish diets. Cultural techniques and
diets were tested for rearing American shad from egg
to sub-adult size

PUBLICATIONS: 76/05 TO 78/12
NO PUBLICATIONS REPORTED THIS PERIOD.

005.014* CRIS0071451
FRESHWATER FOOD ANIMALS

HILL T K; BROWN E E; CHESNESS J L;
ENTOMOLOGY-FISHERIES; GEORGIA COASTAL PLAIN EXPT STA,
TIFTON, GEORGIA. 31794.
Proj. No.: GEO00283 Project Type: HATCH
Agency ID: CS&S Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and Improve Production and
Management Systems for Freshwater Animals Cultured
for Food. Nutrition. Water Quality. Diseases. Culture
Systems. Evaluate the Economics of Production,
Processing and Marketing of Freshwater Food Animals.

APPROACH: Practical diets for channel catfish and
rainbow trout will be tested in raceways. Water
quality in raceways will be monitored and removal of
wastes investigated. Diseases and parasites problems
associated with intensive cultures will be identified
and treated. The double-crop concept of using CC in
summer and RT in winter in raceways will be
continued. Polyculture for increased production
through wastes utilization will be evaluated.
Complete costs and returns analyses will be developed
for different levels of production and management.

PROGRESS: 76/09 TO 78/12. Research has been completed
with a flowing water system for double-crop fish
production in a closed system of raceways. Each
raceway segment, ca. 30 m long by 4.5 m wide, was
stocked with 3,000 rainbow trout (November - March)
and 2,500 channel catfish (April - October) per
segment and produced over 3/4 T. and 1 T. of trout
and catfish, respectively, each year. Water
temperatures for 20 or more days under 4°C reduced
trout production significantly. Multiple harvesting
of catfish resulted in higher net production of fish
per raceway segment. Feed conversion for multiple
harvested/stocked fish was 1.3:1; whereas, once
harvested fish had a conversion of 1.5:1. Feed
conversion ratios were higher for catfish fed a
sinking feed than for those fed a floating feed. To
facilitate management of waste products in raceways,
tilapia were stocked with catfish at 50 and 100
half-pound tilapia. Although they increased in weight
from 1/2 pound to 1.1 pounds per fish, the tilapia
did not reproduce.

PUBLICATIONS: 76/09 TO 78/12
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

005.015 CRIS0074599
NITROGEN METABOLISM OF FRESHWATER PRAWNS IN RELATION
TO DIET

NELSON S G; AGRICULTURE; UNIVERSITY OF GUAM, AGANA,
GUAM. 96913.
Proj. No.: GUA00023 Project Type: HATCH
Agency ID: CS&S Period: 28 FEB 78 To 30 SEP 82

OBJECTIVES: Determination of the assimilation
efficiency of *Macrobachium rosenbergii* and *M. lar.* in
relation to diet. Determine the relationships between
growth, nitrogen excretion and dietary protein.
Determine if growth performance can be predicted by
an examination of nitrogen metabolism in relation to
diet.

APPROACH: Egestion, excretion, growth and molting
will be monitored in relation to dietary nitrogen
content. Nitrogen and caloric values will be
determined for specific diets, fecal wastes,
individual prawns, and shed exuvia. Nitrogen and
caloric budgets be constructed for young prawns on
selected dietary regimes.

PROGRESS: 80/01 TO 80/12. Studies of the freshwater
prawn *Macrobachium* lar focused on the relation
between the rate of ammonia excretion and body weight
as influenced by recent feeding history. The diets
used for these studies ranged from 2 to 14% nitrogen.
The rate of ammonia excretion per gram is a function
of a power of the body weight. This power ranged from
-0.3 to -0.8 for groups of 20 to 30 prawns which were
fed one of 6 experimental diets, although the
relation between excretion rate and body weight was
influenced by the diet. This influence was not
correlated with the nitrogen content of the diet.

PUBLICATIONS: 80/01 TO 80/12
NELSON, S.G. and KROPP, K.K. 1981. Ammonia
Excretion by the Freshwater Prawn *Macrobachium*
lar in relation to Diet. Technical Report 18 of
the University of Guam agricultural Experiment
Station, 12 pp.

005.016 CRIS0082572
STUDY OF MANURE-ENRICHED FOOD WEBS IN MARINE POND
ECOSYSTEMS

HELFRICH P; SHLESER R; AGRIC ENGINEERING; UNIVERSITY
OF HAWAII, HONOLULU, HAWAII. S6822.
Proj. No.: HAW00535-S Project Type: STATE
Agency ID: SAES Period: 28 SEP 79 To 30 SEP 84

OBJECTIVES: Obtain analytical data on the physical,
chemical, nutrient, and trophic cycles of
manure-enriched, marine ponds. Develop
pond-management techniques for working with
manure-enriched, marine ponds. Evaluate the economic
potential of using manure-enriched food webs for
application to a marine-shrimp-production industry.

APPROACH: Growth of *Panaeus stylirostris* will be
measured in 0.1 acre marine ponds fertilized with
standard feed and varying amounts of ground cow
manure as the experimental treatments. Levels of
major nutrients and the species composition of
bacterial phytoplankton and zooplankton will be
determined in the marine environment and correlated
with shrimp growth. These data will be interpreted to
ascertain what trophic levels are the optimal
contributing to shrimp growth and utilization of cow
manure for shrimp production in manure aquaculture
industries.

PROGRESS: 80/01 TO 80/12. The study of
manure-enriched ponds is directed toward improving
the economics of shrimp production by reducing feed
costs. The immediate objectives are 1) obtain
analytical data for the salient physico-chemical,
nutrient and trophic cycles resulting from manure
enrichment of ponds, and by that information: 2)
acquire insights into prudent pond management

practices of strategies for working with manure-enriched ponds; 3) evaluate the biological benefits acquired by a valuable marine culture organisms exploiting the manure-enriched food web; and 4) develop data that can be used to evaluate the potential of using cow manure to improve the economics of shrimp production. Results to date imply that levels of shrimp biomass increase with levels of manure addition. By comparison to ponds which used commercial formulated feeds, manure-enriched ponds did as well or better. However, these preliminary results require further replication, as the number of replicates to date are still too few. Data have accumulated on the physico-chemical and nutrient changes in ponds through two series of pond trials. At the same time, a water quality laboratory has been developed to refine the procedures and methods of analysis. Results thus far have shown considerable ranges to exist in dissolved oxygen, temperature, pH, rainfall and water exchange rates; and both long- and short-term effects of these extremes on shrimp growth need to be further evaluated through laboratory experiments.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

005.017 CRIS0045738
MANURE-ENRICHED FOOD WEBS IN MARINE POND ECOSYSTEMS

HELFRICH P; SELFSER R; ANDERSON L; AGRICULTURAL
EXPER. STATION; UNIVERSITY OF HAWAII, HONOLULU,
HAWAII. 96822.

Proj. No.: 5090-20284-007-A(1) Project Type:
COOPERATIVE AGREE.

Agency ID: AFS Period: 28 SEP 79 TO 30 JUN 81

OBJECTIVES: Obtain analytical data on the physical, chemical, nutrient, and trophic cycles of manure-enriched, marine ponds. Develop pond & aquatic vegetation management techniques for working with manure-enriched, marine ponds. Evaluate the economic potential of using marine-enriched food webs for application to a marine-shrimp-production industry.

APPROACH: Growth of *Penaeus stylirostris* will be measured in 0.1 acre marine ponds fertilized with standard feed and varying amounts of ground cow manure as the experimental treatments. Levels of major nutrients and the species composition of bacterial phytoplankton and zooplankton will be determined in the marine environment and correlated with shrimp growth. These data will be interpreted to ascertain what trophic levels are the optimal contributing to shrimp growth and utilization of cow manure for shrimp production in manure aquaculture industries.

PROGRESS: 80/01 TO 80/12. After conditioning of newly constructed shrimp culture ponds, each was stocked on 13 June with 2,100 *P. stylirostris* (30,000 per acre). Manure was applied two weeks prior to stocking at 0, 2,500, 5,000 and 10,000 lbs. per acre or with standard commercial feed. Sampling included ammonia, nitrate, phosphate, pH, pO₂, chlorophyll, ASP, and temperature. Shrimp were sampled weekly to measure growth rate. Ponds were harvested July 21. Production was highest in manure-enriched pond (10,000 lb/acre) (9 kg); control produced 4.5 kg. Large variations in PC(4), NO(2), NH(3), and pH occurred during the culture. A second stocking was made 7 December at the same rate of manure, and will be harvested in early March 1981.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

005.018 CRIS0077916
WEIGHT GAIN OF FISH

ELCINTZ G W; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IIA-CFU-0058 Project Type: STATE

Agency ID: OCI Period: 01 JUL 78 TO 30 DEC 80

OBJECTIVES: Define and test a method whereby weight gain of rainbow trout may be accurately estimated.

APPROACH: First-feeding rainbow trout fry will be raised through adulthood under closely controlled conditions. The evaluative parameters include weight gain, length gain, feeding rate, dietary composition, water temperature, oxygen availability, and population density. The fish will be fed at a programmed rate and the effects will be measured at biweekly intervals.

PROGRESS: 80/01 TO 80/12. This study was designed to develop a computerized model to predict the growth rate of salmonids in hatchery settings. The input data were water temperature, dissolved oxygen, proximate analysis of the diet, water inflow, ammonia-N generation, and solids generation. The model was developed and tested under laboratory conditions using rainbow trout. The results were very encouraging. When the model was field tested, the results were very encouraging. The model proved so sensitive that small percentage changes in weight gain were easily detected. From the application of the model under field conditions we were able to establish a statistic which we term 'allowable growth rate' based upon weight gain rather than length gain. Work is continuing on another project to incorporate the data and models acquired from this study.

PUBLICATIONS: 80/01 TO 80/12

FOCHT, R.L. 1980. Determination of Allowable Growth in Rainbow Trout. M.S. Thesis, Department of Fishery Resources, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow.

005.019 CRIS0079933
TRACE MINERAL IMBALANCE IN HATCHERY FISH

STOSZEK M J; MACPHEE C; FOREST WILDLIFE & RANGE EXP
ST; UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.

Proj. No.: IDA00778-B Project Type: ANIMAL
HEALTH

Agency ID: CSRS Period: 12 OCT 79 TO 30 SEP 80

OBJECTIVES: Establish basic criteria for diagnosis of trace-mineral disorders in chinook salmon, steelhead and hatchery rainbow trout; determine whether there is a relationship between health problems found in individual hatcheries and mineral contents of fish tissues; accumulate and evaluate information of physiological and chemical parameters associated with different mineral levels, and establish normal and abnormal levels of trace minerals in fish blood and tissue by species and age groups.

APPROACH: The fish will be sampled and shipped frozen to the laboratory at regular intervals from 8 hatcheries. All samples will be analyzed for trace mineral content and levels of several metabolic products and enzymes. Results will be related to existing health problem in hatcheries.

005.020* CRIS0069239
BREEDING, PRODUCTION, NUTRITION AND MARKETING OF
CHANNEL CATFISH

KELLEY J R JR; DEYOE C; KLAASSEN B E; BIOLOGY; KANSAS
STATE UNIVERSITY, MANHATTAN, KANSAS. 66506.

Proj. No.: KAN00902 Project Type: STATE
Agency ID: SAES Period: 01 SEP 75 TO 30 JUN 80

OBJECTIVES: Obtain quantitative data on the growth rates of selective strains of channel catfish and the reaction of selected strains to different dietary formulations. Identify interaction of growth rates, diets and pond water quality degradation. Quantify water quality parameters associated with pond degradation and develop methods of maintaining water quality. Develop methods for product storage and flavor quality.

APPROACH: Earthen ponds will be used to replicated experiments to test diets against four strains of channel catfish. Growth rates will be used to compare the effect of diet on strain performance and for between-strain performance using a factorial arrangement of treatments. Full and half sib analysis will be used to compare within-strain performance. Dietary treatments will include evaluation of protein quality and quantity. Effect of diets with different nutrient densities involving nutrients such as vitamins and minerals will be evaluated in relationship to protein levels.

PROGRESS: 80/01 TO 80/06. Ponds treated with cobalt chloride as a trace component of fertilizer were not found to produce more channel catfish than control ponds. Cobalt chloride was added to the diet of channel catfish to determine if vitamin B(12) could be spared by the addition of this trace mineral. No significant difference was recorded in growth rates of fish receiving normal amounts of B(12) and those fish receiving cobalt in place of B(12) in purified diets. Significant differences were found in serum proteins between three of five populations of catfish. Additional differences in these populations were found in serum esterase patterns. It was concluded that the population of channel catfish in the White River, Arkansas and the Blue River, Kansas, were different from each other and from the other three populations examined. A domestic population from Arkansas, a domestic population from Kansas and wild population in the Kansas River, Kansas.

PUBLICATIONS: 80/01 TO 80/06
NC PUBLICATIONS REPORTED THIS PERIOD.

005.021 CRIS0079383
DEVELOPMENT OF OPTIMUM SUSTAINED YIELD OF FISHES IN
FARM PONDS

KLAASSEN B E; BIOLOGY; KANSAS STATE UNIVERSITY,
MANHATTAN, KANSAS. 66506.
Proj. No.: KAN00118 Project Type: STATE
Agency ID: SAES Period: 01 JUL 79 TO 30 JUN 82

OBJECTIVES: Develop and manage methods to achieve a higher usable yield of largemouth bass and bluegill by evaluating the protected range size limit and total weight limit as a method to prevent over-harvest of bass and maintain high quality bass yield, testing different levels of bluegill harvest to determine the level which will yield the optimum size structure. Develop low level supplemental feeding programs which will yield desired amounts of channel catfish at minimum cost.

APPROACH: Farm ponds with populations of largemouth bass and bluegill will be used. The bass harvest will be regulated by following a 30 cm to 38 cm protected range size limit along with a 22 kg/ha/yr weight limit. Bluegill will be harvested at three levels: 11, 34, and 80 kg/ha/yr. Results will be evaluated by the size structure of fish harvested, population structure of fish in pond (by electrofishing), reproductive success. Some ponds will be stocked only with channel catfish at a rate of 250/ha plus the number of one pound fish desired by the pond owners. They will be fed at amount 3% of body wt/day. Feed adjustments will be made based on calculated growth. The quota by number will be harvested each year and intermediate replacements stocked. Evaluated by size of fish harvested, cost/pound of fish harvested.

PROGRESS: 80/01 TO 80/12. One phase of this project deals with evaluating the population structure of largemouth bass and bluegill in nine ponds subjected to three different levels of bluegill harvest. The bass harvest was the same level in all ponds. The study was initiated during the Summer of 1979 so only the ponds with old established populations were harvested. All fish harvested were measured to determine size structure of the catch. Also the pond populations were sampled and the size structure determined. It is too early in the study to present results. The other phase of the project involves low level supplemental feeding of channel catfish in six additional ponds. Three harvest goals were set (100, 150, and 200 fish per pond). Calculated amounts of

feed were fed three times per week. The harvest goals were not quite reached in the ponds. The fish harvested in most ponds averaged over one pound each. The feed conversion (wt. fed/net wt. harvested) ranged from 1.27 to 2.39.

PUBLICATIONS: 80/01 TO 80/12
NILSON, E.B. and KLAASSEN, E.E. 1980. Aquatic Pest Control; Commercial Pesticide Applicator Certification and Recertification Study Manual. Cooperative Extension Service, Kansas State Univ., Manhattan, 16 pp.

005.022 CRIS0072940
FORMULATION OF FOODS FOR AQUATIC ANIMALS OF ECONOMIC
IMPORTANCE

MEYERS S P; FOOD SCIENCE; LOUISIANA STATE UNIVERSITY,
BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB01918 Project Type: STATE
Agency ID: SAES Period: 01 JUN 77 TO 31 DEC 81

OBJECTIVES: Formulation of nutritionally-balanced diets for various stages of shrimp and prawn growth, especially for larval and juvenile development. Included will be species of marine shrimp (Penaeus), freshwater prawn (Macrobrachium) and crawfish (Procambarus). Use of agricultural and fisheries wastes or byproducts in least-cost grow-out rations for crustacean aquaculture.

APPROACH: Diets and formulations developed and prepared in the Department of Food Science will be tested in cooperative on-going programs with aquaculturists at various sites in this country. Projected areas of continued investigation will include analyses of attractants in diets to enhance chemoreceptor response, studies of modified starches and waterstability of flake/extruded diets, microbial degradation of cellulosic-fiber substrates and diet development for protein-deficient areas, effect of diet on organoleptic qualities of the cultivated animal crop, and transfer of dietary carotenoid pigment to internal/external parts of the fish or crustacea.

PROGRESS: 80/01 TO 80/12. Application of the tropical fish *Trichogaster leeri* as an assay animal for evaluation of carotenoids and carotenoid-containing dietary ingredients has been demonstrated. Methods of analyses for measurement of fin and integument sites of accumulation of the main repository pigment have been developed and are being used to assay astaxanthin-rich substrates, such as crawfish wastes, and isolated pigments in flake and extruded formulations for aquatic animals. Oregon Moist Pellet (OMP) diets, fortified with 20% crawfish waste puree, have yielded significant flesh coloration of rainbow trout as well as coho salmon. Binders used as water stability agents in larval bullfrog (*Rana catesbeiana*) diets have been evaluated in terms of growth and food conversion as well as features of the hydrocolloids themselves. Levels of solids present and features of the dietary ingredients are related to binder performance. The wide application of alginate products is noted in flake and extruded dietary preparations where loss of water-soluble components is critical. A variety of gums have been tested as binding-matrix agents for adult bullfrogs. Moist and semi-moist dietary preparations have been shown to possess desirable binding characteristics and water stabilities for as long as 24 hours. Feeding tests have produced useful information on the feeding response and behavior of bullfrogs.

PUBLICATIONS: 80/01 TO 80/12
MEYERS, S.P., COLLEY JR., D.D., MARSCHALL, D.G. and MARSHALL, G.A. 1980. Evaluation of Binders in Larval Bullfrog Diets. J. Aquaculture 1:20-28.
FEY, M. and MEYERS, S.P. 1980. Evaluation of Carotenoid-Fortified Flake Diets with the Pearl Gorerami *Trichogaster leeri*. J. Aquaculture 1:15-19.
MEYERS, S.P. 1980. Water-Stable Extruded Diets and Feeding of Invertebrates. J. Aquaculture 1:44-46.

LIAC, A. 1980. Fabrication of Amphibian Diets Using Louisiana Shrimp and Crawfish Wastes with Selected Binders. M.S. Thesis. La. State Univ., Baton Rouge. 76 pp.

005.023* CRIS0059059
UTILIZATION OF AQUATIC PLANTS FOR WASTE TREATMENT AND ANIMAL FEEDS

CULLEY D D JR; FORESTRY & WILDLIFE MANAGEMENT;
LOUISIANA STATE UNIVERSITY, EATON BOUGE, LOUISIANA.
70803.

Proj. No.: LAB0155E Project Type: STATE
Agency ID: SAES Period: 01 FEB 71 To 15 MAR 80

OBJECTIVES: To determine the feasibility of utilizing aquatic plants for treatment of agricultural and domestic waste by removing nitrogen compounds, phosphates, and various inorganic salts. To determine if plants grown on waste waters have sufficient nutrient value and can be produced in large enough quantities to warrant use as a feed supplement for poultry, swine, cattle, catfish, etc.

APPROACH: Nutrient value will be determined for various aquatic plants growing under natural conditions. Plants of acceptable nutrient levels will be fed to poultry, swine, catfish, etc. to check for toxic as well as growth responses. Plants that show no signs of toxicity will be placed on water containing agricultural and domestic sewage to see if they will grow. Nutrient analysis will be made for any plants that do grow, and the plants will again be fed to domestic animals (5-10% of regular rations), to determine if the plants are usable as a food supplement. Water quality changes will be recorded and related to the usefulness of aquatic plants to reduce pollution levels in waste waters.

PROGRESS: 71/02 To 80/03. Clones of duckweed *Spirodela polyrrhiza*, *S. punctata*, *Lemna gibba* and *Wolffia columbiana* cultured on dairy waste lagoons gave a mean yield of 23,310 kg/ha/yr dry weight when harvested daily, or 2.3 kg/m²/yr. Maximum yields obtained outdoors in .14 m² tanks was 44,330 kg/ha (4.4m²/yr) dry wt. Daily harvests (25-35% removed/day) gave higher yields than weekly harvests (50% removal). Optimum standing crop density was about 500g/m². Loading rates of fresh manure 10 to 20g/l of water gave maximum growth and highest proximate analysis in the plants. Mixed duckweed cultures gave higher yields than monocultures due to seasonality of growth. Crude protein averaged 38% dry wt. with a maximum value of over 44%; fats 3-6%, NFE 25-35%, fiber 7-13%, P 2%, K 2.5-5%, Ca 1-2%. The amino acid content was equal or superior to most high protein crops. Annual removal (kg/ha) of plant nutrients by duckweed from waste lagoons was: N, 1375; P, 347; K, 441. Removal efficiency was greater in shallow lagoons. 5.3 ha of duckweed would provide total protein requirements of 200 lactating cows. Preliminary studies on feeding cows (up to 75% of diet) and swine (up to 25% of diet) showed no adverse effects of duckweed, wet or dry. Feeding of poultry broilers and layers showed no adverse effects, equal or improved growth, meat and egg color, and egg production and quality. In vitro digestibility ranged from 70 to 97%.

PUBLICATIONS: 71/02 To 80/03

TKAUX, R.E., D.D. Culley, Jr., M. GRIFFITH, W.A. JOHNSON, and J.P. WOOD. 1972. Duckweed for chick feed. *Louisiana Agriculture* 16(1):8-9.
CULLEY, D.D., Jr. and E.A. Epps. 1973. Use of duckweed for waste treatment and animal feed. *Journal Water Pollution Control* 45(2):337-347.
LAWSON, T.E., B.J. BRAUD, and F.L. WEATTEN. 1974. Methods of drying duckweed, Lemnaceae. In *American Society of Agricultural Engineers. Paper No. 74-3531*.
CULLEY, D.D., Jr., J.B. GIBLSON, T.S. CHISHOLM, L.C. STANIFER, and E.A. EPPS. 1978. Water quality renovation of animal waste lagoons utilizing aquatic plants. U.S. EPA Off. Res. & Dev. EPA-600/2-78-153.

005.024* CRIS0083515
LABORATORY CULTURE FOR RESEARCH PURPOSES OF ESTUARINE AND MARINE LOBSTERS, CRABS AND SHRIMPS

TRUESDALE F M; FORESTRY & WILDLIFE MANAGEMENT;
LOUISIANA STATE UNIVERSITY, EATON BOUGE, LOUISIANA.
70803.

Proj. No.: LAB02159 Project Type: STATE
Agency ID: SAES Period: 01 MAR 81 To 30 JUN 86

OBJECTIVES: Rear decapod larvae (lobsters, crabs and shrimps) of as many Louisiana species as possible, from egg through postlarval stages under defined laboratory conditions. Describe and illustrate the developmental stages of each species reared. Compare laboratory reared larvae with corresponding larvae taken in the plankton.

APPROACH: Egg-bearing crabs and shrimps will be collected at coast-wide Louisiana sites. In the laboratory most specimens will be isolated in aquaria under simulated field conditions until eggs hatch; for large species eggs will be removed and hatched in vitro. Rearing procedures will allow the developmental sequence of each larva to be traced; this will entail isolating individual larvae within plastic tray compartments and examining each daily for evidence of molting. Enough larvae will be reared to investigate three salinity/temperature combinations with replication. Daily data on survival, molting, behavior and morphology will be recorded. Larvae will be transferred to compartments with clean water and fresh food (*Artemia* spp.) each day. Detailed descriptions and drawings of each developmental stage will be made. Comparative descriptions of closely related species will be made to elucidate difference. Laboratory-reared specimens will be compared with plankton-caught larvae in order to develop diagnostic guides for fishery researchers.

005.025 CRIS0067268
ENVIRONMENTAL EFFECTS ON PRODUCTIVITY OF CRAYFISH IN POND HABITATS, PHASE I, II

RODDY L R; DAVIS C E; BIOLOGY; SOUTHERN UNIVERSITY,
BATON ROUGE, LOUISIANA. 70813.

Proj. No.: LA-X-PR-0001-8-15-66 Project Type: GRANT
Agency ID: CSRS Period: 29 OCT 74 To 28 OCT 79

OBJECTIVES: Determine the type and amount of food that will yield the best production. Determine the most efficient harvesting method in small ponds. Investigate an early and extended crayfish season in small ponds.

APPROACH: Literature and cooperating personnel will supplement our selection of food types and amount during the feeding season. Standard nets, seines, modified traps and nets will be used. The possible use of chemicals and electric devices will be investigated. Systematic regulation of water will be maintained, to determine the possibility of increase and decrease of water level on an extended season. Statistical analysis will be made.

PROGRESS: 79/01 To 79/12. Feeding: Data obtained from the crayfish project indicated that feeding and fertilizing had great impact on productivity. Feed with a high protein percentage favored productivity, consequently, fish pellets are highly recommended in the feeding regimen. Harvesting: Four different traps were constructed and placed in water depth of 120, 90, 60 and 30 cm respectively. The total weight of each catch per trap was recorded. On the basis of results obtained, Type I trap with 1.5cm mesh wire construction, barrel shape design, 70cm long, 30cm wide with two funnel openings at the bottom is recommended for utilization from January through June. Dual Crop of Crayfish and Fish: 205 fingerlings of hybrid buffalo fish were added to each of the two crayfish ponds. Rice was planted in each pond. None of the fish reached market size over this phase of the investigation but the preliminary results indicate that it is feasible to rear crayfish and these fish in the same pond. Cost Yield Ratio: Based

upon average crayfish price, net profits of \$5.82 in Pond I and \$338.83 in Pond II were realized, thereby indicating the feasibility of commercial crayfish production under small pond conditions.

PUBLICATIONS: 79/01 TO 79/12

NC PUBLICATIONS REPORTED THIS PERIOD.

005.026* CRIS0080671
NUTRITION MANAGEMENT AND DISEASE OF MARINE ANIMALS

HAYER R C; ANIMAL & VETERINARY SCIENCE; UNIVERSITY OF MAINE, ORONO, MAINE. 04469.

Proj. No.: ME08398 Project Type: STATE
Agency ID: SAES Period: 01 JUN 79 To 30 SEP 82

OBJECTIVES: Formulate and evaluate minimal cost lobster rations, study gaffkemia in lobsters including vaccine evaluation and study lobster pound management. Compounded lobster baits will also be evaluated.

APPROACH: Lobsters will be fed diets of various types and growth will be monitored by measuring weight in water and weight in air. Lobsters will be vaccinated with live bacteria so that survival can be measured.

PROGRESS: 80/01 TO 80/12. Practical diets formulated with brewer's yeast, fish meal, kelp meal, alfalfa and wheat flour were fed to adult and juvenile lobsters. The basal diet was supplemented with 20,000, 100,000 and 1,000,000 U.S.F. units of vitamin A per Kg of diet. Growth was greatest in lobsters fed 20,000 U.S.P. units of vitamin A per Kg with growth inhibition seen in lobsters fed the higher level supplements. Adult lobsters were injected with P 3 2 labelled aerococcus viridans, a fatal lobster pathogen, and the distribution of these bacteria in the animal's body was monitored. The bacteria were primarily phagocytized by the hepatopancreas.

PUBLICATIONS: 80/01 TO 80/12

GALLAGHER, M.L., BAYER, R.C., LEAVITT, D.F. and RITTENBURG, J.B. 1979. Effects of Protein Energy Ratio on Growth of Adult American Lobsters. Proc. 10th An Meet. World Mariculture Society.

GALLAGHER, M.L., RITTENBURG, J.B., BAYER, R.C. and LEAVITT, D.F. 1979. Incidence of Aerococcus viridans (var.) hozari in Natural Crab Populations in Maine Coastal Waters. Crustaceana 37:316-317.

HAYER, R.C., GALLAGHER, M.L., LEAVITT, D.F. and RITTENBURG, J.B. 1979. A Radiographic Study of the Lobster (*Homarus americanus*) Alimentary Canal. Proc. 10th An Meet. World Mariculture Society.

BAYER, R.C., ADRON, J.W., MACKIE, A.M., PIRIE, B.J. and RITTENBURG, J.B. 1980. Mechanisms of Food Detection and Feeding Behavior in Dover Sole. Fed. Proc. 38:500.

BAYER, R.C., GALLAGHER, M.L., LEAVITT, D.F. and RITTENBURG, J.B. 1980. Requirements for Diet Formulation for Adult Lobsters (*Homarus americanus*) Held in High Density Confinement. Abst. 72nd Annual Meeting ASAS, p. 186.

005.027* CRIS0083163
BIOSYNTHESIS OF STEROLS IN THE OYSTER AND CORRELATION OF STEROL COMPOSITION TO OYSTER PRODUCTIVITY

PATTERSON G W; BOTANY; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.

Proj. No.: MD-J-114 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 81 To 31 DEC 81

OBJECTIVES: Data from several sources indicate that oysters synthesize only a fraction of their total sterol. Analysis of fast growing oysters from Cape Hatteras indicates that the Chesapeake Bay oyster could, in some cases, be deficient in total sterol composition. Inadequate algae or the wrong kind of algae in the diet could cause this deficiency. The extent of sterol biosynthesis in the oyster will be determined. Oysters from different bars with different degrees of success will be compared with respect to their sterol content. "Good food" algae

will also be examined to determine which sterols they contribute to the oyster's diet.

APPROACH: Oyster samples will be analyzed by standard methods for sterol composition. These samples will be taken from oyster bars showing a great diversity of characteristics with respect to growth rate, spat set, shell growth, and general health of the oyster. An attempt will be made to correlate sterol composition with these characteristics. To determine if the oyster can synthesize sterols, oyster tissue cultures will be incubated with labeled acetate and the sterols isolated and examined. Algae will be examined for sterol composition to determine if sterols correlate with the desirability of certain algae as oyster food.

005.028* CRIS0075003
BEHAVIOR ECOLOGY AND RHYTHMICITY IN THE ROCK CRABS, *CANCER IRROBATUS* AND *CANCER BOREALIS*, PHASE II

KEBACH S; UNIVERSITY OF MARYLAND EASTERN SHORE, PRINCESS ANN, MARYLAND. 21853.

Proj. No.: MLX-PR-0001-URP53 Project Type: GRANT
Agency ID: CSRS Period: 27 FEB 78 To 26 FEB 83

OBJECTIVES: Determine influence of tidal and/or geophysical rhythms or activity of rock crabs. Determine relative influences of photophase & scotophase on molting of rock crabs. Determine effect of short & long day photoperiods on growth, molting & reproduction. Record seasonal distribution of age classes, sexes & molt stage individuals. Develop optimum diet for growth & maintenance & develop a delivery system for diet.

APPROACH: Encourage local utilization of rock crab as an alternate or supplement to blue crab. Correlate observed activity rhythms with tidal, barometric, humidity, magnetic flux cycles. Varying length & proportions of light & dark periods to determine influence on molting. Utilizing less than or greater than 24 hour days in laboratory environment. Utilizing tag and recapture studies at monthly intervals aboard a coastal vessel. Automated system for delivery of optimum protein, fiber & mineral content of presently used nutritional pellets will be developed. Interviews, free samples & information on location & abundance of rock crabs might increase local utilization of rock crab meat.

PROGRESS: 80/01 TO 80/12. Previous work (Kebach, 1977, and in preparation) indicates that length of photoperiod and light: dark ratios are controlling factors in courtship, reproduction and molting of the rock crab, *Cancer irroratus*. The newly opened Crab Lab, a converted 70 foot house trailer, has a water treatment facility and 5 laboratories with running seawater and computer-controlled photoperiods. Tanks and electronic instrumentation have been designed, constructed and tested to allow the test animal to select the duration of light and dark in one laboratory. Total hours of light and dark and light: dark ratios are monitored. Another laboratory allows the animal to control the intensity of illumination. In 1980, after correcting many problems and improving the water delivery and treatment facilities (to produce adequate flow rates to maintain the animals), we were able to introduce our first group of animals. Pilot studies led to further refinement of light control mechanisms in the test tanks. These studies indicated that the animals were able to control the photoperiod and intensity in their respective laboratories. We are now ready to initiate full-scale testing. In order to determine the locations of marketable numbers of animals, a tag-recapture program is planned. However, spaghetti tags injected into the crabs' muscle resulted in a 40% mortality rate in the laboratory. This level is too high for a successful tag and recapture program.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

RECYCLING WASTES INTO ANIMAL FEEDS

JOBNSON B E; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
 Proj. No.: MICL03146 Project Type: STATE
 Agency ID: SAES Period: 01 JAN 74 To 19 FEB 81

OBJECTIVES: Combine dried animal wastes (e.g., poultry wastes) and items from local wastewater ponds into a pellet acceptable for various high yield, low cost fish species grown under intensive culture conditions.

APPROACH: Microplankton and macrophytes will be mechanically harvested from MSU wastewater ponds. Analyses will be made on these and farm animal wastes for components important in fish diets. These products will be processed and combined to form fishfood pellets. Northern climate fishes with potential for high production at low cost will be fed standard commercial diets and experimental pellets. Growth rates, food conversion rates and fish production will be compared, resulting in maximum dietary use of farm animal wastes and biological production from wastewater ponds.

PROGRESS: 74/03 TO 81/02. Rainbow trout grew well on diets formulated from aquatic plants, crustaceans and poultry wastes. Carp growth on this diet was inversely related to quantities of poultry waste. Water quality in a terminal wastewater lake maintained exceptional growth rates for forage and recreational fish without accumulation of harmful levels of toxic materials in fish. The growth of cage-reared channel catfish was significantly impaired by high pH and ammonia concentrations in a terminal wastewater pond.

PUBLICATIONS: 74/03 TO 81/02

JOHNSON, B.E. and DUGGIELD, D.L. 1980. Utilization of Wastewater for Intensive Fish Culture. Project A-082 Completion Report for Office of Water Research and Technology, U.S. Department of Interior. 34 pp.

DUFFIELD, D.J. 1979. Cage Culture of Channel Catfish, *Ictalurus punctatus* (Rafinesque), in a Tertiary Wastewater Treatment Pond and a Private Pond in Southern Michigan. M.S. Thesis, Mich. State Univ.

KERNS, C.L. and ROELOFS, E.W. 1977. Poultry Wastes in the Diet of Israeli Carp. *Bamidgeh* 29(4):125-135.

EAHR, T.G., KING, D.L., JOHNSON, B.E. and KEENS, C.L. 1977. Municipal Wastewater Recycling: Production of Algae and Macrophytes for Animal Food and Other Uses. *Developments in Industrial Microbiology* 18:121-134.

KERNS, C.L. 1976. The Use of Selected Biological Materials Produced by Tertiary Wastewater Treatment Ponds in the Diet of Two Species of Fish. M.S. Thesis, Mich. State Univ., 47 pp.

005.030*

CRIS0012991

FARM FISH POND MANAGEMENT

KEVERN N R; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
 Proj. No.: MICL00064 Project Type: BATCH
 Agency ID: CSRS Period: 22 JUL 44 To 01 JAN 99

OBJECTIVES: Estimate production of plants and animals per unit area or volume of water in farm type ponds, and natural ponds. Determine extent fertilization of ponds will increase production of fish food (plankton, insects) and fish. Devise practical management programs for farm ponds; this includes the number of fish to plant and harvest. Detect and measure possible detrimental effects of use of fertilizers in fish ponds.

APPROACH: Measurement release of stored nutrients in the subaqueous soils by addition of chelating (EDTA, etc.) materials to the waters. Tracing the paths of nutrients added to the waters through tagging nutrients with radioactive tracers (F^{32}), rates of fixation of nutrients and accumulation of organic material (basic productivity) will be measured by the

C^{14} light-and-dark bottle technic. Input of solar radiation will be measured.

PROGRESS: 44/07 TO 79/10. The research has contributed significantly to the management techniques of fish ponds in northern, midwestern areas of the United States. These techniques relate to the stocking densities of fish, the species of fish suitable, fertilization rates for ponds and fish and fish food relationships. Northern ponds must be stocked and fertilized differently than southern ponds in many aspects. Competition among sport versus rough fish in ponds results in reduced growth rates of sport fish when ponds are fertilized. This results apparently from lower dissolved oxygen levels in fertilized ponds. Raising of catfish in Michigan for sale is successful when starting the season with advanced fingerlings.

PUBLICATIONS: 44/07 TO 79/10

GALLOWAY, J. E. AND N. R. KEVERN. 1976. Michigan suckers, their life histories, abundance and potential for harvest. *Mich. Sea Grant Tech. Rpt.* 53: 46 pp.

LU, J. D. AND N. R. KEVERN. 1975. The feasibility of using waste materials as supplemental fish feed. *Prog. Fish-Cult.* 37(4): 241-244.

BAINES, T. A. 1973. Effects of nutrient enrichment and a rough fish population (carp) on a game fish population (small mouth bass). *Trans. Am. Fish. Soc.* Vol. 102: 346-354.

BAHR, T. G., R. C. EALL AND F. F. BOPPER. 1969. Some ecological changes in ponds resulting from treatments of sodium arsenite and copper sulfate. *Michigan Academician*, Vol. 1, Nos.3 and 4.

EAHLS, J. D. AND R. C. BALL. 1976. Response of pond metabolism to sodium arsenite. *Papers of Mich. Acad. of Sci., Arts, and Lett.*, Vol. LI.

005.031

CRIS0071472

CHANNEL CATFISH NUTRITION

WILSON R P; BIOCHEMISTRY; MISSISSIPPI STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI. 39762.
 Proj. No.: MIS-0818 Project Type: BATCH
 Agency ID: CSRS Period: 01 CCT 76 To 30 SEP 80

OBJECTIVES: Determine the dietary requirements and interaction for each of the essential amino acids in fingerling channel catfish. In addition, studies will be conducted on the digestion, absorption and metabolism of proteins, amino acids and carbohydrates.

APPROACH: All nutritional studies will be conducted with small 2-5 inch fingerling channel catfish in glass aquaria, reared on semi-purified diets, with at least 3 replicate groups on each test diet. The experimental diets will be formulated to be equivalent to 24% crude protein and 275 kcal/100 g diet. Casein and gelatin mixtures will be supplemented with L-amino acids to provide the amino acid pattern in 24% whole egg protein. The procedure for diet preparation and storage has already been established in our laboratory and proven satisfactory for the last years. The digestion, absorption and metabolism studies will be conducted by established methods. Preliminary studies in our laboratory have been successful in measuring certain of these parameters.

PROGRESS: 76/10 TO 80/09. A series of growth studies have been completed in order to quantitate the amino acid requirements for fingerling channel catfish. The minimal requirements for the ten essential amino acids expressed as a percentage of dietary protein are as follows: arginine 4.3; histidine 1.5; isoleucine 2.6; leucine 3.5; lysine 5.1; methionine 2.3; phenylalanine 5.0; threonine 2.3; tryptophan 0.5; and valine 3.0. Additional studies have indicated the following: cystine can replace about 60% of the methionine on a mole sulfur basis; DL-methionine was utilized as effectively as L-methionine; methionine hydroxy analogue was only 26% as effective as L-methionine; taugine or inorganic sulfate did not replace any of the L-methionine; tyrosine can replace about 50% of phenylalanine; excess tyrosine (up to 10% of diet) was not toxic to the fish; and no apparent arginine-lysine could be demonstrated.

Lysine was found to be the first limiting amino acid in most feedstuffs used in commercial catfish feeds. Growth and feed efficiency data from studies using peanut meal diets supplemented with feed grade lysine demonstrated that fingerling channel catfish are able to utilize free amino acids effectively in practical diets. Studies have been initiated to determine the amino acid availability values for several common feed ingredients. These data should assist various researchers in formulating various experimental test diets and assist the catfish industry in formulating least cost rations for catfish.

PUBLICATIONS: 76/10 TO 80/09

WILSON, E.F., POE, W.E., and ROBINSON, E.B. 1980. Studies on the amino acid availability of common feed ingredients used in catfish rations. Presented at the annual meeting of Catfish Farmers of American, New Orleans, LA.
ROBINSON, E.P., POE, W.E., and WILSON, E.F. 1980. Arginine requirement of channel catfish. Fed. Proc. 39: 2786.
WILSON, E.F., POE, W.E., and ROBINSON, E.B. 1980. Leucine, isoleucine valine and histidine requirements of fingerling channel catfish. J. Nutr. 110, 627-633.

005.032 CRIS0045643
EVALUATION OF BY-PRODUCTS FROM CATFISH PROCESSING WASTE FOR CATFISH FEED SUPPLEMENTS

WILSON R P; FREEMAN D W; BICCHEMISTRY; MISSISSIPPI STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI. 39762.

Proj. No.: 7003-20530-004-A Project Type: COOPERATIVE AGREEMENT
Agency ID: ARS Period: 07 SEP 79 To 30 SEP 81

OBJECTIVES: Evaluate nutritional value for channel catfish fingerlings of concentrated protein, bone meal and oil by-products made from catfish processing waste; recommend practical catfish feed formulations based on optimum use of these by-products.

APPROACH: Determine protein efficiency ratio, protein digestibility and amino acid availability in aquaria studies with channel catfish fingerlings fed several concentrated protein by-products made from catfish processing wastes (heads, viscera and skins) in isonitrogenous, isocaloric semi-purified diets. Evaluate possible adverse effects of added catfish oil and/or bone meal prepared from catfish processing waste. Incorporate acceptable by-products into practical commercial-type catfish feeds and evaluate in aquaria feeding tests.

PROGRESS: 80/01 TO 80/12. This is a specific cooperative agreement between SEA and Mississippi State University to assist the catfish industry in locating suitable uses for by-products made from processing wastes. Initial fingerling feeding tests were made with four by-products as follows: silage with bones, silage without bones, catfish bone meal, and standard menhaden meal (control). Results were disappointing for the silage by-products. Digestible protein for these products was less than 30% apparently due to uncontrolled protein cleavage. Catfish fingerlings cannot utilize short-chain amino acids. Further work to define this problem has been initiated.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

005.033 CRIS0081712
CHANNEL CATFISH NUTRITION

WILSON R P; POE W E; BIOCHEMISTRY; MISSISSIPPI STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI. 39762.
Proj. No.: MIS-0844 Project Type: BATCH
Agency ID: CSRS Period: 01 OCT 80 To 30 SEP 85

OBJECTIVES: Determine the protein digestibility and amino acid availability in various foodstuffs for channel catfish and test these in least cost rations. Test various foodstuffs for potential antinutritional

factors for channel catfish. Determine the mineral requirements for channel catfish. Investigate various biochemical or metabolic parameters in the catfish as they may be influenced by diet of nutritional status.

APPROACH: The digestibility and availability studies will be conducted with 1.5 to 2 pound fish held in 300 gal raceways and fed the appropriate diet containing the test feed ingredient and 0.5% chromium oxide as an inert marker. Various least-cost formulas will be generated by the computer based on various nutritional restrictions and tested in 3-4 inch triplicate groups of catfish in 29 gal aquaria. The diets will be prepared with a pelleting machine to closely mimic commercially prepared rations. Growth and digestive enzyme studies will be conducted in 29 gal aquaria with 40-50gm catfish to assess the potential of antinutritional factors in various feed ingredients. The mineral requirement studies will be conducted utilizing the same or similar experimental design that was previously used to determine the amino acid requirements.

PROGRESS: 80/09 TO 80/12. The apparent and true amino acid availability values have been determined for the following feed ingredients commonly used in catfish feeds: corn, wheat middlings, rice bran, rice mill feed, soybean meal, peanut meal, cottonseed meal, meat and bone meal and menhaden fish meal. Fingerling channel catfish appear to be more sensitive to the antinutritional factors present in soybean meal than poultry. Studies are currently being conducted to determine the adverse effects of trypsin inhibitors and flavones in soybean meal on catfish. Also, studies have been initiated to determine the dietary requirements for Mg, Mn, Zn, Fe and Cu.

PUBLICATIONS: 80/09 TO 80/12
WILSON, R.P., ROBINSON, E.B. and POE, W.E. 1980. Amino Acid Supplementation of Practical Type Diets for Channel Catfish. Presented at the 9th Annual Fish Feed and Nutrition Workshop, Univ. of Washington, Seattle.
WILSON, E.P., POE, W.E. and ROBINSON, E.B. 1980. Apparent and True Amino Acid Availabilities of Common Feed Ingredients for Catfish Feeds. Presented at the 9th Annual Fish Feed and Nutrition Workshop, Univ. of Washington, Seattle.
WILSON, E.P., ROBINSON, E.B. and POE, W.E. 1980. Antinutritional Factors in Catfish Feeds. Presented at the 9th Annual Fish Feed and Nutrition Workshop, Univ. of Washington, Seattle

005.034* CRIS0071642
FRESHWATER FOOD ANIMALS

REAGEN R E; ROBINETTE B P; WILSON R P; WILDLIFE & FISHERIES SCI; MISSISSIPPI STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI. 39762.
Proj. No.: MIS-0819 Project Type: BATCH
Agency ID: CSRS Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and improve production and management system for freshwater animals cultured for food. Nutrition, genetics and breeding. Evaluate the economics of production processing and marketing of freshwater food animals. Develop and improve products and processing methods that will enhance marketability and insure quality of cultured freshwater food animals.

APPROACH: Project is multidisciplinary with Departments of Biochemistry, Horticulture, Agricultural Economics, and Wildlife and Fisheries. Least cost rations will be tested in aquaria and one-tenth acre ponds. Genetics parameters, heritability, and genetic correlations estimated for several traits with concurrent selection program. Amino acid requirements on quantitative basis and digestibility of common feed stuffs determined for catfish. Processing methods compared for dress out yield, with standard nutritional values of catfish flesh determined.

PROGRESS: 80/01 TO 80/12. Apparent and true amino acid availability values have been determined for the following feed ingredients commonly used in catfish feeds: corn, wheat middlings, rice bran, rice mill feed, soybean meal, peanut meal, cottonseed meal,

meat and bone meal, and menhaden fish meal. Fingerling channel catfish appear to be more sensitive to the antinutritional factors present in soybean meal than poultry. Studies are currently being conducted to determine the adverse effects of trypsin inhibitors and flavones in soybean meal on catfish. Duckweed (Family Lemnaceae) was incorporated at 15 and 20% into isocaloric diets formulated to meet or exceed nutritional requirements of channel catfish. Diets containing duckweed performed as well as the control. Cottonseed meal was incorporated into isocaloric diets at 5, 10, 15, 20, and 25% of the basal diet. Growth suppression of channel catfish was noted at the 20 and 25% cottonseed meal levels. The procedure for canning tuna-style channel catfish was refined, further data on heat-processing developed, and work was initiated on a consumer acceptance study. Selection of catfish for weight gain, gain in dress out percentage, and decreased percent fat with 25% for high selection and 25% low selection was completed. Fish will be mated at 2 years of age to decrease age at maturity. A Micro-computer program designed to provide information for Management decision-making has been developed. This system computes daily feeding rates by pond and projects feeding days to harvest.

PUBLICATIONS: 80/01 TO 80/12

- WILSON, R.F., ROBINSON, E.B. and POE, W.E. 1980. Amino Acid Supplementation of Practical Type Diets for Channel Catfish. Presented 9th Annual Fish Feed and Nutrition Workshop. Univ. of Washington, Seattle.
- WILSON, R.F., POE, W.E. and ROBINSON, E.B. 1980. Apparent and True Amino Acid Availabilities of Common Feed Ingredients for Catfish Feeds. Presented 9th Annual Fish Feed and Nutrition Workshop. Univ. of Washington, Seattle.
- WILSON, R.F., ROBINSON, E.B. and POE, W.E. 1980. Antinutritional Factors in Catfish Feeds. Presented 9th Annual Fish Feed and Nutrition Workshop. Univ. of Washington, Seattle.
- WALDROP, J.E. and SMITH, R.D. 1980. An Economic Analysis of Producing Pond-Raised Catfish for Food in Mississippi: A January 1980 Update. Dept. of Ag. Economics Research Report No. 103, July.

005.035

CRIS0083555

PRACTICAL FEED FORMULATIONS AND FEEDING PRACTICES FOR CATFISH FARMING IN MS

EUSCHER L; TUCKER C S; ROBINETTE B R; DELTA BEANCH EXPERIMENT STA; MISSISSIPPI STATE UNIVERSITY, STONEVILLE, MISSISSIPPI. 38776.

Proj. No.: MIS-0852

Project Type: GRANT

Agency ID: CSFS

Period: 18 FEB 81 To 28 FEB 83

OBJECTIVES: Evaluate the practical application of computer derived least cost ration formulations in catfish production ponds; compare experimental rations developed from the most current catfish nutrition information available to a standard commercial ration used throughout the industry; evaluate any effects of peanut meal as a feed ingredient on the shelf life of processed fish; evaluate diet formulation for winter feeding regimes in catfish production ponds.

APPROACH: Experimental rations will be formulated and compared to currently used commercial rations in both summer and winter feeding studies for channel catfish. Research will be conducted with both fingerling and market-size channel catfish cultured in .04/ha earthen ponds.

005.036

CRIS0073179

ANALYSIS OF THE MARKET POTENTIAL FOR FRESH WATER AQUACULTURAL PRODUCTS PRODUCED IN NEVADA

GARRETT J E; TAYLOR B L; AGRI & RESOURCE ECONOMICS; UNIVERSITY OF NEVADA, RENO, NEVADA. 89557.

Proj. No.: NEV00270

Project Type: PATCH

Agency ID: CSFS

Period: 01 JUL 77 To 30 SEP 80

OBJECTIVES: Determine the cost and availability of byproduct food stuffs for feeding catfish and shrimp in Nevada. Estimate the demand for catfish, shrimp and plants produced in fresh warm water ponds. Estimate the marketing margins for fresh water products and estimate marketing constraints placed on fresh water products by the institutional trade.

APPROACH: Availability and costs will be estimated for byproduct feeds which prove feasible as shrimp and catfish food in a large scale pilot production study. Nevada brokerage firms, and if necessary California processing firms, will be surveyed to ascertain the possibility of marketing live shrimp. These firms will also be interviewed to determine existing marketing margins for different types of products handled by these firms. A similar procedure will be followed for catfish and freshwater plants that might be complementary to shrimp and catfish.

PROGRESS: 77/01 TO 80/09. Budgetary analysis of production costs of freshwater shrimp produced in 10 one-acre plots reflect a cost of \$2.23 per lb. live weight at production levels experienced in the experiment. (About 2,000 lbs. per acre.) Increased feeding levels and other management practices could possibly raise production to 3,000 lbs. or even 4,000 lbs. per acre. Production costs for these levels were estimated to be \$1.60 and \$1.31 per lb., respectively. Four marketing alternatives were considered: whole live, whole fresh, fresh; headless and frozen headless. Processing costs for the first two alternatives were negligible, but both headless process required substantial capital investment and operating costs. Costs for processing 20,000 lbs. of live shrimp were \$7.79 for fresh headless and \$7.91 for frozen headless. Thus, at current production levels, total cost of producing fresh headless shrimp would be \$12.15 per lbs. Even doubling the production level to 40,000 lb. would only reduce the total cost per lb. of product to \$6.53--well above the current wholesale price of \$4.50. Production of live or fresh whole fresh-water shrimp does appear to be a viable pursuit for persons with a source of hot water providing they can develop a ready market for the product.

PUBLICATIONS: 77/01 TO 80/09

- CNYEAGBAKO, C. 1979. Marketing Alternatives of the Grant Malaysian Prawn (*Macrobrachium rosenbergii*), M.S. Thesis, University of Nevada-Reno.

005.037*

CRIS0065603

SALMON CULTURE - DEVELOPMENT OF NUTRITIONAL AND DISEASE CONTROL PROGRAMS

STROUT R G; ANIMAL SCIENCE; UNIVERSITY OF NEW HAMPSHIRE, DUBHAM, NEW HAMPSHIRE. 03824.

Proj. No.: NH00227-S

Project Type: STATE

Agency ID: SAES

Period: 01 JUL 73 To 30 SEP 78

OBJECTIVES: Determine protein level required for feeding at a constant calorie to protein ratio. Determine minimum level of fishmeal without reducing growth. Determine the critical nutrients supplied by fishmeal. Develop an effective autogenous polyvalent bacterin of *Vibrio anguillarum* that will withstand laboratory and field challenge.

APPROACH: Because basically the study involves calorie-protein ratios, initially protein levels will be studied at a constant calorie-protein ratio. Sources of protein will be investigated, particularly in an attempt to lower the quantity of fishmeal used, and to make use of cheaper protein sources. Diets will be studied in both fresh and saltwater rearing programs, and results will be evaluated primarily by growth and feed conversion. Control of vibriosis in sea water reared salmon will be attempted in 2 ways: immunization of the fish using an autogenous bacterin, and investigation of anti-biotic efficacy against *Vibrio anguillarum*. Killed bacterins will be administered parenterally or orally, and the immune response measured by challenge. Antibiotic activity,

screened initially in vitro, will be verified orally in vivo.

PROGRESS: 73/07 TO 78/09. Atlantic salmon (*Salmo salar*) were found to be as susceptible as coho salmon (*Oncorhynchus kisutch*) to Maine-New Hampshire strains of *Vibrio anguillarum* used in both injection and water transmission exposure. Exposure to $1-2.5 \times 10^5$ organisms/ml of one strain (569) in the water for 1 hr. killed fish of both species at 10°C and 15°C . Should similar water exposure conditions occur in Maine estuaries newly released Atlantic salmon smolts may encounter lethal levels of *V. anguillarum*. The organism causing bacterial kidney disease (BKD) in salmonid fishes is a slow growing gram positive rod (perhaps genus *Corynebacterium*) on laboratory media supplemented with cysteine. However, these bacteria grow readily in rainbow trout gonad (RTG-2) cell cultures, using Eagles Minimum Essential Medium Plus 10% newborn calf serum, without antibiotics. Cultures initiated from laboratory media or diseased fish kidneys grow equally well and in six days essentially cover the cell monolayer. No valid data were obtained from the feeding experiment this year because the stock was decimated by kidney disease. This disease is not uncommon in fish culture and unfortunately there is no known cure or effective treatment. Treatment with the antibiotic terramycin and with a greatly elevated level of vitamin C (1000 mg/kg) were without effect. *Vibrio* sp. was isolated from lobsters (*Homarus americanus*) reared in captivity.

PUBLICATIONS: 73/07 TO 78/09

STROUT, R. G., E. S. SAWYER AND B. COUTERMARSH.

1978. Pathogenic vibrios in confinement-reared and feral fishes of the Maine-New Hampshire coasts. *J. Fish. Res. Board Can.* 35:403-406.

SAWYER, E., R. G. STROUT AND B. COUTERMARSH. 1979. Pathogenic vibrios and comparative susceptibility of Atlantic salmon (*Salmo salar*) and Coho Salmon.

005.038

CRIS0075225

INTENSIVE CULTURE OF THE WALLEYE (PERCIDAE: STIZOSTEDION VITREUM)

NICKUM J G; NATURAL RESOURCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.

Proj. No.: NYC-147382

Project Type: STATE

Agency ID: SAES

Period: 01 JAN 78 To 31 DEC 80

OBJECTIVES: Develop started and production diets for walleyes based upon the nutrient content of walleye eggs and/or body tissues. Compare growth and survival of walleye fry and fingerlings fed experimental diets with growth and survival of fry and fingerlings fed live diets. Determine the combination of environmental conditions which obtains the highest survival and most rapid growth of walleye fry and fingerlings. Monitor any histological and/or chemical differences in the tissues of walleye fry and fingerlings reared on various diets. Evaluate the relative economic energy and nutrient efficiencies of intensive walleye culture versus extensive walleye culture.

APPROACH: Experimental diets will be developed in collaboration with the Tunison Laboratory of Fish Nutrition. All growth and survival tests will be conducted in triplicate in running water systems at temperatures between 10°C and 21°C . "Mini"-troughs of six-liter capacity will be used. Lots of 200 walleye fry or 30 walleye fingerlings will be used and feeding trials will be scheduled for 10 weeks. Fish will be fed at five minute intervals with automatic feeders. Five fish from each lot will be selected for histological and pathological analyses. Total costs in terms of nutrients, energy, and money will be determined and compared with those incurred in rearing walleyes under extensive conditions.

PROGRESS: 80/01 TO 80/12. Intensive culture of walleye through all stages of their early life history requires knowledge of the factors effecting the successful conversion of post hatch larvae to artificial or natural diets. Massive mortality of fry usually occurs as they fail to initiate feeding. This study has assessed the role of available energy in the yolk sac to larval development and the role of

feeding initiation in increased survival of fry in cylindrical rearing units. Caloric energy deficits occur in fry at 7 days (20°C) but no survival differences were detected in fish which initiated feeding at 2, 4, or 6 days of age. Death due to starvation occurred at 14 and 21 days for walleye fry held at 17 and 20°C respectively. Survival and growth of juvenile walleye were strongly influenced by the shape of the rearing unit and direction of water flow within the unit. Significantly better results were obtained in hatching jars with an upwelling flow of water in comparison to troughs. Better performance of the cylindrical units could be attributed to two factors: improved food suspension time and reduced competition for food.

PUBLICATIONS: 80/01 TO 80/12

CORAZZA, L. 1980. Intensive Culture of Walleye:

Factors Affecting the Ability of Juveniles to Utilize a Dry Diet. Ph.D. Thesis, Cornell Univ. 78 pp.

JAHNCKE, M. 1980. Selected Factors Influencing Mortality of Walleye Fry in Intensive Culture. M.S. Thesis, Cornell Univ. 45 pp.

005.039*

CRIS0074023

A COMPARISON OF THE ACCUMULATION RATES OF P ABSORBED BY THE VITAL ORGANS OF FISH

VICK A; BIOLOGY; AGRIC & TECH UNIVERSITY OF N C, GREENSBORO, NORTH CAROLINA. 27412.

Proj. No.: NC.X-PR-0006-20094

Project Type: GRANT

Agency ID: CSRS

Period: 26 SEP 77 To 25 SEP 82

OBJECTIVES: Note whether solid or dissolved forms of p^{32} in the medium vary in absorption rates of the material in the organs of fish determine the tolerance level of p^{32} in *Gambusia* during different seasons of the year.

APPROACH: Quantities of minnows will be collected periodically from nearby farms ponds and streams and maintained in aquaria for observation and study. Three ten gallon aquarium tanks will be filled with pond water from which the specimens are taken. The tanks will be labeled "experimental liquid" "experimental solid" "controlled". A daily record will be taken of the room temperature and temperature of each tank. Likewise, the daily pH for each tank and the concentration of p^{32} for the "experimental" and "solid" tanks. (Note: The concentrations of the liquids in these two tanks should be identical). An adequate quantity of specimens will be placed in each tank and at three day intervals. Ten specimens from each tank will be sacrificed and dissected to obtain such vital organs as the eye, brain, gills, heart, liver, skin, kidney, body muscle, gonad, and vertebrae. Each of these organs will be thoroughly dehydrated in a drying oven followed by pulverization. Small aliquot portions of each of the samples will be weighed and tested by the use of equipment manufactured by Searle Analytic, Inc.

PROGRESS: 80/03 TO 81/02. This is a summarized statement of the results of an investigation of a comparison of the accumulation rates of radioactive phosphorus absorbed by the vital organs of fish fed treated solid food to the rates of those imbibing the isotope dissolved directly in water. The experimental results obtained to date by the use of model 470 gas flow detector, model 1042 automatic sample changer and model 8703 decade scaler from Searle Analytic, Inc., are as follows: The kidney, heart, and liver respectively absorbed 1.3 times as much radiation as did similar organs of organisms absorbing the isotope dissolved directly in water; The brain, gonad, vertebrae and gills absorbed 1.4 times as much as did the respective organs of specimens receiving the dissolved form; The skin absorbed 1.5 times as much as its counterpart; The eye 1.6 times as much and the muscle 1.3 times the accumulation as its respective counterpart. Hence, on the basis of these results it may be concluded that it is well worthwhile to dissolve waste (32-P) before disposal.

PUBLICATIONS: 80/03 TO 81/02

VICK, A.E. 1978. A Comparison of the Accumulation Rates of Radioactive Phosphorus in Certain Vital Organs of Fish (*Gambusia affinis*): The Research Bulletin Series, Summer, North Carolina Agricultural and State University.

005.041

NUTRITION OF SALMONID FISHES

CRIS0010091

CRAWFORD D L; LAW D K; FOOD SCIENCE & TECHNOLOGY; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00826 Project Type: STATE
Agency ID: SAES Period: 20 JUL 66 To 31 DEC 80

005.040* CRIS0069960
BIOLOGICAL FEASIBILITY OF INTENSIFIED OYSTER CULTURE

BREESE W P; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00338 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 JUN 81

OBJECTIVES: Cut-bay culture will investigate the biological and economic feasibility of pond or raceway culture under controlled conditions. This will yield data on the influence of parameters such as water volumes, currents and seeding density on oyster growth. Efforts will also be made to correlate changes in available natural food, as measured by dissolved and particulate organic carbon and nitrogen, with changes in oyster growth. These studies may also encourage investors by demonstrating the reduced threat to culture facilities from floods, winds and storms.

APPROACH: Hatchery-produced seed oysters will be placed on the bottom of commercial oyster growing grounds, on oyster growing trays and on experimental rafts. The growth and survival of these oysters will be monitored over a two-year period beginning in the spring of 1975. These data will provide a means of evaluating the relative efficiency and productivity of the various culture methods. Concurrent with the placement of seed oysters in the field, oysters from the same brood group will be held in an existing out-bay rearing pond provided with pumped seawater. The growth and survival of these oysters will be monitored for comparison with other rearing methods. Refinement of the out-bay culture method will be a continuing process.

PROGRESS: 80/01 TO 80/12. Cultchless seed was again planted in Tillamook Bay. As we have had no ice or adverse weather to date, growth and survival data should be collected in the Spring of 1981. *Crassostrea rivularis* has been accepted by some of the growers and eyed larvae and seed are available from two commercial hatcheries. Monthly sampling of the Kumamoto oyster is complete. Three years of data shows this oyster to mature later in the year. As this oyster is a warm water spawner (25 degrees C), this data agrees with our laboratory data which says low temperature delays sexual maturation but does not affect the rate of maturation. For the second year we have successfully spawned this oyster in late summer. Eyed larvae as a seed source is gaining popularity. A failure of domestic wild seed has increased the interests in hatchery seed. Techniques for handling eyed larvae are being perfected. Four hatcheries are now producing eyed larvae for sale. Communication. Held a workshop in Astoria for Oregon and Washington growers to explain the eyed larvae technique for obtaining oyster seed. Visited the interested growers and helped them with the technique of setting eyed larvae.

PUBLICATIONS: 80/01 TO 80/12

LANNAN, J.E. 1980. Broodstock Management of *Crassostrea gigas* I. Genetic and Environmental Variation in the Larval Rearing System. *Aquaculture* 21:323-336.
LANNAN, J.E., ROBINSON, A.M. and BREESE, W.P. 1980. Broodstock Management of *Crassostrea gigas* II. Broodstock Conditioning to Maximize Larval Survival. *Aquaculture* 21:337-345.
LANNAN, J.E. 1980. Broodstock Management of *Crassostrea gigas* III. Selective Breeding for Improved Larval Survival. *Aquaculture* 21:347-351.
LANNAN, J.E. 1980. Broodstock Management of *Crassostrea gigas* IV. Inbreeding and Larval Survival. *Aquaculture* 21:353-356.
MURANAKA, M.S. 1980. Broodstock Management of the Pacific Oyster *Crassostrea gigas* (Thunberg), M.S. Thesis. Ore. State Univ., 55 pp.

OBJECTIVES: Investigate the fundamental nutrition of hatchery salmonids. Further develop and improve, both nutritionally and economically, the Oregon Moist Pellet. Develop a nutritionally adequate and physically available starter diet for young salmonids.

APPROACH: A completely purified diet for salmonid which will produce growth responses as good or better than the Oregon Moist Pellet (OMP) for investigation of the fundamental nutritional requirements of salmonids will be developed. Experiments will be conducted to expand the body of knowledge about the vitamin, mineral, amino acid, and fatty acid requirements of salmonids. The purified diet will be used to evaluate new, more nutritional and economical sources of protein for use in formulating the C.M.P. Modifications in the composition of the C.M.P. to enhance its manufacturing, feeding, and nutritional qualities will be investigated. Means of preserving the C.M.P. by methods other than freezing will be investigated. Basic methods of evaluating nutritive value and quality will be investigated to provide a more critical criteria for evaluating the quality of the OMP. A nutritionally sound and physically available starter diet for juvenile salmonids will be developed.

PROGRESS: 80/01 TO 80/12. Cooperative efforts with the Oregon Department of Fish and Wildlife accomplished research which supported improved production, cost and nutrition in the Oregon pellet feed system. Corn and soybean oil supplements were replaced with fish oil providing superior dietary fatty acids. Chemical indices for the quality of fish oil were correlated with growth. Efforts allowed the use of fillet carcass waste, hake and meals of anchovy, hake and menhaden providing flexibility to specifications. Evaluations of oil seed meals as substitutes for fish protein showed limitations related to availability and/or stress to body functions. Wet heat processing and/or enzymatic modification coupled with dietary mineral and amino acid supplementation failed to improve availability. A phosphoric acid-potassium sorbate stabilization system was developed for wet fish components reducing storage costs. The relationship between dietary ascorbic acid and destruction (production and storage) to body status was estimated. Protected sources of ascorbic acid at appropriate levels were evaluated for the feed system. Fish protein and fat energy levels required for optimum growth in warm and cold water conditions were determined. Two high quality ration concepts based on fish meal, poultry by-product meal and fish press cake were developed and evaluated (laboratory and hatchery scale) to enhance fish survival.

PUBLICATIONS: 80/01 TO 80/12

CRAWFORD, D.L. and LAW, D.K. 1972. Mineral Composition of Oregon Pellet Production Formulations. *The Prog. Fish-Cult.* 34(3):126-129.
CRAWFORD, D.L., LAW, D.K., MCKEE, T.B. and WESTGATE, J.W. 1973. Storage and Nutritional Characteristics of Modified Oregon Moist Rations as an Intermediate-moisture Product. *The Prog. Fish-Cult.* 35(1):33-38.
CRAWFORD, D.L., LAW, D.K., MCKEE, T.B. and WESTGATE, J.W. 1974. Nutritional Characteristics of Oregon Pellet Rations Containing Meals of Different Fish Species. *The Prog. Fish-Cult.* 36(1):3-7.
WESTGATE, J.W., MCKEE, T.B., CRAWFORD, D.L. and LAW, D.K. 1976. Nutritional Effects of Using "Salty" Herring Meal in Oregon Moist Pellets. *The Prog. Fish-Cult.* 38(2):118-119.

005.042 CRIS0078971
USE OF NUTRIENT CONTAINING LIPID VESICLES AS A FOOD
SOURCE FOR SHELLFISH OF PACIFIC NORTHWEST

SELIVONCHICK D P; FOOD SCIENCE & TECHNOLOGY; OREGON
STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE06417 Project Type: HATCH
Agency ID: CSRS Period: 09 MAY 79 To 08 MAY 82

OBJECTIVES: Determine the feasibility of using lipid vesicles (liposomes) for feeding juvenile Pacific oysters in culture. Make comparisons between the digestion of live algae and lipid vesicles. Determine the potential to use lipid vesicles as a means of studying nutritional requirements in oysters. Determine the applicability of the lipid vesicle ration to other suspension feeders, i.e. crabs and shrimp. Determine the feasibility of applying this artificial ration to the study of food chain relationships and environmental toxicants.

APPROACH: Lipid vesicles containing amino acids will be prepared for egg-lecithin and fed to juvenile Pacific oysters in an artificial system. Acceptance and digestion of the vesicles and its contents will be monitored by radiotracer techniques. Growth and development of the oysters fed the liposomal diet will be monitored by radiotracer techniques. Growth and development of the oysters fed the liposomal diet will also be compared to oysters on live food sources. These data should provide information in order to determine the feasibility of using lipid vesicles for growing shellfish in intensive culture systems.

PROGRESS: 80/01 TO 80/12. The ingestion, uptake and metabolism of liposomes by juvenile Pacific oysters (*Crassostrea gigas*) were studied by several methods in an effort to assess their potential as encapsulating agents. Liposomes composed of egg phosphatidylcholine-cholesterol-sterylamine (7:1:2) formed readily and appeared stable in 20⁰/00 seawater. Radiotracer studies with liposomes made with [¹⁴C]-labelled cholesterol or [¹⁴C]-phosphatidylcholine showed substantial uptake of the label throughout the oyster with a high level of label found in the epithelial cells of ducts and tubules of the digestive diverticula from animals fed [¹⁴C]-labelled phosphatidylcholine. To examine metabolism of liposome encapsulated substances, [¹⁴C]-glucose and [¹⁴C]-amino acids were entrapped and fed to oysters. Label from glucose appeared largely in a chloroform-methanol insoluble fraction, while most label from amino acids were recovered in trichloroacetic acid-precipitable protein. Further evidence for intracellular uptake of liposomes were obtained with fluorescence microscopy after feeding oysters liposomes containing bovine serum albumin conjugated with fluorescein isothiocyanate. The ingestion, intracellular uptake, and breakdown of liposomes and their contents indicate a use for these particles in studies of nutrition or pollutant-food web relationships in bivalve molluscs or other filter-feeding organisms.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

005.043 CRIS0064572
OPERATION AND MAINTENANCE OF THE BEPACMA LABORATORY

SINNHUBER R C; FOOD SCIENCE & TECHNOLOGY; OREGON
STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00233 Project Type: STATE
Agency ID: SAES Period: 01 JUL 72 To 01 JAN 99

OBJECTIVES: Provide for the operation and maintenance of the Food Toxicology and Nutrition Laboratory at Corvallis, Oregon.

APPROACH: The Food Toxicology and Nutrition Laboratory provides unique research facilities for conducting experiments in food toxicology and nutrition using rainbow trout and other salmonids as experimental animals. This laboratory provides opportunities for basic and applied research in protecting man's food supply and understanding his nutritional requirements.

PROGRESS: 79/01 TO 79/12. Service Project -- no report required.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

005.044 CRIS0066726
UTILIZATION OF PROTEIN INGREDIENTS IN FISH RATIONS

YU T C; SINNHUBER R O; FOOD SCIENCE & TECHNOLOGY;
OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00195 Project Type: HATCH
Agency ID: CSRS Period: 17 OCT 74 To 31 DEC 82

OBJECTIVES: Feasibility of reducing consumption of fish meal and other animal protein ingredients in fish rations by Utilization of new and/or little used proteins to replace fish meal and other animal proteins in fish rations, maximum use of dietary lipids and carbohydrates to spare protein and satisfy the energy requirements of fish.

APPROACH: Algae, fungal, and leaf proteins will be obtained. Treatments, if needed, will be conducted to inactivate undesirable ingredients, feeding experiments with rations containing these proteins will be conducted. Fish weight gain, mortality, feed conversion and protein efficiency ratio (PER) will be calculated. Different levels of marine lipids and animal fats will be incorporated in fish rations to supply adequate quantities of omega 3 fatty acids and energy for fish. Utilization of carbohydrate for energy will be determined. The minimum and optimum levels of protein in rations containing varying levels of lipid and carbohydrates will be determined.

PROGRESS: 80/01 TO 80/12. A trout feeding experiment was conducted to study the nutritional quality of plant proteins when used for partial replacement of the expensive animal proteins in fish diets. Several soybean products were evaluated. These were two samples of soy protein isolates (82% protein), tempeh, a fermented soybean product, extracted tempeh (about 70% of fat removed), cooked soybean, unfermented. Eight test diets were prepared using these proteins to replace 22 to 44% of animal protein in fish diets. Each test diet was fed to duplicate groups of rainbow trout for 14 weeks. The results indicated that replacing 22% of dietary animal protein by soy protein isolates did not reduce the growth rate of fish. However, replacement of 33 and 44% significantly reduced the fish growth. Trout reluctantly accepted the diet containing 22% protein from cooked soybean. Fermentation of the same soybean by *Rhizopus oligosporus* removed the grassy taste and improved the acceptability of the diet and the fish growth was significantly greater than that of the unfermented soybean diet. Calculation of the feed efficiency (fish wt. gain/wt. of dry feed consumed) showed that the all animal protein control diet was 1.20; diets containing 22% protein isolates 1.15 and 1.17; extracted tempeh diet 1.03; unextracted tempeh 0.99; 33 and 44% soy protein isolates diets 1.00 and the unfermented soybean 0.99. Fish mortality was low (0.5-3.0%).

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

005.045* CRIS0076533
FRESHWATER FOOD ANIMALS

MCGINTY A S; ANIMAL INDUSTRY; UNIVERSITY OF PUERTO
RICO, RIO PIEDEAS, PUERTO RICO. 00928.
Proj. No.: PR00322 Project Type: HATCH
Agency ID: CSES Period: 14 SEP 78 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals cultured for food: Nutrition, genetics and breeding and culture systems.

APPROACH: Experiments will be designed to determine practical feeds for *Tilapia* spp. under tropical conditions. Digestibility coefficients for these diets will be determined for each species.

Development and evaluations of suitable breeding and sexing techniques for mass production of Tilapia species and monosex hybrids. Determine optimum stocking densities and growth of Tilapia spp. in cage cultures and ponds utilizing supplementary feeding and/or pond fertilization. Flavor and texture of the fish (fresh and processed) will be determined by organoleptic tests.

PROGRESS: 80/01 TO 80/12. Six 1 m³ floating cages were suspended in three 0.1 ha ponds and stocked with either 150, 300, 450, or 650 Tilapia nilotica fingerlings (75 to 125 mm/long) per cage. At least one of these densities was either fed a 30% protein sinking pellet at a rate of 4% total body weight daily, six days per week, or not fed. This preliminary study was conducted for 77 days at which time the fish from each cage were weighed and measured. Fish that were not fed merely maintained their initial stocking weight, regardless of density. Fish fed 4% daily gained 0.77, 0.70, 0.59, and 0.53 g/day in cages stocked with 150, 300, 450, and 600 fish/cage, respectively. This indicated T. nilotica fed a complete ration grew at a slower rate in cages when stocked at higher densities. The above preliminary study indicates the need to determine the optimum stocking density of T. nilotica in cages. The effects of pond size may also be important and needs to be studied in conjunction with density. An experiment will be conducted during 1981 to determine these effects. Cages will be suspended in ponds of either 0.70 ha or 0.16 ha and stocked with either 250, 500, 750, or 1000 fingerlings/cage. All fishes will be fed an equal percentage of the total body weight per cage.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

005.046 CRIS0066637
THE TREATMENT AND USE OF WASTE PRODUCTS AND CHEMICALS
IN THE DIET OF AQUATIC ANIMALS

SIMPSON K L; LEE T C; CHICHESTER; FOOD & RESOURCE
CHEMISTRY; UNIVERSITY OF RHODE ISLAND, KINGSTON,
RHODE ISLAND. 02881.

Proj. No.: R100015 Project Type: HATCH
Agency ID: CSRS Period: 03 OCT 74 To 30 SEP 80

OBJECTIVES: Feed crab waste & evaluate it as a feed supplement for trout & salmon. Experiment with microwave energy as an alternate method of cooking crab sections. Utilization of the waste product will determine the value of the process to the producer. We propose to synthesize epoxy canthaxanthin & determine the effect of these alkylating agents on trout. Evaluate citrus peels that have been processed as a feed supplement to some aquatic animals.

APPROACH: Diets for trout & salmon have been developed & in some cases commercial rations are available. The materials to be tested will either be adsorbed on prepared diets or incorporated into defined diets. Where the best diet is at present unknown the effect of various test diets will have to be determined by looking at growth rate & the condition of various organs. An attempt will be made to determine the point of deposition of various compounds that are added. Fish necropsy will be performed to determine abnormal effects particularly with the addition of epoxy canthaxanthin. Microwave energy cooking & thawing will be used as an alternative means of processing crab. The waste material from this will be compared with conventionally cooked material.

PROGRESS: 74/10 TO 80/09. The deposition of carotenoid pigments was studied in the freshwater prawn with and without eyestalk ablation. Ablated prawn fed a pigmented diet showed a significant increase in pigmentation over the nonablated controls fed pigmented diets. The major pigment in the flower Adonis aestivalis was proved to be astaxanthin diester. The diester was completely characterized to the SS' chiral form. The whole flower fed to rainbow trout proved to be toxic but an extract showed good pigmentation. Fatty acid analysis proved that the ester is hydrolyzed and resynthesized in the trout

skin. Adonis flowers represent the only plant source of the salmon pigment. In an effort to assess the cause of some brine shrimp supporting growth and survival of larval fish, Artemia were contaminated with environmental levels of dieldrin and dieldrin. These Artemia were fed to winter flounder. No mortalities were observed but lower growth was noted. Some increased lipid metabolism was seen and some metabolism of the chlorinated hydrocarbons was suggested.

PUBLICATIONS: 74/10 TO 80/09

SCHAUER, P.S., JOHNS, D.M., OLNEY, E.B. and SIMPSON, K.L. 1980. Lipid Level, Energy Content and Fatty Acid Composition of Newly Hatched Nauplii. In: The Brine Shrimp Artemia. Eds., Persoone, G. et al., Universa Press, Wetteren

SEIDE L, C.R., KRYZNOWEK, J. and SIMPSON, K.L. 1980. Amino Acid Composition and Electrophoretic Protein Patterns of Artemia. In: The Brine Shrimp Artemia. Eds. P. Persoone, G., et al., Universa Press, Wetteren (Belgium). 2:375-382.

SOEJIMA, T., KATAYAMA, T. and SIMPSON, K.L. 1980. Carotenoid Composition of Seven Geographical Strains of Artemia. In: The Brine Shrimp Artemia. Eds. Persoone, et al., Universa Press, Wetteren (Belgium). 2:613-622.

MCLEAN, S. 1980. Effects of Cis-chlordane and Dieldrin on the Short Food Chain Artemia to Winter Flounder. M.S. Thesis, University of Rhode Island.

005.047 CRIS0082925
EFFECT OF DIET QUALITY ON AQUATIC ANIMALS

SIMPSON K L; OLNEY C E; FOOD SCIENCE & TECHNOLOGY;
UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND.
02881.

Proj. No.: R100021 Project Type: HATCH
Agency ID: CSRS Period: 01 NOV 80 To 30 SEP 83

OBJECTIVES: Assess the effect of temporal and sampling site variations on the chlorinated hydrocarbons, fatty acids and protein electrophoretic patterns of Artemia from the San Francisco/San Pablo Bays. Assess the variation within commercial lots of Artemia. Develop Artemia as a vehicle to deliver specific nutritional components and/or contaminants to pre- and post-metamorphosed winter flounder. Determine the individual and combined effects of cis-chlordane, dieldrin and long chain fatty acids on growth and survival of winter flounder fed Artemia. Verify a method of "fingerprinting" Artemia populations by isoelectric focusing. Develop and test new sources of astaxanthin for salmonid and crustacean culture.

APPROACH: Artemia from commercial and personal collections will be typed by published & developed procedures for fatty acids, pesticides and electrophoretic patterns GLC/integrators and isoelectric focus equipment will be used. Astaxanthin ester from Adonis flowers will be fed to trout and the color and toxicity if any noted Artemia with specific levels chlorination hydrocarbons and fatty acids will be fed to winter flounder larva.

005.048* CRIS0071761
FRESHWATER FOOD ANIMALS

FOLTZ J W; EVERSOLE A G; FOLTZ J W; ENTOMOLOGY &
ECONOMIC ZOOLOGY; CLEMSON UNIVERSITY, CLEMSON, SOUTH
CAROLINA. 29631.

Proj. No.: SC00241 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals cultured for food. Nutrition, water quality, diseases and culture systems. Evaluate the economics of production processing and marketing of freshwater food animals.

APPROACH: Parasites, nutrition and growth of American eels will be investigated in natural and cultured populations. Tolerance of eels to chemicals commonly used in fish culture will be studied. Nutritional requirements and growth of tilapia and basses will be investigated by feeding diets containing varying percentages of protein and different amino acid mixtures. Effects of waterborne quantities of insecticides (Mirex) on production of freshwater prawns will also be investigated. Economics of a state-operated hatchery for *Macrobrachium rosenbergii* will be investigated. Cooperative involvement in freshwater shrimp culture is not anticipated in South Carolina, but a cottage industry may be assisted by receiving post larvae or juveniles from the state.

PROGRESS: 80/01 TO 80/12. A feeding regime for channel catfish, which takes into account water temperature and body size was tested again during 1980. Results described herein represent data from 1571 channel catfish weighed individually. Average final weight after 174 feeding days was 280 g, representing a 270 g net gain. Conversion (5) averaged 1.20. Catfish continued to feed regularly until harvest, at which time water temperature was 10 degrees C. Final weights and conversions observed in this study represent substantial improvements over previously reported values. The assumption of linearity in daily growth in length was tested in a separate experiment. When water temperature exceeds 25 C, daily growth is essentially linear, averaging 1.27 mm/day (0.05 in/day). Work on the identification and confirmation of parasites found on 21 7 subadult American eels (*Anguilla rostrata*) trapped in Cooper River, S.C. is continuing. New host records were identified for the protozoan *Trypanosoma granulosum*; monogenean *Cyrodactylus anguillae*; trematodes *Stephanostomum imparaspine*, *Opecoeloides fibriatus* and *O. vitellosus*; cestode, *Bothrimonus sturionus*; and crustacean *Ergasilus cerastes*. New distribution records for parasites found in the southeastern region of United States include the protozoans *T. granulosum* and *Myxidium giardi*; monogenean *G. anguillae*; cestode *B. sturionus*; acanthocephalan *Fessisentis iriedi* and crustacean *E. celestis*

PUBLICATIONS: 80/01 TO 80/12

HINTON, M.J. and EVERSOLE, A.G. 1980. Toxicity and Tolerance Studies with Yellow-phase Eels: Five Chemicals. *Prog. Fish-Cult.* 42(4):201-203.
HANSEN, R.A. 1979. Age, Growth, and Sex Ratio of the American Eel, *Anguilla rostrata* (LeSueur), in Brackish Water Portions of Cooper River, South Carolina. M.S. Thesis. Clemson Univ., Clemson, South Carolina, 45 pp.

005.049 CRIS0081599
SOUTH DAKOTA FARM AND RANGE FISHERIES

SCALET C G; MODDE T C; WILDLIFE & FISHERIES SCI; S DAKOTA STATE UNIVERSITY, BROOKINGS, SOUTH DAKOTA. 57007.
Proj. No.: SD00300 Project Type: HATCH
Agency ID: CSRS Period: 01 JUN 80 To 30 JUN 83

OBJECTIVES: determine the feasibility of culturing annual crops of channel catfish and rainbow trout in eastern South Dakota dugouts; determine the forage species which produce the greatest growth rates and harvestable biomass of largemouth bass in South Dakota ponds and determine the panfish species which, when stocked with largemouth bass, is least susceptible to overpopulation.

APPROACH: Ponds and dugouts will be stocked with a variety of fish species. Stocking rates, fish species, artificial feeding and other variables will be utilized to ascertain both sport and commercial value of selected South Dakota pondfish populations.

PROGRESS: 80/06 TO 80/12. Sixteen dugout ponds in eastcentral South Dakota were stocked with fingerling channel catfish (*Ictalurus punctatus*) at stocking rates of 309, 618, 1235, and 1853/ha. After one growing season average weights for catfish at the various stocking rates were 180, 193, 173, and 105 g, respectively. Survival rates were 54, 34, 66, and 51%. Taste tests resulted in all fish rating as fair

or better. Twenty-one dugouts were stocked with rainbow trout (*Salmo gairdneri*) at stocking rates of 200, 400, 600, 800/ha. Survival rates for the whole growing season were poor, however, growth and survival for approximately the first 2 months of the study were excellent. Average length for the initial 2 month period was 188 mm (135-239 mm range); average weight was 79 g (27-170 g range). A taste panel rated all but one group of fish as at least fair to good. Analysis of data concerning the stocking of 80 South Dakota ponds with a number of different species compositions is being completed. Initial results indicate significant differences in first year growth of largemouth bass (*Micropterus salmoides*) and black bullheads (*I. melus*) between southern and northern quadrats. No difference in the first year growth rates of largemouth bass were observed among stocking combinations. First year survival of game species was 67.5% for black bullheads, 50.8% for largemouth bass, and 28.7% for bluegill (*Lepomis macrochirus*).

PUBLICATIONS: 80/06 TO 80/12

MODDE, T.C. 1980. Evaluation of Fish Stocking Combinations in South Dakota Ponds. South Dakota Dept. Game, Fish and Parks. *Prog. Rept.* 80-9. 22 pp.
MODDE, T.C. 1980. State Stocking Policies for Small Warmwater Impoundments. *Fisheries* 5:13-17.
MODDE, T.C. and STONE, C.C. 1980. Growth and Biomass of Largemouth Bass (*Micropterus salmoides*) in a Western South Dakota Stock Pond. *Proc. S.D. Acad. Sci.* 59:138-146.
SCALET, C.G. 1980. Endangered and Threatened Fishes of South Dakota. South Dakota State Univ. *Coop. Ext. Serv.* ESS 27E. 7 pp.

005.050* CRIS0028152
FISHERIES UNIT

APPLGATE R L; WILDLIFE MANAGEMENT; S DAKOTA STATE UNIVERSITY, BROOKINGS, SOUTH DAKOTA. 57007.
Proj. No.: SD00914 Project Type: STATE
Agency ID: SAES Period: 17 JAN 67 To 01 JAN 99

OBJECTIVES: Research various problems of fish and aquatic habitats in South Dakota.

APPROACH: Partial contribution by University to M/U between U and Cooperative Fishery Unit between U. S. Sport Fisheries and Wildlife and S. D. Department of Game, Fish, & Parks. Work program varies according to the annual agreement of the coordinating committee.

PROGRESS: 80/01 TO 80/12. The study concerning fish interactions in a power plant cooling reservoir continued. The estimated standing crop of the 4 major forage fish species was 28.1 kg/ha. The forage fish population was dominated by age-groups I and II. Impingement of forage fishes was primarily restricted to young-of-the-year and highest impingement rates usually occurred in the evening. Muskellunge (*Esox masquinongy*) were most vulnerable to impingement during the first 2 months after their introduction. The growth rate of muskellunge in the reservoir (Age-II, 753 mm average; Age-I, 465 mm average) was higher than all reports for this species in North America. Alimentary canal development of muskellunge was studied with relation to invertebrate food sources. The most selected for food organism during both day and night was *Moina brachiata*. *Cyclops vernalis* was also selected for during night. Muskellunge selected against *Asplanchna sieboldi*, *Potamocypis* sp., and *Daphnia* sp. Food organisms collected from the foregut of fry collected at 2300 hours were significantly larger, but not more numerous, than those in the foregut of fry collected at 1300 hours. As the fry grew and the mouth diameter increased, the sizes of food organisms increased. Fry initially selected for the first and second instars of *M. brachiata* and against the later instars and adults; by day 23 they selected for adults and against immature instars.

PUBLICATIONS: 80/01 TO 80/12

BENDA, R.S. 1978. Analysis of Catch Data for 1968 Through 1976 for Nine Fish Landings in Kenya Waters of Lake Victoria. J. Fish Biol. 15:385-387.

BENDA, R.S. 1979. Occurrence of *Argulus appendiculatus* Wilson, 1907 (Branchiura) in Indiana. Indiana Acad. Sci. 89:344.

ROSEN, R.A. and BALES, D.C. 1980. Occurrence of Scarred Fiddlefish in the Missouri River, South Dakota-Nehraska. Prog. Fish-Cult. 40(2):82-85.

WABL, J.F. 1980. Forage Fish Populations and Growth of Muskellunge in a South Dakota Power Plant Cooling Reservoir. M.S. Thesis. South Dakota State University, Brookings. 71 p.

SLOANE, G.E. 1980. Macroscopic Benthos Populations in a South Dakota Power Plant Cooling Reservoir. M.S. Thesis. South Dakota State University, Brookings. 67 p.

culture.

APPROACH: Shrimp reproduction of natural populations will be biochemically and nutritionally characterized. Nutritional, environmental and cultural requirements for reproduction in captivity will be studied. By comparing reproduction obtained in captivity to baseline reproductive data from natural populations and evaluating laboratory experiments, the understanding of reproduction and basis for reproduction in captivity will be obtained. Shrimp nutrition will be evaluated by determining food conversion ratios, % assimilation values, growth rates, % mortalities, organ indices and biochemical changes to different dried prepared foods. Improvement of shrimp production from intensive (tank) and extensive (pond) culture will be from nutritional, salinity, temperature and polyculture studies.

PROGRESS: 80/01 TO 80/12. General objective of this project is to obtain technology with knowledge and understanding of basic biological principles necessary to establish shrimp mariculture as a new agricultural crop in Texas. Accomplishments for last year were: Construction of maturation/reproduction facility at Corpus Christi; Maturation with spawning of fertile eggs of three species of marine shrimp, *Penaeus vannamei*, *P. stylirostris* and *P. setiferus*; Evaluation of lipid requirement in marine shrimp maturation/reproduction; Seedstock supply of marine shrimp is most limiting to establishment of shrimp mariculture in Texas. The preceding represent significant steps in removing this obstacle. Overwintering of broodstock in ponds receiving heated effluent. Overwintering of broodstock is a necessity for a guaranteed source of seedstock and future genetic/domestication studies. Determination of chill tolerance of brine shrimp larvae and importance of cryoprotectants and viability of marine shrimp frozen to -16 degrees C. The preceding represents a step toward cryopreservation of marine shrimp seedstock which will be required to guarantee seedstock supply at minimum cost. Determination of osmoregulation of juvenile and mature marine shrimp. Knowledge of osmoregulatory ability of marine shrimp is needed since sea water along Texas coast is variable.

PUBLICATIONS: 80/01 TO 80/12
MIDDLEBITCH, B.S., MISSLER, S.R., HINES, B.B., MCVEY, J.P., BROWN, A., WARD, D.G. and LAWRENCE, A.L. 1980. Metabolic Profiles of Penaeid Shrimp: Dietary Lipids and Ovarian Maturation. Journal of Chromatography, 195:359-368
BAUST, J.G. and LAWRENCE, A.L. 1980. Ontogenetic Variability of Chill Tolerance in Larval *Artemia salina* II. Single Type Cryoprotectants. Aquaculture, 20:305-311.
BAUST, J.G. and LAWRENCE, A.L. 1980. Ontogenetic Variability of Chill Tolerance in Larval *Artemia salina* I. Dual Type Cryoprotectants. Aquaculture, 20:313-321.
CASTILLE JR., F.L. and LAWRENCE, A.L. 1980. The Effect of Salinity on the Osmotic, Sodium and Chloride Concentrations in the Beroymph of the Euryhaline Shrimp of the Genus *Penaeus*. Comparative Biochemistry and Physiology.

005.051*

CRIS0071695

FRESHWATER FISH ANIMALS

WILSON J L; FORESTRY & WILDLIFE; UNIVERSITY OF TENNESSEE, KNOXVILLE, TENNESSEE. 37916.
Proj. No.: TEN00491 Project Type: HATCH
Agency ID: CERS Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for Freshwater animals cultured for food.

APPROACH: Standard methods will be employed to determine the effects of steroids and selected marking techniques (branding, tagging, multilocation) on survival and growth of catfish. Polycultural methods using food fishes such as catfish, sunfish hybrids, etc., will be compared to monocultural practices as relating to growth and total production.

PROGRESS: 80/01 TO 80/12. Experimentation evaluating the feasibility of polyculturing channel catfish and tilapia in a high-density, flow-through system was completed. Growth and condition of catfish were significantly reduced in all polyculture treatments as compared to monoculture treatment. Correlation of species densities (3:1, 6:1, 12:1 tilapia/catfish) and growth of catfish resulted in a significant negative relationship. Tilapia growth and condition were unaffected except at the highest stocking density. Water quality parameters were similar between the treatments, except for dissolved oxygen levels which at times were lower in the polyculture treatments. A tetracycline-resistant strain of *Edwardsiella tarda* was isolated from infected fish; this is the first report of this strain in channel catfish. Preliminary work was restricted to examine the feasibility of using freshwater mussels as a food source. Replicate samples using the washboard variety of mussel are being examined for composition, microbial profile, and quality of surrounding water.

PUBLICATIONS: 80/01 TO 80/12

BILTON, R. and WILSON, J.L. 1980. Tetracycline-resistant *Edwardsiella tarda* in Channel Catfish. Prog. Fish Culturist 42(3):159.
BILTON, R. 1980. Effects of Tilapia Densities on Growth of Channel Catfish in Flow-through Polyculture. M.S. Thesis, 29 pp. The University of Tennessee, Knoxville.

005.052

CRIS0080188

SHRIMP MATURATION, REPRODUCTION, DEVELOPMENT, NUTRITION, INTENSIVE-EXTENSIVE CULTURE AND MARICULTURE

LAWRENCE A; TEXAS A&M UNIVERSITY, CORPUS CHRISTI, TEXAS. 78406.
Proj. No.: TEX06325 Project Type: STATE
Agency ID: SAES Period: 01 OCT 79 To 30 SEP 83

OBJECTIVES: Obtain basic and applied knowledge required for development of penaeid shrimp mariculture as a successful industry. This includes reproduction in captivity, development of satisfactory dried prepared feeds and improvement of shrimp production from intensive and extensive

005.053

CRIS0060713

LIPID METABOLISM IN AQUATIC ORGANISMS

BOTTINO R R; BIOCHEMISTRY & BIOPHYSICS; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX01926 Project Type: STATE
Agency ID: SAES Period: 01 SEP 71 To 31 MAY 81

OBJECTIVES: Characterize the fatty acyl lipids of various trophic levels in open waters in the proximity and under the Ross Ice Shelf. Evaluate the transfer of lipids through these trophic levels. Characterize the influence of a reduced degree of illumination on the polyunsaturated fatty acid content of the lipids of various trophic levels.

APPROACH: Various experiments are proposed to study the metabolism of lipids in aquatic organisms and its application to improve the quality of these aquatic products as human food. Various fatty acid mixtures will be fed to shrimp and the growth rate determined. Seasonal variations in the sterol composition of shrimp from the Gulf of Mexico will be characterized. Groups of *Tilapia aurea* will be fed different diets and the degree of fat production will be determined, and Marine invertebrates will be grown in the presence of inorganic selenium and the incorporation of the element will be followed. Furthermore, the selenium-compounds formed will be characterized.

PROGRESS: 80/01 TO 81/05. Studies were continued on basic and applied aspects of the metabolism of lipids (fats) and selenium in aquatic organisms. The sterols of Gulf of Mexico shrimp (white and brown shrimps) were analyzed; were 90 to 85% cholesterol plus small amounts (1 to 2% each) of other components. The level of cholesterol in shrimp muscle was about 1 g per 100 g. About 90% of the cholesterol was free, the rest being cholesterol esters. No major differences were detected between the two species of shrimp that were studied. *Tilapia aurea* is a freshwater fish that is becoming very popular among aquaculturists. Our studies on this advanced significantly when we were able to adapt recently developed methods to the isolation of *Tilapia* liver mitochondria. These studies will be subject of a future publication. Work on the physiological and toxicological effects of selenium in a algae continued vigorously. We are in the process of analyzing the selenium-containing gases (probably selenides) exhaled by various algae. Furthermore, we have analyzed the biochemical components of various algae after their exposure to selenium and found selenium in amino acids, proteins, carbohydrates and lipids in decreasing order. These and experiments with radiolabeled selenium indicate that selenium is incorporated into the algal cells and also that selenium as selenite is much better incorporated than selenium as selenate.

PUBLICATIONS: 80/01 TO 81/05

HOTTINO, N.E., GENNITY, J., LILLY, L.M., SIMMONS, E. and FINNE, G. 1980. Seasonal and Nutritional effects of the fatty acids of three species of shrimp, *Penaeus setiferus*, *P. aztecus*, and *P. duorarum*. *Aquaculture* 19:139.

005.054*

FRESHWATER FOOD ANIMALS

CEIS0061207

STICKNEY R B; STRAWN K; COBB B E; WILDLIFE & FISHERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.

Proj. No.: TEX02831 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals cultured for food, including: Nutrition, genetics and breeding, water quality, diseases, and culture systems. Develop and improve products and processing methods that will enhance marketability and insure quality of cultured freshwater food animals.

APPROACH: Various methods will be utilized to meet the objectives of the overall S-38 project in the several cooperating institutions. The thrust of the Texas Agricultural Experiment Station will be on channel catfish, *Tilapia* and freshwater shrimp, with emphasis being placed on objectives I above, especially nutrition, water quality and culture systems.

PROGRESS: 80/01 TO 80/12. Lipid energy requirements of channel catfish fry were evaluated with semipurified diets over the period from onset of feeding until the fish reached several grams in weight. The data obtained will be utilized to aid in the preparation of fry feeds specifically developed for channel catfish. It is anticipated that the protein: energy ratio will be adjusted as food particle size is increased during the initial year of life. Semipurified diets with varying lipid sources and percentages revealed no significant differences in channel catfish fingerling growth over the lipid

range from 6 to 14% at a mean temperature of 22 degrees C, though fish fed 10% lipid were slightly larger in mean size at the end of the 20 week experiment. Fatty acid composition revealed that there were no significantly different patterns among diets with the same lipid source, but there were differences among lipid sources with respect to final fatty acid composition. Polyculture studies with freshwater shrimp and *tilapia* revealed some depressed growth when the two were stocked together, but in general, feeding on the basis of estimated fish biomass will yield a secondary shrimp crop, without the need to provide shrimp feed. Overwintering of large numbers of *tilapia* is being conducted to determine if the technique is feasible for use in central Texas and to provide fish for a study of second year growth potential of this fish. Plastic and fiberglass covered ponds as well as indoor overwintering facilities are being compared.

PUBLICATIONS: 80/01 TO 80/12

BENDERSOHN-ARZAPALO, A., STICKNEY, R.B. and LEWIS, D.B. 1980. Immune Hypersensitivity in Intensively Cultured *Tilapia* Species. *Trans. Am. Fish. Soc.* 109:244-247.

YINGST III, W.L. and STICKNEY, R.B. 1980. Growth and Survival of Caged Channel Catfish (*Ictalurus punctatus*) fingerlings on Diets Containing Various Lipids. *Prog. Fish-Cult.* 42:24-26.

BURNS, R.P. and STICKNEY, R.B. 1980. Growth of *Tilapia aurea* in Ponds Receiving Poultry Wastes. *Aquaculture* 20:117-121.

CUENCO, M.L. and STICKNEY, R.B. 1980. Reliability of an Electrode and a Water Analysis Kit for Determination of Ammonia in Aquaculture Systems. *Trans. Am. Fish. Soc.* 109:571-576

MCGEACHIN, R.B. 1980. Production of *Tilapia aurea* in Simulated Lagoons Receiving Laying Hen Wastes. Ph.D. Dissertation, Texas A&M University, 71 pp.

005.055

CRIS0074600

EVALUATION OF RELATIVE PROTEIN PERFORMANCE IN PELLETED FISH RATIONS USING PHYSIOLOGICAL INDICES

KIEKPATRICK R L; FISHERIES & WILDLIFE; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.

Proj. No.: VA-0838003-1 Project Type: STATE
Agency ID: SAES Period: 01 OCT 77 To 30 SEP 78

OBJECTIVES: Develop a physiological chamber to facilitate collection of blood and urine from fish, determine the response of selected physiological indices of channel catfish maintained in physiological chambers and feed diets containing different single and combined protein sources, develop methodology for predicting relative protein performance, test the above methodology.

APPROACH: Design chamber for simultaneous blood and urine collection, identify physiological responses of channel catfish to different dietary protein sources through colorimetric determinations of blood and urine selected indices, apply appropriate statistical analysis and multiple regression analysis to develop diagnostic methodology, test methodology through addition protein evaluations.

PROGRESS: 80/01 TO 80/12. Progress on this project falls into two main areas of evaluating enzyme indicators for rapid evaluation of fish growth response to different protein diets and evaluating the utility of seafood waste products as an ingredient for fish feeds. Evaluation of enzyme indicators in laboratory experiments indicates that glutamate oxaloacetate transaminase and glutamate dehydrogenase reliably predict the continued growth rate of channel catfish after four weeks of testing. Similar results occur when both the quantity or quality of protein in the diets are varied. This technique has widespread applicability to the feed industry because rapid experiments are more economical and controllable than long-term feeding trials and because protein is the most expensive ingredient in diets. Evaluation of seafood wastes as a dietary ingredient for catfish culture indicates that both crab and finfish wastes have more than 60% protein and that the amino acid composition of wastes is balanced with respect to catfish nutritional needs, containing all essential

amino acids. Use of seafood wastes is important to the seafood industry, which must find alternative means for disposal of wastes, and for the aquaculture industry, which needs inexpensive forms of protein for fish ponds.

PUBLICATIONS: 50/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

005.056* CRIS0083531
AQUACULTURE FOR RESOURCE ENHANCEMENT

AMUNDSON C H; KAYES T H; FOOD SCIENCE; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.
Proj. No.: WIS02581 Project Type: STATE
Agency ID: SAES Period: 01 SEP 80 To 31 AUG 84

OBJECTIVES: To determine the quantitative amino acid requirements of rainbow trout and yellow perch; to examine the feasibility of employing anabolic substances; to control sexual differentiation and enhance growth and food conversion efficiency and to apply this information to the propagation and culture of Great Lakes fishes.

APPROACH: An amino acid test diet will be developed to promote good growth at 15°C for trout and 22°C for perch. The dietary requirements of these species will be determined under high NH₃ versus low ammonia condition and to determine his, ile, leu, phe, thr, and val requirements and amino acid interrelationships. These studies will be undertaken to determine whether selected biochemical correlates of growth can be used in evaluating the amino acid in protein quality requirements of fishes. With respect to yellow perch only, a study will be undertaken to determine the size or age at which sexual differentiation occurs. Selected androgenic and estrogenic compounds will be used to control sexual differentiation or reverse the sex of immature fish. The dosages and length of treatment required to control sexual differentiation will be studied. A comparison will be made of the growth rate, food consumption, food conversion efficiency, protein conversion efficiency, and body composition of treated and untreated fish. Finally, the treated & untreated species will be evaluated for the effect of these substances on production & palatability of edible flesh.

005.057* CRIS0062972
DEVELOP OF AQUACULTURE SYSTEMS FOR COOL WATER FISH SPECIES

CALBERT H E; FOOD SCIENCE; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.
Proj. No.: WIS01953 Project Type: STATE
Agency ID: SAES Period: 01 SEP 72 To 30 AUG 81

OBJECTIVES: Maintain a facility for fish growing operations and research as a service unit. Improve the reproductive efficiency of cool water species of fish to be used in aquaculture. Improve the acceptability and nutritive value of formulated feeds used in aquaculture. Improve methods of yellow perch fingerling production.

APPROACH: The aquaculture research facility at 6080 McKee Road, Madison, WI and the outside ponds on the UW Experimental Farms will be maintained and operated to provide research facilities and fish to be used in aquaculture research. Selective breeding of yellow perch and other cool water species will be used to improve the strains of fish and adapt them to aquaculture operations. Studies on the preservation of fish sperm, ova, and fertilized eggs by cryobiological methods will be made. Various types of protein sources will be investigated for incorporation into formulated diets used in fish growing operations. The care, management and productivity of outside ponds for fingerling production will be investigated.

PROGRESS: 79/01 TO 79/12. Project emphasis over the past 4 years has been on developing methods of commercially culturing yellow perch indoors in closed water-recycling systems. Research has shown that this type of culture is technically feasible, through the application of sanitary engineering principles but is too capital intensive for commercial development. Project emphasis has been shifted to pond, raceway and cage culture, both for commercial applications and wild fisheries enhancement. The project has also worked extensively on diet development, control of reproduction, cryopreservation of sperm, and fingerling production of coolwater species of fish. Dietary recommendations regarding coolwater fish production have been made available through the National Coolwater Fish Diet Steering Committee. Methods for controlling reproduction in coolwater fish have been developed and applied to improve the predictability of spawning. Sperm from yellow perch, northern pike and walleye have been frozen, stored and later used to fertilize eggs. Such research will aid in improving the efficiency and profitability of fish rearing operations, whether they be for commercial purposes or fishery enhancement.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

6. Production Management Systems

006.001 CRIS0080491
DEVELOPMENT OF AN INTEGRATED SYSTEM FOR TOTAL UTILIZATION OF SWINE WASTE

HILL D T; MCCASKEY T A; PRINCE T J; AGRICULTURAL ENGINEERING; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
Proj. No.: ALA00515 Project Type: HATCH
Agency ID: CSRS Period: 05 NOV 79 To 30 SEP 84

OBJECTIVES: Determine basic relationships of the unit processes of screening, pressing, anaerobic digestion and algae production at the bench and field scales using flushed swine waste. Determine the potential feeding value of the screened raw swine waste, the residue of digestion and the harvested algae in varying combinations with conventional feeds. Provide a facility for demonstration of the concept of total waste utilization that would be viewed as a forerunner or model for the future.

APPROACH: Investigation of screening and pressing will be performed at the field scale. Basic characteristics of screen rigs and flowrate and separation of solids fraction will be studied. Suitability of screened solids for refeeding and anaerobic digestion will be evaluated. Pressing will be used to dewater the solids before refeeding. Anaerobic digestion will be studied at the bench scale (100 gal.) in continuously expanding volume operation. Basic relationships of temperature, gas production and quality, etc. will be studied followed by installation of field unit. Algae production will be studied using field scale production ponds.

PROGRESS: 80/01 TO 80/12. Work on this multi-phased project progressed well in 1980. Full scale components installed at the 600 head swine research unit comprising a waste processing laboratory consisted of a deep pit for waste storage, a constant volume waste handling pump, a vibrating screen for solids separation and a metal building for housing the components. Studies involving nutrient separation of the flushed swine waste will begin in early 1981. Three bench scale (378.5L) anaerobic digestors were constructed and placed in operation using the continuously expanding digester concept and swine waste. One run (90 day cycle time; 10, 22.5, 35 degrees C; and .32 kg VS/day loading) has been completed. Results of this particular run show poor performance based on VS reduction and gas quantity and quality. Chemical analysis of the digester contents clearly show overloading. VFA content was 8000-10000mg/l, NH₄⁺ concentration was about 3000

mg/l and pH values were in the 6.3 to 6.6 range. Loading rate and cycle time studies (.16 and .48 kg VS day and 90,135 and 180 day cycle times) will continue in 1981. The 10 degree C digester temperature will be discontinued following the current run due to extremely poor digester performance. Mild acid and alkaline hydrolysis studies as a pretreatment to enhance gas production during digestion were also started during 1980.

PUBLICATIONS: 80/01 TO 80/12

MCCASKEY, T.A. and SHEHAVE, J.E. 1980. Lactic Acid Fermentation Reduces Risk of Mycobacteria Transmission by Bovine Manure - Formulated Ration. In "Livestock Waste." A Renewable Resource, ASAE, St. Joseph, MI.

LINCOLN, E.P., HILL, D.T. and HALL, T. Field Scale Algae Production - Four Years of Operating Experiences. ASAE Paper No. 80-5043. ASAE 1980, St. Joseph, MI.

HILL, D.T. and TOLLNER, E.W. 1980. Chemical and Physical Properties of Flushed Swine Waste After Screening. ASAE Paper No. 80-4056. ASAE, St. Joseph, MI.

006.002*

CRIS0067635

EVALUATION OF A CLOSED SYSTEM FOR THE CULTURE OF FISH, SHELLFISH AND AQUATIC PLANTS

ALLISON R; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.

Proj. No.: ALA00399

Project Type: HATCH

Agency ID: CSRS

Period: 14 APR 75 To 30 JUN 80

OBJECTIVES: Maximize animal protein production from a fed fish population in a closed system through the use of aquatic plants, fish and shellfish grown in the effluent. Develop management plan for growing fish from recently hatched fry to harvestable size in a closed system. Determine the carrying capacity of closed systems for various sizes of food fish fingerlings.

APPROACH: Food fish populations will be grown in tanks and fed a complete diet. The effluent will be reconditioned by circulation through tanks containing populations of filter feeding fish and shellfish. It will be further reconditioned with the removal of dissolved nutrients by aquatic plants. Reconditioned water will be aerated by air blower and returned to the food fish population.

PROGRESS: 75/04 TO 80/06. During 1980 all data for the year 1979 were summarized and recorded in a doctoral dissertation and two technical papers. Data collected during the five-year period of the project were summarized and the various modifications of the systems used were compared. This project was initiated 14 April 1975 and terminated 30 June 1980. Initial experiments were conducted in dual tanks, one for production and one for filtration. In this system dense populations of unicellular algae developed and was not adequately removed by the filter or filter feeding fish. Maximum production of channel catfish was 2.65 kg/m³ and tilapia was 4.54 kg/m³. A system of one production and three filtration tanks was developed. Aquatic macrophytes were used to control unicellular algae. Maximum production of Tilapia was 38.8 kg/m³.

PUBLICATIONS: 75/04 TO 80/06

RAKOCY, J.E. 1980. Evaluation of a Closed Recirculating System for Tilapia Culture. Ph.D. Dissertation. Auburn Univ. Auburn 118 pp.

006.003

CEIS0082106

INTEGRATION OF A SOLAR GREENHOUSE WITH A RECIRCULATING FISH CULTURE SYSTEM

ALLISON R; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.

Proj. No.: ALA00527

Project Type: HATCH

Agency ID: CSRS

Period: 24 JUL 80 To 30 JUN 83

OBJECTIVES: Determine the operational characteristics of a solar heated greenhouse, thermal storage and heat recovery facility for fish culture. Evaluate a recirculating fish culture system compatible with the greenhouse, thermal storage and heat recovery facility. Develop design and cost information based on the above to enable full scale production system to be built.

APPROACH: Food fish populations will be grown in tanks. The effluent will be reconditioned by circulation through a clarifier and tanks containing aquatic macrophytes. Reconditioned water will be aerated and returned to the food fish production tanks. The fish culture units will be housed in a solar heated greenhouse. The greenhouse will contain a heat storage facility and a heat recovery system.

PROGRESS: 80/07 TO 80/12. A parabolic greenhouse covered with fiber glass panels has been constructed. Six fiber glass tanks with drains, air and water supply systems have been installed. Two large circular pools (6 and 10 ft. diameter) were also installed. During the summer period air temperatures in excess of 50 degrees C were recorded. Evaporative cooling was used to reduce air temperatures to 30 degrees C. The base of the greenhouse was flooded with water to a level where the sand floor was moist. Exhaust fans moved outside air over the moist floor and effectively reduced excessive air temperatures. Low air temperatures of -1 degrees C have been recorded during the winter period. Water temperatures in the small tanks have remained above 10 degrees C and that of the large tanks above 16 degrees C. Tilapia have survived in both systems. A modified hydroponic system was developed using effluent from the large circular pool. Seeds of cotton, soybeans, wheat and rye germinated well and produced good vegetative growth.

PUBLICATIONS: 80/07 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

006.004

CRIS0073917

FRESHWATER FOOD ANIMALS

HUSCH C D; HOYD C E; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.

Proj. No.: ALA00453

Project Type: HATCH

Agency ID: CSRS

Period: 01 OCT 77 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals cultured for food; water quality.

APPROACH: An improved design for paddlewheel aerators will be undertaken and their use for enhancing water quality in enriched culture ponds will be evaluated. Application of the aerators will be extended through simulation and hydraulic modeling.

PROGRESS: 80/01 TO 80/12. Pond stirring, to more fully utilize the daytime oxygen surplus, and emergency aeration were observed at Auburn's Fisheries Research Unit in 1980. Between one and five waterblenders, designed and built in the Agricultural Engineering Department, provided daily circulation in a 1.42 ha pond. A trailer-mounted paddlewheel powered (via PTO) by a Ford 4000 tractor provided emergency aeration in a 1.12 ha pond. The emergency aerated pond was stocked at the rate generally considered to be a safe maximum with emergency aeration available, 7,400 fish/ha. The stirred pond was stocked at a higher density, 10,000 fish/ha, anticipating, in part, some benefits from pond stirring. This trial was not replicated, however, the heavier stocking of the pond relying on daily circulation would have made that pond more susceptible to oxygen problems. Total aeration energy costs were \$91.60/ha for emergency aeration and \$54.89/ha for aeration through circulation.

PUBLICATIONS: 80/01 TO 80/12

HUSCH, C.D. and FLOOD JR, C.A. 1979. Pond Water Movement Can Improve Natural Aeration. Highlights of Agricultural Research 26(1):8.

BUSCB, C.D., FLOOD JR., C.A. and CAKES, F.L. 1980. Fulltime Simulation of Pond Water Quality. Paper No. 80-5C45, Annual Meeting of ASAE, June 15-18, San Antonio, Texas.

006.005
SPORTFISH MANAGEMENT

CRIS0069485

DAVIES W D; FRATHER E E; SBEITCN W L; FISEERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
Proj. No.: ALA-27-0004 Project Type: STATE
Agency ID: SAES Period: 01 NOV 75 To 30 OCT 85

OBJECTIVES: Conduct various experiments in sportfish management.

APPROACH: Ponds well stocked with a combination of species of sportfish. Specific management techniques will be applied. Effectiveness of the technique will be measured in terms of angler catch and in catch per unit of effort. In streams and large reservoirs information will be collected on age, growth and population structure. From this information management schemes for increasing sportfish harvest will be devised.

PROGRESS: 80/01 TO 80/12. Predator-prey relationships are usually based on the assumption that if prey is present that can be swallowed then it is available and will be utilized. This premise has been evaluated by examining actual length of prey eaten by largemouth bass from a large (10,500 ha) main stream reservoir in the Southeastern United States. The data suggest a well defined tendency for larger bass to eat larger prey; large bass do not utilize the smaller size prey usually assumed to be available. The range in prey size (sunfishes and shad) utilized by bass was predicted from a regression of prey versus predator length and the associated 95% confident interval. These studies have also suggested a shift in prey preference from bluegrill to shad at lengths greater than 200 mm. The availability of small size bluegrill, however, may be critical in determining the number of young-of-year bass eventually recruited as age 1(+) fish into the population. Three systems were compared as to the number of largemouth bass recruited. Farmponds (bass and bluegrill only); community fishing lakes (bass, bluegrill, shad); large impoundments (23-plus species including all of the above). Recruitment on the average was estimated to be 24-54, 24-44 and 7 respectively. In each case when shad was present, bluegrill condition and spawning frequency decreased. Our conclusion is that bass populations in complex communities may be recruitment limited

PUBLICATIONS: 80/01 TO 80/12

TIMMONS, T.J., SHELTON, W.L. and DAVIES, W.D. 1980. Differential Growth of Largemouth Bass in West Point Reservoir, Alabama-Georgia. Trans. Am. Fish. Soc. 109:176-186.

TIMMONS, T.J., SHELTON, W.L. and DAVIES, W.D. 1980. Gonad Development, Fecundity and Spawning Season of Largemouth Bass in Newly Impound West Point Reservoir, Alabama-Georgia. U.S. Fish Wildlife Service, Tech. Paper 100. 6 pp.

006.006
FRESHWATER FOOD ANIMALS

CRIS0058961

LOVELL R T; MCCOY E W; FISEERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.

Proj. No.: AIA00630 Project Type: BATCB
Agency ID: CSRS Period: 01 FEB 71 To 30 SEP 81

OBJECTIVES: Evaluate economics of production, processing, and marketing of freshwater food animals. Develop and improve products and processing methods that will enhance marketability and insure quality of cultured freshwater food animals.

APPROACH: Mechanically deboned flesh from various fishes will be evaluated with regard to yield, quality, and storage stability. Waste from fish processing will be evaluated chemically and biologically, and technology will be developed for economic waste utilization. Methods will be tested for control of geosmin related off-flavor in pond raised fish. Costs and returns associated with production of food fish in various culture systems will be assessed. Identify and evaluate alternative marketing and distribution systems for fish with respect to market expansion, consumer reactions, and optimizing income to producers and processors.

PROGRESS: 80/01 TO 80/12. 59 collections of catfish processing waste (head, skin, viscera) from the major processing plants and representing production ponds from Ala., Miss. and Ark. were analyzed for a-BHC, heptachlor, DDE, DDT, Dieldrin, endrin and toxaphene. All samples contained toxaphene. All samples contained toxaphene; the range was 0.06 to 3.6 mg/kg. DDE and DDT was found in most; the range of DDE was 0.01 to 0.56 mg/kg and the range of DDT was 0.01 to 0.58 mg/kg. None of the pesticide concentration in any sample exceeded the levels allowed in human foods, indicating the waste should be safe to use in commercial fish feeds. 35 off-flavored catfish collected from processing plants in Mississippi during April-June 1980 were evaluated by a trained sensory panel for quality and intensity of off-flavor. Only six of the samples had the distinct geosmin flavor which was formerly thought to be the major off-flavor in pond raised catfish. The most prominent flavor was "fecal" (sewage or manure); other were "rancid", "paint", "diesel", and "algae". Extracts from each fish were sent to the Southern Regional Research Center (USDA - AR) for compound identification.

PUBLICATIONS: 80/01 TO 80/12

LOVELL, R.T. 1980. Utilization of Catfish Processing waste. Auburn Univ. Agri. Exp. Sta. Bull. S 21. 19 p.

LOVELL, R.T. 1980. S-83 Annual Report: Freshwater Food Animals. So. Coop. Ser. Sp. Rep., June, 1980. 20 pp.

LOVELL, R.T. 1980. Effects of Feeding Full-Fat Soybean Meal on Growth and Flesh Quality in Catfish. Aquaculture 6(3):39.

LOVELL, R.T. 1980. Nutritional Value of Fish. Aquaculture 6(5) 45.

LOVELL, R.T. 1980. Effects of Feed on Sensory Quality of Fish. Aquaculture 6(6) 41.

006.007
AQUACULTURE

CRIS0069484

SMITHERMAN R C; ALLISON R; FRATHER E E; FISEERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.

Proj. No.: ALA-27-0006 Project Type: STATE
Agency ID: SAES Period: 01 NOV 75 To 30 OCT 85

OBJECTIVES: Conduct various experiments on aquaculture.

APPROACH: A species or several species of fish will be stocked into aquaria, troughs, pools, ponds or raceways. Treatments appropriate to the research will be applied for a pre-determined time when the fish will be removed and weighed and measured.

PROGRESS: 80/01 TO 80/12. Over a 3-year culture period, trapping experiments in a 10-hectar catfish pond yielded 1996 kg/ha/year of which 75% was caught by trapping and 25% upon draining the pond. Feed conversion was 2.0. Similar results were obtained in 1-ha ponds, but draining was every or every other year and production was approximately 3000 kg/ha. During 1980, one pond stocked at 8000 catfish/ha, and managed with improved genetic stock, destratification technique, and 15% floating 85% sinking feed yielded 4000 kg/ha and 1.5 feed conversion. Silver carp in catfish ponds changed algae dominance from blue-green to green, made catfish harvest more difficult, and decreased the number of emergency aerations. Large variations of the sex ratios in individual spawn of Tilapia nilotica and T. aurea indicate sex

determination is not a simple 1-locus system. Sex reversed males were potent allowing a workable system. One out of four sex-reversed grass carp males (gynogenetic female) produced milt and was able to fertilize eggs. Protective net covering over ponds improved paddlefish fry survival. Maintaining 0(2) levels of at least 5.5 ppm was critical for good fry survival. When inoculated into pond water, 95% of Salmonella typhimurium disappeared within 6 hours. Salmonella could be detected in Tilapia viscera but not in the dressed carcass.

PUBLICATIONS: 80/01 TO 80/12

LCPEZ, J. 1980. Comparative Efficacy of Two Androgens and Two Estrogens in Functional Sex Reversal of Tilapia aurea. M.S. Thesis, Auburn Univ., AL. 36 pp.

MERRIWETHER III, F.N. 1980. Progeny Sex Ratios for Spawning of Tilapia aurea (Steindachner). M.S. Thesis, Auburn Univ., AL. 61 pp.

006.008

CRIS0078875

CULTURE SYSTEMS FOR YEAR-ROUND MARKETING OF FISH FROM WATERSHED PONDS

SMITHERMAN E O; MCCOY E W; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.

Proj. No.: ALA00496

Project Type: EATCE

Agency ID: CSRS

Period: 01 APR 79 To 30 SEP 83

OBJECTIVES: Develop techniques for producing, harvesting, and marketing aquacultural crops from watershed ponds throughout the year.

APPROACH: Channel catfish, tilapia, silver carp, and rainbow trout will be produced in watershed ponds up to 8.9 ha. Partial harvesting with cages, drop nets and corral seines will be evaluated to extend the marketing season and to improve cash flow.

PROGRESS: 80/01 TO 80/12. Tilapia aurea fingerlings cultured in cages at stocking rates of 400, 800, 1200, and 1600/m³ for 92 days gained an average of 127, 124, 114, and 100 grams, respectively. The weight of fish in a cage was more important than the number; growth was reduced as the standing crop exceeded approximately 100 kilograms/m³. Tilapia in cages were fed a standard ration. One treatment received the daily allotment in one feeding; the other treatment had its daily ration divided into two feedings per day. After two months, fish fed once per day gained an average of 129 grams, those fed twice per day gained 149 grams, an increase of 16% due to feeding frequency. Blue tilapia (T. aurea) and golden hybrids (T. hornorum x T. mossambica) were cultured in cages. At harvest, male golden hybrids averaged 435 grams, while male blue tilapia averaged 288 grams. Female golden hybrids averaged 173 grams and female blue tilapia were 254 grams. Male golden hybrids and both male and female blue tilapia were 100% marketable (total length 19 cm) but only 67% of the golden hybrid females were marketable.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

006.009

CRIS0067351

A POLY-CULTURE SYSTEM OF FISH PRODUCTION FOR DISADVANTAGED FARMERS IN ARKANSAS

NEWTON S B; AGRICULTURE; UNIVERSITY OF ARKANSAS, PINE BLUFF, ARKANSAS. 71601.

Proj. No.: AR-X-PP-0006-858

Project Type: GRANT

Agency ID: CSRS

Period: 10 MAY 74 To 09 MAY 79

OBJECTIVES: See Approach.

APPROACH: Feed and labor records will be kept and all species in the study will be harvested and marketed to arrive at a cost of production and returns.

PROGRESS: 74/05 TO 79/05. Polycultural fish production studies in small ponds (0.1 ha) have been supportive of the combined culture of channel catfish as the primary species along with "exotic" Chinese

carps, buffalo, bluegill, and largemouth bass. Concurrent experiments over four seasons of study have indicated substantially greater yields for polyculture combinations over monoculture stockings of catfish alone. Polyculture production yields are greater due to more efficient useage of the available food sources by a variety of compatible fish species. Total fish production in shallow ponds (1m) was equal to or greater than that in deep ponds (1.5m) for comparable systems, with catfish stocked at 3,150 fish/ha in each. Shallow ponds are less expensive to construct and operate as well as usually being better suited for rotation with rice or row-crops. Fish survival was high for all species used in mixed culture combinations with minimal disease or parasite problems. When warmwater pond water temperature remains below 18°C, rainbow trout may be produced in otherwise idle production ponds. Or, trout and catfish can be overwintered together, then the trout may be selectively harvested in the spring in the presence of catfish, which usually remain for production during the period when the water temperature exceed 21°C. There is a need for continued study to further determine the role of each species in mixed culture systems especially those of exotic carps, and predator-prey relationships.

PUBLICATIONS: 74/05 TO 79/05

NEWTON, S.B. 1977. Fisheries Research at the University of Arkansas at Pine Bluff. State Report Section. Sixth Inland Commercial Fisheries Workshop, 53-54.

BAILEY, W.M., M.D. GIPSON, S.E. NEWTON, J.M. MARTIN AND D.L. GRAY. 1976. Status of Commercial Aquaculture in Arkansas in 1975. Proc. 30th Annual Conf. S.E. Assoc. Game and Fish Commissioners, 30: 246-50.

006.010*

CRIS0045715

POLY-CULTURAL PRODUCTION OF FISH IN FARM PONDS

NEWTON S B; GIFFORD J R; AGRICULTURE; UNIVERSITY OF ARKANSAS, PINE BLUFF, ARKANSAS. 71601.

Proj. No.: 7002-20380-001-A

Project Type:

COOPERATIVE AGREEMENT

Agency ID: ARS

Period: 07 SEP 79 To 30 SEP 83

OBJECTIVES: Develop management techniques for polycultural fish production in farm ponds that are adaptable to and will provide maximal fish yields for small acreage farmers.

APPROACH: Existing cooperators farm ponds of 2 acres or less with controlled stocking of channel catfish, largemouth bass, bluegill, buffalo, and fathead minnows will be evaluated relevant to costs for labor, chemicals, fish for stocking, controlled feeding, pond fertilization as based on age of pond, water source, disease problems, etc., and total production yields. Biotic and abiotic parameters in the ponds will be monitored for environmental changes and impact. Pond cage studies, coupled with intensive feeding, will be made to maximize harvestable catfish yields. Grass carp, Tenopharyngodon idella, will be tested for vegetation control in farm ponds in an attempt to reduce the need for chemicals and increase farm pond total fish yields.

PROGRESS: 80/01 TO 80/12. This farm pond production study is on schedule with twelve ponds in South Central Arkansas prepared for a 3-5 year population development period. Data collection will commence during the spring 1981 following the stocking of all ponds with channel catfish, buffalo, grass carp, bluegill, largemouth bass and fathead minnows. Techniques of pond fertilization and fish feeding will be employed along with the use of cages in four of the ponds. Fish harvest will be recreational and commercial methods with production information collections based upon three different management approaches.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

006.011 CRIS0073005
DEVELOP AND IMPROVE PRODUCTION AND MANAGEMENT SYSTEMS
FOR FRESHWATER ANIMALS CULTURED FOR FODD

NEWTON S B; HASKINS C J; ECBISCN W E; AGRICULTURE;
UNIVERSITY OF ARKANSAS, PINE BLUFF, ARKANSAS. 71601.
Proj. No.: AE.Y0901 Project Type: GRANT
Agency ID: CSRS Period: 01 APR 77 To 31 MAR 82

OBJECTIVES: Select and evaluate fish species combinations (polyculture) with potential for adaptation to extensive cultural environments (farm ponds). Incorporate the use of hybrid fishes (sunfish and buffalo) as well as species (Chinese carp) relatively new to pond culture to increase total fish production. Evaluate various environmental situations and management techniques for adaptation to polycultural fish production. Develop basic techniques and guidelines to provide fish culture information for low-income farmers as well as large commercial fish producers.

APPROACH: Establish several different combinations of fishes in 0.1 ha ponds and evaluate seasonal performance variations within each situation and among the combinations subjected to certain extensive cultural practices. Study possibilities of several hybrids and new species of fishes for adaptation to commercial fish farming.

PROGRESS: 80/01 TO 80/12. All experimentation and data collection for this project have been completed. Bigmouth X black and black X bigmouth buffalo hybrids were compared with bigmouth parentals when reared in polyculture with channel catfish, grass carp, and largemouth bass over a two-season period in 0.1 hectare ponds. Stocking rates per hectare were 2500 catfish, 30 grass carp, 100 bass, and 250 buffalo or buffalo hybrids. All fish harvested were of marketable size. Highest catfish yields and greatest total fish production were achieved with the polyculture combinations. Parental bigmouth buffalo appeared to be most satisfactory for this polycultural combination (over buffalo hybrids) with channel catfish as the primary species. Additional publications and termination report are forthcoming, pending additional data analyses.

PUBLICATIONS: 80/01 TO 80/12
NEWTON, S.B. 1980. Catfish Farming with Chinese Carps. Arkansas Farm Research Journal 29(1):28.

006.012 CRIS0076706
BIOLOGICAL STUDIES WITH THE MOSQUITOFISH, GAMBUSIA AFFINIS, UNDER CULTURAL SITUATIONS

NEWTON S B; ECBISCN W E; AGRICULTURE; UNIVERSITY OF ARKANSAS, PINE BLUFF, ARKANSAS. 71601.
Proj. No.: AE.X0959 Project Type: 1890/T
Agency ID: CSRS Period: 06 CCT 78 To 30 SEP 83

OBJECTIVES: Investigate and refine pond culture techniques for production of mosquitofish. Develop techniques for stocking, harvesting, holding, and transporting of mosquitofish. Collect economic information for Mosquito Abatement District usage in mosquito control programs. Evaluate mosquitofish production systems for application to current pond production systems.

APPROACH: Use ponds and indoor tanks to improve culture techniques for mosquitofish, especially related to harvest and transportation methods for use as biological control agents against field mosquitoes.

PROGRESS: 80/01 TO 80/12. Preliminary studies have produced yields of over 224 kg per ha by multiple harvest of mosquitofish. Additional yields of 1122 kg per ha of companion food fishes have been harvested from polyculture combinations. Gambusia were maintained best in tanks by using a high exchange rate (5.7 L/min) of fresh water circulation. Fish survival was also aided by adding 0.2% NaCl by weight to holding tanks, with mechanical agitation of the water. A series of predator/prey aquaria and tank experiments are planned for Winter 1981. Both inter- and intra-specific predation will be examined.

Practical pond production studies and reproductive schedules will be monitored in 0.1 and 0.05 ha ponds during the 1981 growing season. Several publications are forthcoming on pond production, harvesting, handling, and holding of mosquitofish during 1981.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.013 CRIS0081624
SHALLOW-WATER POLYCULTURE OF FISHES IN PONDS DESIGNED FOR ROTATION TO GRAIN CROPS

NEWTON S B; HASKINS C J; DEPARTMENT OF AGRICULTURE;
UNIVERSITY OF ARKANSAS, PINE BLUFF, ARKANSAS. 71601.
Proj. No.: AR.X1043 Project Type: 1890/T
Agency ID: CSRS Period: 29 MAY 80 To 30 SEP 85

OBJECTIVES: Evaluate polycultural fish production in shallow water ponds (average depth = 1 m); evaluate fish systems in conjunction with grain crop production for maximal utilization of marginal farmland; experiment with Chinese carps and hybrid carp for vegetation control and water quality effects in shallow fish ponds and document economic aspects of fish/grain crop rotational systems on marginal farmland.

APPROACH: Construct shallow fish ponds for economical use of marginal farmland to produce fish and grain crops through rotational management.

PROGRESS: 80/01 TO 80/12. A fish/row crop rotation project was initiated in July 1980. Project efforts were directed toward facilities construction of 19 shallow ponds and related water supply systems for filling and draining the ponds. All construction aspects of the ponds were completed, as well as an 800 square foot feed and chemical storage building by mid-winter. In order to test the new system, a winter feeding study with fingerling channel catfish was conducted during November-March 1981. Fish/crop rotation experiments in shallow ponds will commence during the Spring, 1981.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.014* CRIS0066365
NUTRITIONAL ASPECTS OF AQUACULTURE SYSTEMS

BROWN W D; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-PST-3010-E Project Type: HATCH
Agency ID: CSRS Period: 10 SEP 74 To 30 SEP 82

OBJECTIVES: Learn more of nutrient requirements of crustacea, including such things as optimal dietary level of protein and the interrelationship of energy and protein in diets for juvenile and adult crustacea; develop the technology of better feed delivery systems, including encapsulation and other means of preventing nutrient loss by leaching.

APPROACH: A system for holding several hundred juvenile crustacea (or other aquatic animals) has been designed and built and will be installed in the Ecology Institute of the University of California at Davis. Experimental animals will be housed in this system with controlled water quality, temperature, light etc. Feeding experiments will be conducted according to established protocol, and will be based on our earlier work in this area.

PROGRESS: 80/01 TO 80/12. Delivery of essential nutrients is the primary purpose of any animal ration. We have been able to demonstrate the failure of conventional shrimp and lobster in water soluble nutrients for periods long enough to assure effective delivery to the target animal. The loss due to leaching of riboflavin, choline, vitamin C, free amino acids and potassium was found to be rapid and independent of a ration's physical stability, regardless of the binding agent used in the diet. Losses of total nitrogen and trace minerals were found to be negligible when examined on a per gram

ration recovered basis. We have investigated the use of ethyl cellulose as a coating agent to retain water soluble nutrients in pelleted feeds. When the entire ration pellet was coated, minimal nutrient leaching occurred, even after 6 hours. Inclusion of individually coated micronutrients was less effective than total pellet coating for nutrient retention, but did help prevent losses due to leaching.

PUBLICATIONS: 80/01 TO 80/12

GCLDEBLATTI, M.J., CONKLIN, D.E. and BROWN, W.D.
1980. Nutrient Leaching from Coated Crustacean Rations. *Aquaculture* 19(4):383-388.

**006.015* CRIS0084225
CRAYFISH IN CALIFORNIA RICE FIELDS: DIET, IMPACT ON RICE PRODUCTION AND POSSIBLE RETURNS IN HARVEST**

GOLDMAN C R; INST OF ECOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ECL-4127 Project Type: STATE
Agency ID: SAES Period: 01 MAR 81 To 30 SEP 83

OBJECTIVES: To establish feeding habits of crayfish in rice fields with emphasis on their relationship to rice plants, insects, weeds and rice straw. To determine the extent of crayfish population development in California fields. To investigate the effect of crayfish on rice production and field damage. To examine the feasibility of a commercial fishery in the rice fields.

APPROACH: Extensive mark and recovery methods and behavioral observations will be done in rice fields. Stomach content analysis and observations will also be conducted in the lab. Population data will be correlated with figures on rice production and field damage. The feasibility of a fishery will be established from population data and simulated harvest.

**006.016* CRIS0067184
CLEAR LAKE ECOSYSTEM ANALYSIS: THE FISHES**

LI B W; MOYLE P B; WILDLIFE & FISBERIES BIOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-WFB-3205-E Project Type: EATCB
Agency ID: CSRS Period: 13 JAN 75 To 31 DEC 79

OBJECTIVES: Study the ecology of game and nongame fishes of Clear Lake, centering around the recently introduced *Menidia* and devise a fisheries management plan for the lake.

APPROACH: Determine the ecological significance of Clear Lake tributaries, especially ephemeral ones, by comparative population analyses. Production of *Menidia* will be estimated by the method of Bamilton (1969). The effectiveness of *Menidia* as a biocontrol agent will be evaluated by studying its prey electivity.

PROGRESS: 79/01 TO 79/12. This project was terminated this year, although analysis of data concerning the biology of the recently (1967) introduced Mississippi silversides in the lake is still proceeding by B. W. Li (now at Oregon State Univ.) and by W. W. Wurtsbaugh (Ph.D. thesis). Overall we have found that the silversides may be having some controlling impact on the populations of the prolific Clear Lake gnat but that its impact on gamefish populations and those of native nongame fishes has been negative or neutral. Similar effects, or worse, are expected in the Sacramento-San Joaquin Delta where the fish has just become established, and in numerous reservoirs.

PUBLICATIONS: 79/01 TO 79/12

MOYLE, PETER B. and N. J. HOLZHAUSER. 1978. Effects of the introduction of Mississippi silverside (*Menidia audens*) and Florida largemouth bass (*Micropterus salmoides floridanus*).

BROADWAY, J.E. and P. B. MOYLE 1978. Aspects of the ecology of the prickly sculpin, *Cottus asper* Richardson, a persistent native species in Clear Lake, California. *Env. Biol. Fish.* 3(4):337-343.

**006.017* CRIS0072302
INTENSIVE CULTURE OF TILAPIA IN GEOTHERMAL WATERS IN THE SAN LUIS VALLEY, COLORADO**

FLICKINGER S; FISHERY & WILDLIFE BIOLOGY; COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO. 80523.
Proj. No.: COL00067 Project Type: STATE
Agency ID: SAES Period: 15 FEB 77 To 30 JUN 80

OBJECTIVES: Develop techniques to spawn tilapia year-round and to have only males for rearing either through early sorting or through hybridization to produce all male offspring.

APPROACH: Brood fish will be held under various photoperiods to determine what length induces spawning and what length inhibits spawning. With controlled spawning to produce large numbers of offspring at the same time, grading to sort faster growing, and hence larger, males will be tried for accuracy in sorting sexes. Hybrid crosses will also be made to test for unusual sex ratios.

PROGRESS: 80/01 TO 80/12. No progress report this period.

PUBLICATIONS: 80/01 TO 80/12

MAICLIE, M.A. 1979. Effects of Various Photoperiods on the Spawning of *Tilapia aurea*. M.S. Thesis, Colorado State University, Fort Collins, 41 pp.

**006.018 CRIS0065908
MINNOWS AS FORAGE IN THE FARM POND PRODUCTION OF FINFISH**

HODOLA A; AGRI & NATURAL RESOURCES; DELAWARE STATE COLLEGE, DOVER, DELAWARE. 19901.
Proj. No.: DELX-PR-0002-3266/7 Project Type: GRANT
Agency ID: CSRS Period: 22 MAR 74 To 21 MAR 79

OBJECTIVES: Determine which minnow species can be satisfactorily utilized as forage in Delaware farm ponds. Determine the nature and extent of a "refuge" area required for continuous minnow production in the presence of predatory fish. Determine the optimum degree of fertilization of pond waters for maximum production of minnows. Determine which potentially marketable piscivorous finfish can be satisfactorily reared in Delaware farm ponds. Determine which permutations of the above result in maximum production of each of the finfish species determined in the previous objective.

APPROACH: During the execution of the program the literature will be thoroughly searched for information. State and Federal agencies will be consulted. For the implementation of the program pond owners will be contacted regarding use of their ponds. A series of 1/8 acre experimental ponds for close continuous study of the specific facets of the program will be constructed at Delaware State College.

PROGRESS: 79/01 TO 79/12. The year-long test for suitability of a minnow to be forage in farm ponds in Delaware was completed for the swamp darter, *Etheostoma fusiforme*. It survived well in the pond habitat and reproduced prolifically. The study to determine the optimum size of refuge for minnows in ponds with predatory fish indicated increased production of both predator and prey biomass with increase in refuge size. Refuges in the 9 x 15 meter pools ranged from a 1/2 meter band of aquatic plants along the pond's edge to a 2 meter band in increments of 1/2 meter. Experiments on selective feeding (preference) by largemouth bass and white perch on eight forage species were completed. A paper is currently being prepared. A pilot study of the feeding rates by week of certain predatory fish has been completed.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.019 CRIS0077158
THE RESOLUTION OF SOME PROBLEMS ATTENDING THE
EMPLOYMENT OF MINNOWS AS FORAGE FOR FARMPOUND FISHES

BODCLA A; PETROSKY B; WJTEWICZ D; AGRI & NATURAL
RESOURCES; DELAWARE STATE COLL, DOVER, DELAWARE.
19801.

Proj. No.: DELX-0003-79-2 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 78 To 30 SEP 82

OBJECTIVES: Find refuges acceptable to the farmpond owner and to prey minnows but which resist incursion by the large predatory fish. Find the size of refuge needed (ratio of the pond surface) to maintain a perennial population of prey minnows in the presence of predatory fish. Determine the suitable ratio of predatory fish to prey minnows to ponds area in the presence of refuges. Evaluate the two methods of producing finfish: By use of minnows and refuge. By use of bluegills and no refuge.

APPROACH: Present various refuges - artificial and natural - to minnows in an observation pool introduce a predatory fish and note which refuges are used the most. Set up a series of pools with increasing amounts of refuge. To this add 100 individuals of a suitable species of minnow and two large predators. Check at the end of a year for evidence of minnow survival and reproduction. Find the smallest effective refuge. Set up a series of similar sized pools complete with the preferred refuge of adequate size and minnows. Add predators to pools - one in pool 1, two in pool 2, etc. At the end of the year determine what combinations resulted in optimal gains. 4. Set up two sets of pools, one with the best (3), the other with bluegills as per usual farm-pond practice. At end of year determine which method provided the results.

PROGRESS: 79/10 TO 80/09. Two papers were presented at the Bicentennial Meeting of the Association of Research Coordinators: "Selective Predation by Largemouth Bass on Eight Forage Fishes" and "The Effect of Refuge Size on Forage Production and Largemouth Bass Production in Small Ponds". In the former paper, selectivity by the bass was indicated by the greater consumption of certain species when a surfeit of each of eight or nine forage species was offered the predator. Always eaten were *Enneacanthus* spp.; *Fundulus heteroclitus* and *Umbrina pygmaea*. Seldom eaten were *Fundulus diaphanus*, *Notropis chalybeus* and *Notropis procerus*. *Gambusia affinis*, *Micropterus salmoides* fingerlings and *Pimephales promelas* were intermediate. The second paper showed that both predator and prey biomass were enhanced with increased refuges in ca 0.01 hectare pools. Refuges from 17% to 65% of pool surface. Predator biomass for the year increased steadily from 21.5% at least refuge to 40.5% at most refuge. Prey biomass from 4925 gms at least refuge steadily to 11660 gms at most refuge. Further, it was determined that the refuge area of a pool produced 131.5 g/m² of prey while the non-refuge area produced only 17.2 g/m². The study of weekly feeding rates of *Esox niger*, *Micropterus salmoides*, *Morone americana* and *Pomoxis nigromaculatus* was concluded after a year. Results are currently being compiled. A preliminary study of relative productivities of weedless pools, pools including a refuge of dead branches, and one including a refuge of living plants was completed.

PUBLICATIONS: 79/10 TO 80/09
NO PUBLICATIONS REPORTED THIS PERIOD.

006.020* CRIS0064913
UTILIZATION OF KRAFT MILL EFFLUENT FOR FISH
PRODUCTION

SHIREMAN J V; JUUL R B; FOR RES & CONSERV; UNIVERSITY
OF FLORIDA, GAINESVILLE, FLORIDA. 32601.

Proj. No.: FLA-FY-01671 Project Type: BATCH
Agency ID: CSRS Period: 06 FEB 74 To 30 JUN 79

OBJECTIVES: Determine the suitability of secondarily treated kraft effluent for fish growth and production. Establish the feasibility of utilizing pulp mill effluent as a medium for fish production systems. Determine the effects of intensive fish culture on the environmental quality of effluent waters.

APPROACH: Field and laboratory studies will be conducted to determine the effects of kraft mill effluent on warm water fish populations. An effluent channel coming from four oxidation ponds at the Budson Pulp and Paper Corporation Secondary Wastewater Facility will be surveyed for biological and chemical parameters. Studies pertaining to the influence of kraft effluents on fish growth, movement, distribution, food consumption, and food preference will be conducted in the effluent channel. Measurements obtained from populations inhabiting the channel will be compared to those obtained from naturally occurring populations. Fish will be contained within cages in order that growth and other measurements can be obtained from known individuals. This study should provide information as to the fitness of kraft effluents for warm water fish production.

PROGRESS: 79/01 TO 79/06. Terminated 30 Jun 1979.

PUBLICATIONS: 79/01 TO 79/06
NO PUBLICATIONS REPORTED THIS PERIOD.

006.021* CRIS0079914
THE ECOLOGICAL IMPACT OF INTEGRATED CHEMICAL AND
BIOLOGICAL AQUATIC WEED CONTROL

SHIREMAN J V; SCHOOL OF FOREST RESOURCES; UNIVERSITY
OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-FY-01987 Project Type: STATE
Agency ID: SAES Period: 01 AUG 78 To 31 DEC 82

OBJECTIVES: Determine the impact of chemical/biological control on the fishery environment, and to ascertain the most desirable balance of vegetation versus open water that will maintain desirable water quality, fish growth and reproduction. Evaluate the feasibility of combining chemical and biological weed control in a natural lake and determine cost benefit ratios. Determine the effects of dense submersed aquatic weed growth on the recreational utilization, fish production and water quality of shallow inland Florida lakes.

APPROACH: Two lakes and 24 ponds will be utilized to test the above objectives, water quality, fish population, benthos, zooplankton, and phytoplankton will be analyzed in each habitat.

006.022* CRIS0066524
FRESHWATER FOOD ANIMALS

ANDREWS J W JR; ENTOMOLOGY-FISHERIES; GEORGIA COASTAL
PLAIN EXPT STA, TIFTON, GEORGIA. 31794.

Proj. No.: GEO00254 Project Type: BATCH
Agency ID: CSRS Period: 05 SEP 74 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals cultured for food. Nutrition; culture systems.

APPROACH: Studies will be conducted to determine protein, amino acid, energy, vitamin and mineral requirements of catfish and relate these requirements to environmental and cultural conditions and least-cost feed formulations. Polyculture studies will be conducted with species which can utilize effluent waste products from catfish tanks.

PROGRESS: 76/09 TO 78/12. Studies were conducted on the dietary protein, lipid, carbohydrate, thiamin, riboflavin, niacin, pyridoxine pantothenic acid, vitamin D, vitamin K, vitamin C, potassium and copper requirements of catfish and culture techniques for catfish, bait minnows, goldfish *Macrobachium* shrimp and American shad. Results indicated free amino acids and simple sugar were poorly utilized by channel catfish. High dietary levels of linoleic acid (4% of diet) had a growth depressing effect when compared to saturated fats. Studies were conducted on the relative values of various animal and plant protein sources in catfish diets. Cultural techniques and diets were tested for rearing American shad from egg to sub-adult size

PUBLICATIONS: 76/09 TO 78/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.023*
FRESHWATER FCOD ANIMALS

CRIS0071491

BONDARI K; BILL T K; ANDREWS J W JR;
ENTOMOLOGY-FISHERIES; GEORGIA CCASTAL PLAIN EXPT STA,
TIFTON, GEORGIA. 31794.

Proj. No.: GEO00286 Project Type: HATCH
Agency ID: CSRS Period: 01 CCT 76 To 30 SEP 82

OBJECTIVES: Develop and Improve Production and Management Systems for Freshwater Animals Culture for Food. Genetics and Breeding.

APPROACH: Estimation of genetic parameters of commercially important characters. Selection of growth, viability, feed conversion, dressing percentage and fecundity. Selection will be made initially on fish raised in high-density tanks with subsequent evaluation in ponds. Development through individual and family selection of a genetically improved strain of channel catfish.

PROGRESS: 80/01 TO 80/12. One generation of bi-directional selection for body weight and size uniformity has increased body weight and total length at 40 wks of age 22.2% and 9.2% and 9.2% respectively. The rates of decline in the downward line were 18.7% for body weight and 4.1% for total length. Family coefficient of variation for 40-wk body weight in the upward line was also 7% less than in the downward line. Fingerlings produced from 5-year old brood channel catfish weighed 20% less and were 8% shorter in total length than fingerlings produced from 3-year old brood fish. Multipletrait selected fingerlings were also 10.4% heavier in body weight and 3.3% longer in total length than unselected control fingerlings at 40 weeks of age. Genetic selection for growth rate will continue for several generations. One generation of inbreeding study with channel catfish resulted in 7.4% and 5.9% growth depression at 16 and 40 weeks of age, respectively. A study concerning the effects of albinism on growth of channel catfish indicated that normal fingerlings were in a 13% and 20% growth advantage over their full-sib albinos at 16 and 28 weeks of age, respectively. The albinos, however, possessed the ability to compensate in growth at 40 and 70 weeks of age.

PUBLICATIONS: 80/01 TO 80/12

BONDARI, K. 1980. Genetic Experiments in channel Catfish. *Aquaculture Magazine* 6(4):38-39.

BONDARI, K., SHEPPARD, D.C. and MINEAR, L.E. 1980. The Use of Soldier Fly Larvae in Diets of Channel Catfish. Third Annual Proceedings Catfish Farmers of America Research Workshop 31-32.

006.024*
FRESHWATER FCOD ANIMALS

CRIS0071451

BILL T K; BROWN E E; CHESNESS J L;
ENTOMOLOGY-FISHERIES; GEORGIA CCASTAL PLAIN EXPT STA,
TIFTON, GEORGIA. 31794.

Proj. No.: GEO00283 Project Type: HATCH

Agency ID: CSRS

Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and Improve Production and Management Systems for Freshwater Animals Cultured for Food. Nutrition. Water Quality. Diseases. Culture Systems. Evaluate the Economics of Production, Processing and Marketing of Freshwater Food Animals.

APPROACH: Practical diets for channel catfish and rainbow trout will be tested in raceways. Water quality in raceways will be monitored and removal of wastes investigated. Diseases and parasites problems associated with intensive cultures will be identified and treated. The double-crop concept of using CC in summer and RT in winter in raceways will be continued. Polyculture for increased production through wastes utilization will be evaluated. Complete costs and returns analyses will be developed for different levels of production and management.

PROGRESS: 76/09 TO 78/12. Research has been completed with a flowing water system for double-crop fish production in a closed system of raceways. Each raceway segment, ca. 30 m long by 4.5 m wide, was stocked with 3,000 rainbow trout (November - March) and 2,500 channel catfish (April - October) per segment and produced over 3/4 T. of trout and catfish, respectively, each year. Water temperatures for 20 or more days under 4°C reduced trout production significantly. Multiple harvesting of catfish resulted in higher net production of fish per raceway segment. Feed conversion for multiple harvested/stocked fish was 1.3:1; whereas, once harvested fish had a conversion of 1.5:1. Feed conversion ratios were higher for catfish fed a sinking feed than for those fed a floating feed. To facilitate management of waste products in raceways, tilapia were stocked with catfish at 50 and 100 half-pound tilapia. Although they increased in weight from 1/2 pound to 1.1 pounds per fish, the tilapia did not reproduce.

PUBLICATIONS: 76/09 TO 78/12

NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

006.025*
EFFECTS OF ENVIRONMENTAL CONTAMINANTS ON GEORGIA FARM POND FISHES

CRIS0083648

REINERT R E; SHRODE J; FOREST RESOURCES; UNIVERSITY OF GEORGIA, ATHENS, GEORGIA. 30602.

Proj. No.: GEO00738 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 81 To 31 JAN 84

OBJECTIVES: Refine an adenylate (ATP, ADP, AMP) assay procedure for determining energy charge (ATP + 1/2 ADP divided by ATP + ADP + AMP) in farm pond fishes; Test the applicability of energy charge as a sensitive indicator of stress caused by various contaminants and water quality parameters associated with agricultural and forestry practices; Determine the capacity of farm pond fishes to acclimate to changes in pH.

APPROACH: In our Whitehall Laboratory energy charge values will be determined for fishes that are stressed by handling, by changes in temperature and dissolved oxygen, and by exposure to sublethal concentrations of insecticides and herbicides. Fishes will be tested using static and flow-through bioassay tests; Fish from low and neutral pH environments will be tested by first exposing them to a series of pHs and then transferring them directly to aquaria adjusted to low pH levels. For each acclimation group, median resistance time determined by probit transformation will be plotted against pH.

006.026
SYSTEMS ANALYSIS OF INTENSIVE AQUACULTURE: A CASE STUDY OF OYSTER PRODUCTION

CRIS0074563

YAMAUCHI B; DAVIDSON J R; AGRI ECCNOMICS; UNIVERSITY
OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW004705 Project Type: STATE
Agency ID: SAES Period: 01 NOV 77 To 30 SEP 80

OBJECTIVES: The overall goal is to generate information which can be useful for improving on the economic efficiency of commercial oyster production in the State. Specific objectives are: Conduct a feasibility study which will examine biological, technical, and economic parameters in an intensive oyster production system, and develop and analyze alternative management strategies for the current specie and system configuration.

APPROACH: A systems analytic approach will be followed in this study. A simulation model will be developed of the land-based oyster culture operations of the Kabuku Seafood Plantation. This simulation model will incorporate the relevant biological, technical, and economic parameters of the operating system. The model will be used in the feasibility study and analysis of alternative management strategies.

PROGRESS: 77/11 TO 80/09. This study assessed the feasibility of land-based oyster aquaculture for Hawaii and examined the constraints which are likely to affect the development of an industry. Conclusions were: small scale land-based oyster culture is technically feasible. Commercial production on a limited scale is being attempted in Hawaii, but as yet, without sustained outputs. Opportunities to realize further efficiency gains through economies of scale are limited. Emphasis is on developing new management techniques within existing scales. Various uncertainties make it difficult for conventional commercial lending sources to assess the viability of oyster aquaculture ventures. Therefore, scale expansion will probably not be forthcoming.

PUBLICATIONS: 77/11 TO 80/09
NO PUBLICATIONS REPORTED THIS PERIOD.

006.027 CRIS0068896
PRAWN AQUACULTURAL ENGINEERING

WANG J K; AGRI ENGINEERING; UNIVERSITY OF HAWAII,
HONOLULU, HAWAII. 96822.
Proj. No.: HAW00524 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 75 To 30 SEP 81

OBJECTIVES: Develop a harvesting system, including equipment and strategy, for the continuous production of prawn in Hawaii. Further investigate and evaluate high density nursery culture. Develop a post-harvest handling system for live prawn for both local and export market. Develop an engineering-economic analysis model to evaluate alternative prawn production systems.

APPROACH: Prototype harvesting equipment will be field tested and a suitable harvesting strategy developed. Experiments will be carried out to determine the effects of density and size on nursery mortality rates and growth rates. Storage and transportation of live animal under low temperature will be tested in the laboratory. An engineering economic analysis of prawn production using nursery stocking strategy and inventory pond will be performed to determine optimum harvesting strategy and facility requirements.

PROGRESS: 80/01 TO 80/12. A simple net reel was designed and fabricated. It mounts on a standard three point hitch and is powered by the tractor hydraulics. Using the reel, one man can pick up or set a prawn harvesting seine for a 40 m wide pond in 5-10 minutes. The net reel is being field tested by local prawn farmers. Prawn physical dimensions of engineering significance, such as overall length, tail length, orbit length, height, width, and mass are being collected and analyzed. Relationships of various dimensions to orbit length and mass will be determined. Live transport of prawn was investigated. Life support was limited to bubbling air in water and temperature control. The initial 18 liter of water per 1 kg prawn was not changed or filtered. Dissolved

oxygen was above 7.0 ppm and temperature 16 to 18 degrees C. No mortalities were experienced in the first 20 hours. Two replications did not have a mortality for 114 hours. If the initial mortality was not removed, the mortality rate increased rapidly. Conditioning and selection of prawn before transport appear significant to the length of transport allowed.

PUBLICATIONS: 80/01 TO 80/12
WANG, J.K. and WILLIAMSON, M.R. 1980. Aquacultural Engineering in Fresh Water Prawn Production. ASAE Transactions 23(5):1318-1321, 1325.
KNEALE, D.C. and WANG, J.K. 1979. A Laboratory Investigation of Macrobrachium rosenbergii Nursery Production. Proc. of the World Mariculture Society 10:359-368.

006.028* CRIS0077715
OYSTER PRODUCTION EQUIPMENT DEVELOPMENT

WANG J K; AGRI ENGINEERING; UNIVERSITY OF HAWAII,
HONOLULU, HAWAII. 96822.
Proj. No.: HAW00528-S Project Type: STATE
Agency ID: SAES Period: 01 JAN 79 To 30 SEP 81

OBJECTIVES: Develop a system for flushing and cleaning stacked oyster trays of pseudofeces; ideally without breaking open the stacks.

APPROACH: In depth review of literature covering applicable methods and technology. Determine physical and hydraulic properties of oyster at different stages of growth. Design and testing of prototype equipment.

PROGRESS: 80/01 TO 80/12. A prototype oyster cleaning and sorting equipment was designed and constructed. Preliminary tests were conducted on the mechanical oyster cleaner by varying the oyster feed rate, water flow rate, and water pressure. It was found that the oyster cleaner provides satisfactory cleaning for oysters of length greater than 2.5 cm (1 inch). It can clean 250 marketable oysters per minute (about 30 bushels per hour or 680 kg per hour). A water flow rate of greater than 1.58 L/s (25 GPM) and a water pressure of 103 kPa (15 psi) are required. It was found that a 6-inch diameter by 50-foot long parallel rollers can effectively size artificially grown oysters. The prototype sizer can size oysters satisfactorily at a feed rate of 200 marketable oysters per minute (about 24 bushels per hour or 540 kg per hour) at a roller inclination of 175 rad (10 degrees).

PUBLICATIONS: 80/01 TO 80/12
WANG, J.K. and YOW, K.W. 1980. Analysis of Oyster Production in Hawaii. Paper Presented at the ASAE Summer Meeting, San Antonio, TX. ASAE Paper 80-5047.
YCW, K.V. and WANG, K.J. 1980. Mechanical Cleaning and Sorting of Hawaiian Cultured Oysters. Paper Presented at the ASAE Winter Meeting, Chicago, IL. ASAE Paper 80-6502.

006.029* CRIS0081904
AQUACULTURAL WASTEWATER MANAGEMENT AND UTILIZATION IN HAWAII

YANG P Y; AGRI ENGINEERING; UNIVERSITY OF HAWAII,
HONOLULU, HAWAII. 96822.
Proj. No.: HAW00531-S Project Type: STATE
Agency ID: SAES Period: 01 MAR 80 To 30 SEP 82

OBJECTIVES: Characterize effluent quality (organics and inorganics) of aquacultural pond; determine the role of oxygen demand in the water column of the pond; explore the appropriate control of oxygen concentration in the pond; explore the appropriate treatment alternatives in order to control water quality and water reuse of pond effluent.

APPROACH: Establishment of data collection plan, sample collection and analysis of wastewater characterization. Conduct oxygen demand study in the field and laboratory and establishment of the

relationship between oxygen consumption rate and available oxygen demand material in the pond. Search available techniques and develop new ways to control oxygen level in the pond. Conduct laboratory and pilot plant study on the treatment alternative for water quality control and water reuse of pond effluent.

PROGRESS: 80/03 TO 80/12. Investigations were conducted into the qualitative and quantitative nature of the water column oxygen demand of prawn (*Macrobrachium rosenbergii*) grow-out ponds. It was found that the water column oxygen demand represented between 48 to 87% of the total pond oxygen loss at night. A good correlation existed between the oxygen uptake rate and the total COD, particulate COD, suspended solids, volatile suspended solids and secchi disk depth measurements of the water column. Water quality management guidelines and procedures regarding oxygen demand in the pond were developed. This will provide a more positive control of the causes of oxygen depletion in the prawn production ponds and reduce the damage of cost of prawn production. Characterization of effluent quality (organics and inorganics) of aquacultural pond and the appropriate treatment alternatives for controlling water quality and water reuse of pond effluent are under investigation.

PUBLICATIONS: 80/03 TO 80/12

LOSOLDO, T.M. 1980. An Investigation of the oxygen Demand Materials of the Water Column in Prawn Grow-out Ponds. M.S. Thesis, Univ. of Hawaii, Honolulu, 100 pp.

006.030* CEIS0083554
PRAWN AQUACULTURE PROGRAM - BIOLOGICAL BASIS OF PRODUCTION

MALECHA S E; LAWS E; ANIMAL SCIENCE; UNIVERSITY OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW00250-S Project Type: STATE
Agency ID: SAES Period: 01 OCT 80 To 30 SEP 82

OBJECTIVES: To aid the development of an improved feed and better feed management; to aid the development of management strategies for crises associated with low oxygen levels in ponds; to test management strategies emphasizing the pattern of growth (observed size-frequency distribution) in pond populations of prawns; to contribute to the controlled domestication of prawns; and to aid the development of alternative stocking and harvesting strategies and management systems.

APPROACH: To determine oxygen budget and nutrient flux to simulated pond ecosystems; to size grade prawn populations and test them against ungraded groups; raise and compare growth of individuals under a variety of confinements; determine tolerances and growth to low fluctuating dissolved oxygen and temperature; assess the degree of domestication between cultured stocks and wild ancestors; estimate the heritability of size variation using analysis of variance in full and half sib families; and compare larval growth among genetic groups.

006.031 CEIS0079155
IMPROVEMENT OF OGO PRODUCTION AND MARKETING IN HAWAII

DOTY M S; BOTANY; UNIVERSITY OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW00688 Project Type: HATCH
Agency ID: CEES Period: 24 APR 79 To 30 SEP 82

OBJECTIVES: Inventory the current OGO (*Gracilaria*) industry its problems and potentials. Identify and appraise the environments of potential production areas in Hawaii. Experimentally grow *Gracilaria* in those areas and seasonally determine its market value and growth rates. Adapt methods of algal farming used elsewhere to selected areas and develop recommendations for pest and fertilizer control, and marketing. Demonstrate adapted farming technologies

and provide technical advice with the aim of inducing *Gracilaria* farming in USA.

APPROACH: Analyze the results of interviews with the people now active in the *Gracilaria* industry to appraise the industry in Hawaii and elsewhere. Survey the environments of potential farm sites in Hawaii to select the more favorable and enlist owner interest. Monitoring test plantings to yield growth rates and market quality during the seasons will permit selection among the sites. Adapt farming methods in use elsewhere for optimal production and market plans at the selected sites. Demonstration plots at suitable sites, discussions with the nearby people, and technical help will be used to get farming initiated and stabilized.

PROGRESS: 80/01 TO 80/12. The local *Gracilaria* fresh vegetable market shortage has continued. Curiously, quality and form variations have been found in the course of the seasonal study that seem to follow quickly upon changes in the environment. Thus, the correlated studies of the environments and growth rates are being continued and an experimental program added with additional appropriate measurements to elucidate the nature of these phenomena. Experiments to shorten the lag time observed in the harvesting methods used to date have been begun. These, in short, are primarily experimental harvesting by cutting off only certain of the longest more central branches of the thalli with the controls being the complete abbreviation of the thalli found to be the most favorable among the earlier harvest methods recommended as management practice. The work has been extended from Oahu to the island of Molokai under such staffing conditions that an equitable amount of effort may be spent on both as success in farming progresses. Interestingly, the *Gracilaria* species from Molokai are different both in form and gel nature from those on Oahu. This is hard to understand in view of the wide geographic distribution of the two principle species and so by transplanting experiments explanations are being sought.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

006.032 CEIS0077915
FISH CULTURE USING GEOTHERMAL WATER

BELEAU M; FOREST WILDLIFE & RANGE EXP ST; UNIVERSITY OF IDAHO, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0057 Project Type: STATE
Agency ID: OCI Period: 01 JUL 78 To 30 DEC 80

OBJECTIVES: Assess the economic feasibility of raising fresh water fin fish in geothermal waters.

APPROACH: The objective will be attained by raising carp and channel catfish in natural geothermal waters and in non-geothermal waters. The growth rates, hematological parameters, bioaccumulations of heavy metals, and proximate analyses of white muscle will be measured and used as validating criteria.

PROGRESS: 80/01 TO 80/12. Use of thermal effluents for aquaculture has received increasing interest from fish culturists for reducing production costs and from industry for productively exploiting energy rich waste streams, however, the culture of fish directly in geothermal water is an emerging field. Geothermal discharges represent a large thermal energy source for continuously maintaining the temperature of culture fluids while providing a constant source of water for year-round intensive culture of warmwater fish species. The commercial potential for geothermal aquaculture was evaluated for 2 years at the Department of Energy's Raft River geothermal site in Southcentral Idaho. Common carp (*Cyprinus carpio*) and channel catfish (*Ictalurus punctatus*) were selected as culture species. Objectives included investigation of growth rates; nutrition trials; histological and physiological parameters; bioaccumulation of heavy metals, and reproductive capacity. Growth rates of cultured channel catfish and common carp were high throughout the study. Various physiological and morphological parameters were monitored; no differences were detected between fish reared in

geothermal or fresh water. Tests were designed to evaluate the reproductive capacity of common carp (*Cyprinus carpio* L.) reared directly in geothermal water. In 1988, two groups of females were naturally induced to spawn.

PUBLICATIONS: 80/01 TO 80/12

SULLIVAN, J.F. and BELEAU, M.H. 1979. Potential for Using Geothermal Resources for the Culture of Freshwater Fish. *Trans. Exp. Geotherm. Front.* 3:689-692.

WOIWODE, J.G. 1980. Studies on the Effects of Geothermal Water on the Reproductive Capacity of Common Carp (*Cyprinus carpio* L.) at the Raft River Geothermal Site, Idaho. M.S. Thesis. Univ. Idaho, Moscow. 39 pp.

006.033

CRIS0084237

ADULT FALL CHINOOK TRAPPING FOR SNAKE RIVER EGG BANK PROGRAM

BJORN T C; FOREST WILDLIFE & RANGE EXP ST;
UNIVERSITY OF IDAHC, MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0077 Project Type: STATE
Agency ID: OCI Period: 19 AUG 80 To 31 DEC 80

OBJECTIVES: Trap one half of the fall chinook salmon run (or up to 400 fish) which passes Ice Harbor Dam. Transport them to hatcheries in Washington and Idaho for use in an egg bank program.

APPROACH: To accomplish our objective we installed a trap near the top of the south shore fish ladder at Ice Harbor Dam. This trap was operated from September 2, 1980 to October 8, 1980. We collected 394 adult fall chinook. One hundred ninety-eight (198) fish were hauled by truck to the Tucannon Fish Hatchery (Washington Department of Game) in S.E. Washington and 196 to Dworshak National Fish Hatchery in northern Idaho. The eggs from these fish will be used to supplement wild Snake River Fall chinook runs which have fallen to perilously low numbers.

PROGRESS: 80/01 TO 80/12. The fall chinook salmon trap was installed in the south shore fish ladder at Ice Harbor Dam on September 2, 1980 and removed October 9, 1980. During that period, Idaho Cooperative Fishery Research Unit personnel trapped and transported 394 adult and 20 jack chinook salmon for use in the Snake River fall chinook egg bank program. The 394 adults transported comprised 35 percent of the estimated 1126 adult fall chinook counted over Ice Harbor Dam in 1980. Dworshak National Fish hatchery received 195 adults between September 3 and October 2 and Tucannon Fish Hatchery manager, we also hauled 10 jacks to each hatchery to provide a larger source of spers for early egg takes. Fish were hauled in a 1000 gallon recirculating refrigerated tanker supplied by Dworshak National Fish Hatchery. The trap was operated during the daylight hours only from approximately 6:30 a.m. to 7:30 p.m. We used a cut off length of 24 inches for jacks rather than 20 inch length used at the Ice Harbor counting window because Tucannon Hatchery personnel have stated that a high percentage of fish below 24 inches are males. Our counts at the trap indicated that when we were operating, 75 percent of the steelhead and 57 percent of the adult chinook counted at the south shore counting station near the base of the ladder passed through the trap. We passed 22 percent more jacks than the counting station as a result of the 24 inch rather than 20 inch designation for jacks.

PUBLICATIONS: 80/01 TO 80/12

BJORN, T.C. and RUDY E. RINGE. 1981. Fall chinook trapping at Ice Harbor Dam, 1980, Summary of Operation. Report to U.S.F.W.S. Areas Office, Boise. 3 pp.

006.034*

CRIS0027228

EVALUATION OF METHODS FOR INCREASING NATIVE CUTTHROAT STOCKS IN NORTHERN IDAHO

BJORN T C; FORESTRY; UNIVERSITY OF IDAHC, MOSCOW,
IDAHO. 83843.
Proj. No.: IDA-CFU-0003 Project Type: STATE
Agency ID: OCI Period: 01 JUL 66 To 01 JAN 89

OBJECTIVES: Ascertain ecological factors limiting production of cutthroat in northern Idaho. Develop management techniques to maximize production of cutthroat.

APPROACH: Survey St. Joe River drainage to locate cutthroat rearing areas and classify them as to quality. Study ecology of cutthroat trout with special emphasis on movements, growth, and seasonal distribution. Evaluate squawfish as a potential predator and competitor for cutthroat.

PROGRESS: 76/01 TO 76/12. We studied the fish and fisheries of three Northern Idaho streams to assess the impact of catch-and-release (Kelly Creek), trophy-fish (upper St. Joe River), and standard (North Fork of the Clearwater River) angling regulations on native cutthroat trout populations. Since the initiation of the special regulations, cutthroat abundance increased in Kelly Creek (7-fold) and the upper St. Joe River (3- to 7-fold), but has not changed on the North Fork. The mean size of the cutthroat, the number of large cutthroat, and the catch rate of cutthroat per hour have increased as a result of the special regulations. The annual mortality rates of cutthroat declined and allowed more cutthroat to mature and spawn. The catch of cutthroat by anglers increased, but the angler harvest of cutthroat decreased. Angler effort declined initially, but had recovered by 1975 to 20% of 1969 effort on Kelly Creek and to 100% of 1969 effort on the upper St. Joe River. Characteristics of anglers fishing Kelly Creek (angling method, age, sex, residency) and the upper St. Joe River (method, residency) changed since the special regulations. Tagged cutthroat migrated from the study areas to overwinter in the lower drainage and returned the following spring and early summer. Multiple recaptures of tagged cutthroat was common during the summer.

PUBLICATIONS: 76/01 TO 76/12

JOHNSON, T. H. and T. C. BJORN. Special angling regulations in the management of cutthroat trout in northern Idaho streams. Job Performance Report, Project F-59-R-7, Idaho Fish and Game Department. 1977.

006.035*

CRIS0072914

EVALUATION OF JUVENILE SALMON AND STEELHEAD DENSITY AS RELATED TO DENSITY OF SPAWNERS AND FRY RELEASE

BJORN T C; FORESTRY & WILDLIFE; UNIVERSITY OF IDAHC,
MOSCOW, IDAHO. 83843.
Proj. No.: IDA-CFU-0047 Project Type: STATE
Agency ID: OCI Period: 01 JAN 77 To 30 MAY 79

OBJECTIVES: Evaluate data collected on the density of juvenile salmon and steelhead in good and marginal nursery streams following small spawning escapements (such as 1974, 1975, and 1976) and with larger escapements. Evaluate data on the impacts and success of releasing large numbers of steelhead fry into nursery streams and compare with survival obtained in other streams.

APPROACH: Select transect areas in good and marginal areas were counted in 1975 and 1976 with snorkel gear. The data was analyzed and a report is in preparation. Steelhead fry were released in selected study streams to evaluate movements, growth, survival, competition with natural fry. Data on this segment of study will be analyzed and a report prepared.

PROGRESS: 80/01 TO 80/12. Juvenile steelhead densities decreased from 1975-77 and increased in 1978. Age I and 0 steelhead densities for the four years correlated ($r = .62$ to $.89$) with the respective adult escapements. Densities of fry in tributaries in August ranged from 0.0 to 92.0/100 m². Streams that did not receive hatchery fry had the largest (92.0 fry/100 m²) and also the smallest densities (0.0

fry/100 m²). Highest mean densities (44.1 fry/100 m²) were associated with streams that had both hatchery and wild fry. Streams with only wild fry had mean densities of 33.8 fry/100 m² and streams (2) that had only hatchery fry had densities of 7.3 fry/100 m². Steelhead fry densities of 20-40/100 m² and probably higher may be expected in fully seeded rearing areas. Tributaries in 1978 that had hatchery fry introduction of 520 fry/100 m² were below fry densities needed to fully seed the rearing areas. If steelhead fry are available, stocking at a rate of 100 fry/100 m² may be needed to insure full seeding of the rearing areas. Fish movement through traps in Post Office and Weir Creeks, 1977-78, was highest when traps were installed in early July, then decreased near the end of July and through August. Nearly all movement of age I and older steelhead ceased in August with the exception of fish movement associated with freshets.

PUBLICATIONS: 80/01 TO 80/12

MAHHOTT, L. BRENT. 1981. Density and habitat of wild and introduced juvenile steelhead trout in the Lochsa River Drainage, Idaho. Masters Thesis. University of Idaho. 94 pp.

006.036* CRIS0073360
INVESTIGATION OF AQUATIC ECOSYSTEMS IN SMALL PONDS

LIBBY G S; FREESTRY & NATURAL RESOURCES; PURDUE UNIVERSITY, LAFAYETTE, INDIANA. 47907.
Proj. No.: IND059044 Project Type: HATCH
Agency ID: CES Period: 01 OCT 77 To 30 SEP 82

OBJECTIVES: Determine the interactions in the Plankton community of small impoundments; investigate the relationship of plankton to young fish; evaluate the effect on fish populations of ecosystem changes.

APPROACH: Ecosystem measurements will be made in the field. A time series of population data will be used to evaluate interactions in the plankton community. Fish population on plankton will be determined by comparing populations from ponds containing no fish with populations from ponds with young fish. Adult fish populations status will be monitored and changes resulting from natural or induced disruptions measured.

PROGRESS: 80/01 TO 80/12. The farm pond is an important aquatic ecosystem in the midwestern United States. Fish population imbalances in ponds are often caused by wide variations in the size of predator or prey year classes. These variations can be the result of fluctuations in larval mortality. Food availability and competition for food are the primary determinants of larval mortality and growth. Experiments conducted at various prey levels showed survival as a function of prey density was different for bluegill, green sunfish, and large mouth bass. Green sunfish survival was superior to either bluegill or bass. Bluegill survival improved as prey density increased, but bass had a low survival at most prey levels. The influence of competition between bluegill and green sunfish on their natural diet was investigated in a series of partitioned areas in a local pond. The presence of interspecific competition did not alter the diet of either species, but competition with older individuals produced major dietary shifts. In a study on the genetics of channel catfish, triploidy was induced by cold-shocking fertilized eggs. The triploid catfish are as viable as their diploid full sibs and tolerate the polyploidy condition well. Evidence for an increased growth rate due to triploidy and due to the lack of sexual maturation in sterile triploids was noted.

PUBLICATIONS: 80/01 TO 80/12

HOLLAND, L.E. and LIBBY, G.S. 1980. Inexpensive Egg-Hatching Jar. Prog. Fish-Cult. 42(2):112.
LIBBY, G.S. and EELTJ, J.R. 1980. Method for Monitoring Downstream-Migrating Alewives. Prog. Fish-Cult. 42(3):172-173.
LIBBY, G.S. and HOLLAND, L.E. 1980. The Use of Periodic Light Applications of Fotenone as a Management Technique for Small Impoundments. Purdue Univ., Water Resources Research Center, Tech. Report No. 132. 30 pp.

006.037 CRIS0079173
BIOLOGICAL DATA FOR MANAGEMENT OF WALLEYES AND OTHER FISHES

CARLANDER K D; ANIMAL ECOLOGY; IOWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: IOW02378 Project Type: STATE
Agency ID: SAES Period: 01 JUL 79 To 30 JUN 84

OBJECTIVES: Summarize and publish in Volume 3, the available data on the Perciform fishes other than the Centrarchidae; maintain a bibliography so that the original references and data can be readily located; maintain a cross index to the literature on all species so that future revisions can be prepared; develop and demonstrate methods of utilizing the data.

APPROACH: The systems of recording and tabulation used in volumes 1 and 2 of "Handbook of Freshwater Fisheries Biology" will be followed for Volume 3 but possibilities of using computer programs will be investigated. Newer methods of representing growth rate will also be incorporated in the study. Data will come from all available publications and special reports.

PROGRESS: 80/01 TO 80/12. In the last 15-20 years many scientists have apparently used body-scale regressions as predictive equations in calculating lengths from scale measurements. This practice is contrary to previous methods and results in greater variance because differences in scale size are not properly adjusted. I prepared a paper cautioning scientists on the method, which is to be published in January 1981, and presented two papers at national and regional meetings. Two additional papers on standardization of methodology have been prepared for submittal. Material for Volume 3 of the Handbook of Freshwater Fishery Biology and for revision of Volumes 1 and 2 has been recorded as the publications arrive. Tabulation and manuscript preparation has proceeded on the section on white perch, *Morone americanus*, and is about half completed.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

006.038* CRIS0082533
FACTORS AFFECTING FISH POPULATIONS IN IOWA WATERS

NICKUM J G; HUBERT W A; ANIMAL ECOLOGY; IOWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: IOW02465 Project Type: STATE
Agency ID: SAES Period: 31 JUL 80 To 30 SEP 85

OBJECTIVES: To determine the factors influencing fluctuations in abundance of selected populations. To identify man-made habitat alterations that impact or enhance environmental conditions for aquatic life. To increase understanding of environmental contaminants transport and dynamics. To evaluate fishery management techniques aimed at enhancing fishery quality or productivity.

APPROACH: Research will consist of field and laboratory studies on the life history, environmental requirements, and population dynamics of fish species in Iowa waters. Data on environmental contaminants in fish and their habitats will be obtained by standard analytical procedures. Established methods for population assessment will be used to determine the effects of various management techniques.

PROGRESS: 80/07 TO 80/12. Two individual studies were conducted within the scope of this project: one dealing with pesticide residues in the Des Moines River and another concerned with the propagation of walleyes, *Stizostedion vitreum*, (propagated walleyes may be stocked so as to manipulate resident fish populations). Concentrations of dieldrin and DDT in muscle tissue of carp, *Cyprinus carpio*, from the Des Moines River, Iowa, were compared relative to month of collection, age of fish, and sampling location. Statistically significant differences were observed for all three factors. Expression of pesticide levels on the basis of wet weight of flesh often produced different results than when comparisons were made on a fat basis. Samples from reservoir locations tended

to have higher dieldrin levels than samples from riverine locations. However, no similar trend was detected for DDT levels. Walleye fry fed a mixture of a diatom (*Melosira* sp.), decapsulated brine shrimp eggs, and dry feed (W-7) exhibited higher survival rates than those fed any of these items alone or in pairs. Walleye fingerlings were reared in ponds to a length of 35 mm and successfully transferred to hatchery production units. Substantial mortality occurred later, apparently due to stress from subsequent handling. Acceptance of dry feed by walleye fingerlings was highest in those rearing units in which water flow patterns held the feed in suspension for the longest times. Research in the coming year will proceed along similar lines for each study.

PUBLICATIONS: 80/07 TO 80/12
BUBBET, W.A. 1980. Aldrin and DDT Residues in Carp from Impounded and Riverine Segments of the Des Moines River 1979. In: Proceedings of a Seminar on the Water Quality in Corps of Engineers Reservoirs in Iowa. U.S. Army Corps of

006.039* CRIS0073386
WATER QUALITY ENHANCEMENT OF LAKES BY MECHANICAL PUMPING

SUMMERFELT R C; MCALEXANDER A K; BOLT B F; ANIMAL ECOLOGY; ICWA STATE UNIVERSITY, AMES, IOWA. 50011.
Proj. No.: ICW02233 Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 JUN 82

OBJECTIVES: Enhance water quality of lakes by in situ aeration with an axial-flow, mechanical pump. Specially, pumping will be done to increase total content of dissolved oxygen, and to decrease the concentration of organic matter, and the toxic substances, namely ammonia and hydrogen sulfide.

APPROACH: Dissolved oxygen, BOD, hydrogen sulfide and ammonia will be measured by standard procedures at intervals and depths which will allow characterization of total mass of these chemical characteristics of water quality. Pumping will be done with an axial-flow mechanical pump of the Quintero-Garton design. Evaluation will be done on the basis of changes in these water quality variables and improvement in species diversity of aquatic life.

PROGRESS: 80/01 TO 80/12. An axial-flow pump of the Quintero-Garton (1968) design, with a 120-cm diameter impeller, was operated on McFarland Lake, Story County, Iowa from 13 May through 22 October 1980 to prevent normal summer stratification. The temperature, and concentration of dissolved oxygen, chlorophyll a, BOD, CO(2), B(2)S, total phosphate, and orthophosphate were measured once each month at three sample sites in the lake and at each depth contour from 1 to 5 meters. During mid-summer, when expected temperature and chemical stratification in this lake would be substantial, maximum temperature difference was less than 2.0 C, and the substrate of the lake was warmed nearly 10 C over the expected temperature without artificial destratification. Without pumping, the lake would be anoxic below 4 meters, but with pumping, oxygen in the deepest contour was never less than 1.6 mg/l (25 June) and otherwise between 2.1 and 3.6, June through August. Long-term trends in lake improvement could be seen by comparing conditions occurring in the summers of 1978, 1979, and 1980. BOD values for the summer of 1980 were about half that of previous two summers and Chlorophyll a concentration in the surface (0-1 meter) stratum of the lake for the June through August period was the lowest of the years. Transparency (Secchi disc) was higher than in previous years.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.040* CRIS0069239
BREEDING, PRODUCTION, NUTRITION AND MARKETING OF CHANNEL CATFISH

KELLEY J R JR; DEYOE C; KLAASSEN B E; BIOLOGY; KANSAS STATE UNIVERSITY, MANHATTAN, KANSAS. 66506.
Proj. No.: KAN00962 Project Type: STATE
Agency ID: SAES Period: 01 SEP 75 To 30 JUN 80

OBJECTIVES: Obtain quantitative data on the growth rates of selective strains of channel catfish and the reaction of selected strains to different dietary formulations. Identify interaction of growth rates, diets and pond water quality degradation. Quantify water quality parameters associated with pond degradation and develop methods of maintaining water quality. Develop methods for product storage and flavor quality.

APPROACH: Earthen ponds will be used to replicated experiments to test diets against four strains of channel catfish. Growth rates will be used to compare the effect of diet on strain performance and for between-strain performance using a factorial arrangement of treatments. Full and half sib analysis will be used to compare within-strain performance. Dietary treatments will include evaluation of protein quality and quantity. Effect of diets with different nutrient densities involving nutrients such as vitamins and minerals will be evaluated in relationship to protein levels.

PROGRESS: 80/01 TO 80/06. Ponds treated with cobalt chloride as a trace component of fertilizer were not found to produce more channel catfish than control ponds. Cobalt chloride was added to the diet of channel catfish to determine if vitamin B(12) could be spared by the addition of this trace mineral. No significant difference was recorded in growth rates of fish receiving normal amounts of B(12) and those fish receiving cobalt in place of B(12) in purified diets. Significant differences were found in serum proteins between three of five populations of catfish. Additional differences in these populations were found in serum esterase patterns. It was concluded that the population of channel catfish in the White River, Arkansas and the Blue River, Kansas, were different from each other and from the other three populations examined. A domestic population from Arkansas, a domestic population from Kansas and wild population in the Kansas River, Kansas.

PUBLICATIONS: 80/01 TO 80/06
NO PUBLICATIONS REPORTED THIS PERIOD.

006.041 CRIS0067654
DEVELOPMENT OF MAXIMUM SUSTAINED YIELD IN KANSAS FARM PONDS

KLAASSEN B E; BIOLOGY; KANSAS STATE UNIVERSITY, MANHATTAN, KANSAS. 66506.
Proj. No.: KAN-05-344 Project Type: STATE
Agency ID: SAES Period: 01 JUL 73 To 31 DEC 80

OBJECTIVES: Develop procedures of obtaining sustained yield of edible fish in Kansas farm ponds.

APPROACH: A number of ponds will be cleared of fish and then restocked and managed with various species and practices.

PROGRESS: 77/01 TO 77/12. The study continued into its fifth year. The 30 study ponds were checked periodically and physical & chemical data were collected. The previous year had been very dry & most of the ponds were low. Some of the ponds experienced a winterkill. Then during summer there were several periods of excessive flooding and numerous fish washed out of the ponds. Due to these problems much of the year was spent in readjusting the population and allowing them to build up through reduced harvest.

PUBLICATIONS: 77/01 TO 77/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.042

CRIS0084700

MECHANIZATION OF CRAWFISH HARVESTING AND PRODUCTION

EDLING R J; AGRICULTURAL ENGINEERING; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.

Proj. No.: LAB02184

Project Type: STATE

Agency ID: SAES

Period: 01 AUG 81 To 30 JUN 84

OBJECTIVES: Develop one or more methods to mechanically harvest crawfish. Mechanize and develop aeration, water management and other systems for crawfish production.

APPROACH: The development of one or more mechanical harvesters and other mechanical devices will relate to practical application needs. The primary harvesting method to be pursued is formulated around a relatively expensive baited trap. The trap design permits easy entrance but makes exit difficult. The added entrance-exit design requirements and the stronger construction needed for mechanical handling make the trap relatively expensive. The expense is defrayed by highly efficient use, characterized by frequent movement. A large number of trap placements per unit area and the frequent movement of the traps will be feasible with a mechanical carrier. The carrier will be self propelled and programmed with timers to remain stationary for given time periods and to move given distances. A device will be made to lower, raise and invert the trap for emptying. Crawfish will be deposited in an inclined pipe through which they will be transported by a stream of water to the end of the wide-span carrier. A linear move irrigator may serve as a carrier and would also be used to aerate the water.

006.043*

CRIS0055844

ECOLOGICAL STUDIES WITH RED SWAMP CRAWFISH AND WHITE RIVER CRAWFISH

AVAULT J W; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.

Proj. No.: LAB01192

Project Type: STATE

Agency ID: SAES

Period: 11 AUG 64 To 31 OCT 80

OBJECTIVES: Study factors influencing ecology of crawfish, such as temperature, season, water quality and depth, vegetation, soil type, and agricultural practices, in relation to feeding, growth, reproduction, behavior, populations, diseases, predators, and competitors.

APPROACH: Experiments will be set up in aquaria to determine temperature tolerance of crawfish. Past crawfish production records for certain areas will be compared to weather records. Small ponds will be stocked with crawfish and effects of water level fluctuations studied. Crawfish movements will be studied in laboratory and in the field. Methods for food habits studies will be developed and applied in the laboratory. Water from natural crawfish habitats will be analyzed. Natural crawfish populations will be studied in relation to soil fertility. Population dynamics of crawfish will be studied, including mortality and predators. Crawfish carrying capacity will be determined from small ponds.

PROGRESS: 80/01 TO 80/10. Studies conducted during reporting period on influence of pesticides, rice residue, and planted rice on crawfish production indicated: No differences in growth, survival and yield of crawfish in tanks planted with untreated rice, planted with untreated rice, or planted with treated rice plus receiving Propanil, Ordram and Furadan. No pesticide residues were detected in flesh. In lab studies, a combination of Propanil, Ordram and Furadan was more toxic to crawfish than any single pesticide. After rice was harvested in crawfish ponds the stubble was left standing (S), baled (H) and added back to ponds periodically, or disked (D) into the soil. Half the ponds were flooded early (E), Sept. 20, and half late (L), Oct. 10. Crawfish in S, H and D ponds grew to 19, 18, and 17 g respectively. Crawfish in E and L flooded ponds grew to 92 and 83 mm in length, respectively. Rice straw decomposed fastest in E ponds, followed by S and D

ponds, with weight loss of 77, 67, and 49%, respectively, after 5-months. Dissolved oxygen was consistently higher in E flooded ponds than in L flooded ponds; 18 weeks after flooding, periphyton in g/m² was E 337, L 216, S 358, H 333, D 307. Ponds containing crawfish were planted with or without rice. Ponds with no rice receiving range pellets (crude protein 9.0%) from Sept. 25 to May 3 produced 881 kg of crawfish/ha. Ponds with rice receiving range pellets from March 1 through May 3 produced 2016 kg.

PUBLICATIONS: 80/01 TO 80/10

WITZIG, J.F. 1980. Spatial and Temporal Patterns of Macroinvertebrate Communities in a Small Drawfish Pond. M.S. Thesis. LSU, 113 pp.

CHIEN, Y.H. 1980. Effects of Flooding Dates and Disposal of Rice Straw on Crayfish, *Procambarus clarkii* (Girard), Culture in Rice Fields. Ph.D. Thesis. LSU, 120 pp.

WITZIG, J.F., AVAULT JR., J.W. and CONNER, J.V. 1980. Insect Dynamics in a Crawfish Pond with Emphasis on Predaceous Insects (Abstract Only). In Abstr. of Fish Culture Sect. of the Amer. Fish. Soc. 14.

CHIEN, Y.H. and AVAULT JR., J.N. 1980. Effects of Flooding Dates and Type Disposal of Rice *Oryza sativa*, Straw on the Crawfish, *Procambarus clarkii* (Girard), Culture in Rice Fields, In: Abstr. of Fish Culture Sect. of the

JOHNSON, W.B. and AVAULT JR., J.W. 1980. Some Effects of Poultry Manures Supplement to Rice/Crawfish Experimental Earthen Ponds. In Abstr. of Fish Culture Sect. of the Amer. Fish. Soc. 15. (Abstract Only).

006.044*

CRIS0056869

IMPROVEMENT OF CATFISH STOCK THROUGH SELECTIVE BREEDING

AVAULT J W; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.

Proj. No.: LAB01524

Project Type: STATE

Agency ID: SAES

Period: 01 JAN 70 To 30 SEP 81

OBJECTIVES: Improve catfish stock, used in fish culture, by selective breeding for fast growth rate, high dressing percentage, and other desirable traits.

APPROACH: Initially, five spawns of channel catfish will be collected for each of four populations from diverse areas of the southeastern United States. Each spawn will be stocked separately in a pond. At maturity male and female sibs will be mated for each of the four populations. All possible crosses and reciprocal crosses between the four populations will be made. Ultimately, it is hoped to develop inbred lines for crossing.

PROGRESS: 80/01 TO 80/12. Fifteen channel catfish families from the Yazoo strain and eight from the LSU strain were tested for genetic variability in mortality rate at a low level of dissolved oxygen (1.1 ± 0.01 mg/l). Channel catfish fry of both strains ranging from 2 to 10 days of age were administered low dissolved oxygen shock tests for 10-hour periods following 12-hour acclimation. There was no significant difference (P greater than 0.05) between the LSU and Yazoo strains in mortality. Test fish of each strain averaged 63% mortality during the shock tests. No significant differences (P greater than 0.05) were detected among the age groups of fry (3 and 4; 5 and 6; 7 and 8; and 9 and 10 days old). There were highly significant (P less than 0.01) and significant (p less than 0.05) intra-class correlations among the families. These led to high heritability estimates for the trait of being resistant to low dissolved oxygen. The heritability estimates ranged from 0.9 ± 0.3 to 1.7 ± 0.1. These inflated heritability estimates were probably due to excess environmental effects common to each family. Based on the high intra-class correlations for low-DO resistance found in this study, one could probably select among 2 to 10-day-old channel catfish fry for the trait of being resistant to low DO. It is not known, however, whether the ability to resist low DO at these ages will hold for the same fish or family of fish at older ages, such as among grow-out fish

for the food market or brood fish.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.045* CRIS0071457
FRESHWATER FOOD ANIMALS

AVAULT J W; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, EATON BOUGE, LOUISIANA. 70803.
Proj. No.: LAB01878 Project Type: STATE
Agency ID: SAES Period: 01 CCI 76 To 30 SEP 81

OBJECTIVES: Develop and improve Production and Management Systems for Freshwater Animals Cultured for Food. Genetics and Breeding. Culture Systems.

APPROACH: Catfish. Improved strains of channel catfish will be developed through cross-breeding and progeny testing. Crawfish. Various agricultural by-products will be fed to rawfish in replicated ponds. Production per acre will be compared between treatments. Populations of crawfish will be monitored in ponds to determine management techniques. Various stocking rates and feeds will be tested with crawfish in tanks. Crawfish will be stocked together with various other species to determine best combinations for increasing production. Traditional trapping methods will be compared, and new methods, such as the use of electricity, will be tested.

PROGRESS: 80/01 TO 80/12. Research conducted on catfish management under well-aerated culture and prawn-catfish culture indicated: (1) Catfish were stocked into ponds at rates of 7,500, 15,000, and 22,000 per ha. All ponds received aeration each day from 0200 hrs until 1 hr after sunset. In control unaerated ponds, catfish were stocked at 7,500 per ha. Fish in all ponds were fed a commercial ration containing 36% protein. Production of catfish in kg/ha was: 2717 at a stocking of 7,500; 3,474 at 15,000; and 5,277 at 22,000. In non-aerated ponds production was 1,870 kg/ha. (2) Prawns were stocked into ponds at rates of 25,000/ha, at 50,000/ha, and at 25,000/ha plus channel catfish fry at 75,000/ha. Ponds were also stocked with catfish fry only at 75,000/ha. Prawns and catfish in all ponds were fed Purina catfish chow. Prawn survival, 22%, and production 265 kg/ha were greatest in ponds stocked at 25,000/ha. This production was much lower than that from 1979 study at a stocking density of 25,000/ha. Overall, catfish survival was 33% and production was 695 kg/ha.

PUBLICATIONS: 80/01 TO 80/12

PLEMMONS, E. 1980. Effects of Aeration and High Stocking Density on Channel Catfish Production. M.S. Thesis. LSU. 37 pp.

AVAULT JR., J.W. 1980. Fishery Products from Aquaculture and Capture Fisheries, pp. 142-155. In: Cole, B.H. and Garrett, W.N. (Editors) Animal Agriculture. San Francisco: W. B. Freeman and Co., 739 pp.

AVAULT JR., J.W. 1980. Management of Aquatic Species, pp. 658-674. In: Cole, B.H. and Garrett, W.N. (Editors), Animal Agriculture. San Francisco: W. B. Freeman and Co., 739 pp.

PLEMMONS, E. and AVAULT JR., J.W. 1980. Use of Aeration to Increase Catfish Production (Summary Only). In: Res. Work. Sum. of Papers Catfish Farmers of Amer. Annu. Conv. 1980:12-13.

BUNER, J.V., MILNER, M., BEAN, R.A. and AVAULT JR., J.W. 1980. Survival and Reproduction of Blue Tilapia, *Tilapia aurea*, in Ponds Stocked with Bowfin, *Amia calva*, to Serve as Predators (Summary Only). In: Res. Work. Sum. of Papers

006.046 CRIS0082871
MANAGEMENT TECHNIQUES FOR INCREASING CRAWFISH PRODUCTION

AVAULT J W; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, EATON BOUGE, LOUISIANA. 70803.

Proj. No.: LAB02133 Project Type: STATE
Agency ID: SAES Period: 01 NCV 80 To 30 SEP 85

OBJECTIVES: Develop better methods of harvesting crawfish. Develop forage/feeding schemes to maximize crawfish yields. Multiple crop crawfish with rice, soybeans and other crops on the same lands. Improve methods of maintaining optimum water quality.

APPROACH: Most of the research will be carried out in replicated Louisiana Agricultural Experimental ponds using field-plot techniques. Outfield research will be conducted in commercial ponds. Pesticide research will be conducted in the field and in the lab.

PROGRESS: 80/01 TO 80/12. During reporting period research continued on: improved methods of harvesting crawfish; evaluation of artificial baits for harvesting crawfish; and evaluation of two varieties of rice, Saturn and LaBelle with and without fertilizer, as forages for crawfish. Such research established under LAB01192 which was terminated 31 Oct 1980.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.047* CRIS0083021
EFFECTS OF ENVIRONMENTAL CONDITIONS AND MANAGEMENT PRACTICES ON COMMERCIAL PRODUCTION OF CRAWFISH

RCMAIRE E P; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, EATON BOUGE, LOUISIANA. 70803.

Proj. No.: LAB0213E Project Type: STATE
Agency ID: SAES Period: 01 NOV 80 To 31 DEC 85

OBJECTIVES: To delineate the major environmental factors that regulate production of crawfish in commercial ponds. To develop management strategies that optimize economic yields of crawfish from commercial ponds. To evaluate new management techniques developed by the La. Agricultural Experiment Station in commercial crawfish ponds.

APPROACH: Environmental factors that regulate production of crawfish in commercial ponds will be evaluated. Initial investigations will concentrate on water quality dynamics, effluent discharge determination of mineral requirements, and the effects of agricultural pesticides on crawfish. Decay dynamics of forage biomass will be assayed and its effects on crawfish population dynamics ascertained. Conventional traps and new trap designs will be tested for efficiency in harvesting. Forage research will concentrate changes in nutritive quality, biomass production and preference of vegetation types by crawfish.

PROGRESS: 80/11 TO 80/12. Harvesting crawfish with traps is the largest variable expense to commercial producers in Louisiana, generally comprising 40 to 60% of the gross revenues. Six types of traps presently used in the commercial industry and three new trap designs are being evaluated for harvest efficiency in three commercial ponds during the 1980-81 crawfish season. Concomitantly, trap placement, trap density, frequency with which traps are emptied and manipulation of environmental parameters, such as water circulation, are being investigated to ascertain those combinations of harvesting strategies that minimize cost and maximize catch. Seven commercial crawfish ponds are being sampled biweekly with dip nets, seines, and small and large mesh traps during 1980-81 season to quantify growth, mortality, and recruitment patterns of crawfish populations. Seasonal changes in vegetation cover and plant species composition are being determined by the line-intercept method. These data along with catch and effort data supplied by cooperating producers are being used to develop a mathematical model capable of evaluating management strategies that optimize crawfish yields.

PUBLICATIONS: 80/11 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

006.048* CFIS0067268
ENVIRONMENTAL EFFECTS ON PRODUCTIVITY OF CRAYFISH IN
POND HABITATS, PHASE I, II

RODDY L R; DAVIS C E; BIOLOGY; SOUTHERN UNIVERSITY,
BATON ROUGE, LOUISIANA. 70813.
Proj. No.: LA.X-PR-0001-8-15-66

Project Type: GRANT
Agency ID: CSRS Period: 29 OCT 74 To 28 OCT 79

OBJECTIVES: Determine the type and amount of food that will yield the best production. Determine the most efficient harvesting method in small ponds. Investigate an early and extended crayfish season in small ponds.

APPROACH: Literature and cooperating personnel will supplement our selection of food types and amount during the feeding season. Standard nets, seines, modified traps and nets will be used. The possible use of chemicals and electric devices will be investigated. Systematic regulation of water will be maintained, to determine the possibility of increase and decrease of water level on an extended season. Statistical analysis will be made.

PROGRESS: 79/01 TO 79/12. Feeding: Data obtained from the crayfish project indicated that feeding and fertilizing had great impact on productivity. Feed with a high protein percentage favored productivity, consequently, fish pellets are highly recommended in the feeding regimen. Harvesting: Four different traps were constructed and placed in water depth of 120, 90, 60 and 30 cm respectively. The total weight of each catch per trap was recorded. On the basis of results obtained, Type I trap with 1.5cm mesh wire construction, barrel shape design, 70cm long, 30cm wide with two funnel openings at the bottom is recommended for utilization from January through June. Dual Crop of Crayfish and Fish: 205 fingerlings of hybrid buffalo fish were added to each of the two crayfish ponds. Rice was planted in each pond. None of the fish reached market size over this phase of the investigation but the preliminary results indicate that it is feasible to rear crayfish and these fish in the same pond. Cost Yield Ratio: Based upon average crayfish price, net profits of \$85.82 in Pond I and \$338.83 in Pond II were realized, thereby indicating the feasibility of commercial crayfish production under small pond conditions.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.049* CFIS0082633
CRAWFISH CULTURE STUDIES IN SMALL PONDS: BURROWING,
POLY-CULTURE AND NATURAL POND FLOODING

BUNER J V; COLLEGE OF AGRICULTURE; SOUTHERN
UNIVERSITY, BATON ROUGE, LOUISIANA. 70813.
Proj. No.: LA.X-81-2003-2044 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 80 To 30 SEP 85

OBJECTIVES: Determine the spatial and seasonal burrowing patterns of crawfish in small, open crawfish ponds. Assess the effectiveness of various techniques for facilitating successful burrowing of crawfish in crawfish ponds. Determine the effects of soil tilling practices on crawfish burrows in crawfish ponds. Determine the commercial feasibility of cultivating channel catfish and crawfish together in small, open south Louisiana crawfish ponds. Determine the commercial feasibility of using rainfall to flood crawfish ponds in south Louisiana.

APPROACH: Objectives 1, 2, 4 and 5 will be pursued in the four, one acre crawfish ponds located at Southern University. Objective 3 will be pursued in a nearby commercial pond. During the first two years, burrows will be marked and mapped on a biweekly basis and several types of materials will be tested to determine their effectiveness as burrowing facilitators. Also, during the first two years, marked burrows will be subjected to disking and

tractor-hush hog compaction early and late during the dry season to determine their impact on the occupants. In years 2 and 3, channel catfish will be stocked in test ponds after they have been filled with water in the fall. Catfish production and catfish impact on crawfish production will be recorded. In years 4 and 5, test ponds will be permitted to fill naturally in the fall and winter. The impact on this action on crawfish production will be measured.

006.050* CRIS0080671
NUTRITION MANAGEMENT AND DISEASE OF MARINE ANIMALS

BAYER R C; ANIMAL & VETERINARY SCIENCE; UNIVERSITY OF
MAINE, ORONO, MAINE. 04469.
Proj. No.: ME08398 Project Type: STATE
Agency ID: SAES Period: 01 JUN 79 To 30 SEP 82

OBJECTIVES: Formulate and evaluate minimal cost lobster rations, study gaffkemia in lobsters including vaccine evaluation and study lobster pound management. Compounded lobster baits will also be evaluated.

APPROACH: Lobsters will be fed diets of various types and growth will be monitored by measuring weight in water and weight in air. Lobsters will be vaccinated with live bacteria so that survival can be measured.

PROGRESS: 80/01 TO 80/12. Practical diets formulated with brewer's yeast, fish meal, kelp meal, alfalfa and wheat flour were fed to adult and juvenile lobsters. The basal diet was supplemented with 20,000, 100,000 and 1,000,000 U.S.P. units of vitamin A per Kg of diet. Growth was greatest in lobsters fed 20,000 U.S.P. units of vitamin A per Kg with growth inhibition seen in lobsters fed the higher level supplements. Adult lobsters were injected with P 3 2 labelled aerococcus viridans, a fatal lobster pathogen, and the distribution of these bacteria in the animal's body was monitored. The bacteria were primarily phagocytized by the hepatopancreas.

PUBLICATIONS: 80/01 TO 80/12

GALLAGHER, M.L., BAYER, R.C., LEAVITT, D.F. and
RITTENBURG, J.H. 1979. Effects of Protein Energy
Ratio on Growth of Adult American Lobsters. Proc.
10th An Meet. World Mariculture Society.

GALLAGHER, M.L., RITTENBURG, J.H., BAYER, R.C. and
LEAVITT, D.F. 1979. Incidence of Aerococcus
viridans (var.) homeri in Natural Crab
Populations in Maine Coastal Waters. Crustaceana
37:316-317.

BAYER, R.C., GALLAGHER, M.L., LEAVITT, D.F. and
RITTENBURG, J.H. 1979. A Radiographic Study of
the Lobster (Homarus americanus) Alimentary
Canal. Proc. 10th An Meet. World Mariculture
Society.

BAYER, R.C., ADRON, J.W., MACKIE, A.M., FURIE, B.J.
and RITTENBURG, J.H. 1980. Mechanisms of Food
Detection and Feeding Behavior in Dover Sole.
Fed. Proc. 38:500.

BAYER, R.C., GALLAGHER, M.L., LEAVITT, D.F. and
RITTENBURG, J.H. 1980. Requirements for Diet
Formulation for Adult Lobsters (Homarus
americanus) Held in High Density Confinement.
Abst. 72nd Annual Meeting ASAS, p. 186.

006.051* CRIS0074202
MATHEMATICAL MODEL OF OYSTER POPULATION IN THE
CHESAPEAKE BAY

WHEATON F W; CABRAAL A; AGRICULTURE; UNIVERSITY
OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MD-E-057 Project Type: BATCH
Agency ID: CSRS Period: 01 OCT 77 To 30 SEP 80

OBJECTIVES: Develop a bank of pertinent data to study oyster productivity in the Maryland portion of the Chesapeake Bay. Develop a mathematical model for describing the production function of oysters, this model will incorporate economic and management factors affecting the productivity of an oyster bar.

Evaluate the effectiveness of the oyster repletion program in Maryland and suggest means of optimizing the operation.

APPROACH: A data bank will be established incorporating oyster catch, effort and spatfall data, and seed and shell planting data. This data will be stored on computer tape and coded so data is available by bar and is accessible by river basin code, oyster bar code, Davis code, NOAA code, by latitude and longitude or by official or common bar name. This and other data will be used to develop an oyster demand equation, catch effort equation and production function. The effects of existing catch limits will be determined. Existing oyster population size will be estimated and management alternatives determined.

PROGRESS: 77/11 TO 80/09. A computerized data bank was developed which contains Maryland oyster seed and shell plantings by bar from 1964 to 1975, natural oyster spatfall for 1955 to 1975, harvest and effort for 1964 to 1975 and several more general economic statistics such as ex-vessel price of oysters. The Maryland portion of the Chesapeake Bay was divided into 6 general areas. Production functions relating catch to effort, lagged spatfall, seed and shell plantings, were developed for each area. Fresh shell was the most successful cultch material with dredge shell being less efficient in catching spat. Seed plantings produced 12 to 19 bushels of marketable oysters per 100 bushels of seed planted depending on the area planted. The State run oyster repletion program returned about 300,000 bushels of marketable oysters per year for the approximately \$1,000,000 annual expenditure. Estimates of oyster population were made for each of the six areas for the beginning of the 1975-76 harvest year using the Leslie and DeLury equations. Calculated rates of resource exploitation varied from 17 to 31 percent, depending on the area. Demand equations developed indicated oysters had a unitary demand elasticity. Effort equations developed showed that the boat-days of harvesting effort were stable over time for most river systems.

PUBLICATIONS: 77/11 TO 80/09

CABRAAL, R.A. 1978. Systems Analysis of the Maryland Oyster Fishery: Production Management and Economics. Ph.D. Thesis. University of Maryland, College Park. 318 pp.
CABRAAL, R.A. and WHEATON, F.W. 1978. A Predictive Model for Chesapeake Bay Oyster Productivity. Paper No. 78-5036. American Society of Agricultural Engineers. St. Joseph, Michigan.

006.052 CRIS0074565
WATER QUALITY MAINTENANCE IN CLOSED CYCLE FISH CULTURE SYSTEMS

WHEATON F W; LAWSON T H; AGRIC ENGINEERING; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MD-R-058 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 78 To 30 SEP 80

OBJECTIVES: Develop design data for filtration systems to control water quality in closed cycle aquatic culture systems.

APPROACH: Several types of filters will be studied as a means of removing metabolic wastes from closed cycle fish culture systems. Laboratory tests with these filters will be carried out to develop design equations for the filters. Water quality data, physical data from the filters and biological data will be combined by statistical and mathematical techniques to produce equations, graphs and other results which can be used to design filtration systems for prototype and commercial fish culture systems.

PROGRESS: 78/01 TO 80/09. A venturi air injection system for mixing air and an aqueous solution of surfactant, triton X-100, was used on a foam fractionation system. Using similtude principles, surfactant extraction efficiency was determined as a function of four independent variables grouped into three pi terms: ratio of area of air holes to throat

area of venturi (A(H)/A(T)), ratio of air flow rate to liquid flow rate (Q(A)/Q(L)), and number of air holes (n). The equations developed from the model predicted prototype triton X-100 extraction efficiency with 71% accuracy. Six of the eight equations necessary to combine 4 pi terms and their tests for applicability were worked out. A review of foam fractionation research has also been developed as part of this Project.

PUBLICATIONS: 78/01 TO 80/09

WHEATON, F.W., LAWSON, T.B. and LOMAX, K.M. 1980. Foam Fractionation Applied to Aquacultural Systems. Proceedings World Mariculture Society 10:795-808.
LAWSON, T.B. 1978. Venturi Design Parameters for Air Injection into a Foam Fractionation System. Ph.D. Thesis. University of Maryland. 204 pp.

006.053* CRIS0082911
CLOSED CYCLE FISH CULTURE WATER FILTRATION USING BIOLOGICAL SYSTEMS

WHEATON F W; LAWSON T H; KARLANDEE E P; AGRIC ENGINEERING; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MD-RK-066 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 80 To 30 SEP 83

OBJECTIVES: Determine efficiency of nitrification filters for closed cycle aquacultural systems as a function of various operating parameters. Determine effectiveness of aquatic plants in removing nutrients from aquatic closed cycle culture systems. Use the data gathered from objectives one and two above to develop design equations for nitrification and plant filters.

APPROACH: Design equations for nitrification filters will be developed by operating pilot scale filters using an inorganic nitrogen source. Filter inlet ammonia concentration, oxygen concentration, temperature and pH will be varied and the filter's efficiency for converting ammonia to nitrate monitored. Macroscopic plants will be used to filter water containing an inorganic nutrient mix. The nitrogen and phosphate concentrations, water temperature, water retention time in the filter, pH and physical filter dimensions will be varied and related to nutrient extraction rates. Light levels will be maintained at a constant value. Filter design equations will be developed from the data collected.

006.054 CRIS0073525
ECONOMICS OF BIVALVE MOLLUSK AQUACULTURE IN NEW ENGLAND

ALLEN P G; STOREY D A; CONRAD J M; FOCD & RESCUCHE ECONOMICS; UNIVERSITY OF MASSACHUSETTS, AMHERST, MASSACHUSETTS. 01002.
Proj. No.: MAS00415 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 77 To 30 OCT 80

OBJECTIVES: Construct biological response models; specify alternative plausible technical alternatives; combine biological and engineering components into production models; conduct marketing and demand analyses to determine marketing costs, price and income elasticities and gross revenues for different output levels; combine production and marketing analysis to determine economic feasibility of different systems at different individual plant scales and aggregate levels of output.

APPROACH: Generate a data base, develop cost of production estimates and provide subsystem modeling support in cooperation with Texas A&M University. Modify Texas A&M computer program to fit local conditions.

PROGRESS: 77/10 TO 80/10. Two activities have been carried out on cooperative projects supported by NOAA-Office of Sea Grant. In cooperation with Texas A and M University. Data for the aquaculture budget

generator were provided by a survey of shellfish aquaculturalists in New England and by the economic-engineering analysis of three synthetic model plants. As the budget generator becomes operational locally, it will enable the marine advisory service to provide detailed cost information to existing and prospective aquaculturalists. The economic-engineering analysis indicated that it was possible to produce 60g (85 mm) oysters at 1979 costs which ranged from \$18.50 in the lowest cost system to \$34.50 per bushel in the highest cost system. By comparison prices received for high-quality half-shell oysters were \$33.75 per bushel in 1979. Most operating oyster-producers had costs of at least \$37.50 per bushel, due to the experimental nature of their operations. In cooperation with Woods Hole Oceanographic Institution: A computer program has been written based on the lobster aquaculture program of the University of California, Davis. The new program contains features not found in any other bioeconomic simulator and in a variable planning horizon framework it includes both start up and operation sequences for either identical or nonidentical seasonal conditions for single, repeated batch or continuous batch operation.

PUBLICATIONS: 77/10 TO 80/10

DCNOHUE, M. 1980. An Analysis of the Economics of Shellfish Aquaculture Systems in New England, M.S. Thesis, Univ. of Mass.

SAWICKI, V. 1980. The Economic Feasibility of Intensive Culture Oyster Production, M.S. Thesis, Univ. of Mass.

006.055*

CRIS0012991

FARM FISH POND MANAGEMENT

KEVERN N R; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48624.

Proj. No.: MICL00064 Project Type: HATCH
Agency ID: CSRS Period: 22 JUL 44 To 01 JAN 99

OBJECTIVES: Estimate production of plants and animals per unit area or volume of water in farm type ponds, and natural ponds. Determine extent fertilization of ponds will increase production of fish food (plankton, insects) and fish. Devise practical management programs for farm ponds; this includes the number of fish to plant and harvest. Detect and measure possible detrimental effects of use of fertilizers in fish ponds.

APPROACH: Measurement release of stored nutrients in the subaqueous soils by addition of chelating (EDTA, etc.) materials to the waters. Tracing the paths of nutrients added to the waters through tagging nutrients with radioactive tracers (P^{32}), rates of fixation of nutrients and accumulation of organic material (basic productivity) will be measured by the C^{14} light-and-dark bottle technic. Input of solar radiation will be measured.

PROGRESS: 44/07 TO 79/10. The research has contributed significantly to the management techniques of fish ponds in northern, midwestern areas of the United States. These techniques relate to the stocking densities of fish, the species of fish suitable, fertilization rates for ponds and fish and fish food relationships. Northern ponds must be stocked and fertilized differently than southern ponds in many aspects. Competition among sport versus rough fish in ponds results in reduced growth rates of sport fish when ponds are fertilized. This results apparently from lower dissolved oxygen levels in fertilized ponds. Raising of catfish in Michigan for sale is successful when starting the season with advanced fingerlings.

PUBLICATIONS: 44/07 TO 79/10

GALLICWAY, J. E. AND N. R. KEVERN. 1976. Michigan suckers, their life histories, abundance and potential for harvest. Mich. Sea Grant Tech. Rpt. 53: 46 pp.

LU, J. D. AND N. R. KEVERN. 1975. The feasibility of using waste materials as supplemental fish feed. *Prog. Fish-Cult.* 37(4): 241-244.

HAINES, T. A. 1973. Effects of nutrient enrichment and a rough fish population (carp) on a game fish population (small mouth bass). *Trans. Am. Fish. Soc.* Vol. 102: 346-354.

BAHR, T. G., R. C. BALL AND F. F. HOPPER. 1965. Some ecological changes in ponds resulting from treatments of sodium arsenite and copper sulfate. *Michigan Academician*, Vol. 1, Nos.3 and 4.

BAILS, J. D. AND R. C. BALL. 1976. Response of pond metabolism to sodium arsenite. *Papers of Mich. Acad. of Sci., Arts, and Lett.*, Vol. LI.

006.056*

CRIS0071642

FRESHWATER FOOD ANIMALS

REAGEN R E; ROBINETTE H R; WILSON R P; WILDLIFE & FISHERIES SCI; MISSISSIPPI STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI. 39762.

Proj. No.: MIS-0819 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and improve production and management system for freshwater animals cultured for food. Nutrition, genetics and breeding. Evaluate the economics of production processing and marketing of freshwater food animals. Develop and improve products and processing methods that will enhance marketability and insure quality of cultured freshwater food animals.

APPROACH: Project is multidisciplinary with Departments of Biochemistry, Horticulture, Agricultural Economics, and Wildlife and Fisheries. Least cost rations will be tested in aquaria and one-tenth acre ponds. Genetics parameters, heritability, and genetic correlations estimated for several traits with concurrent selection program. Amino acid requirements on quantitative basis and digestibility of common feed stuffs determined for catfish. Processing methods compared for dress out yield, with standard nutritional values of catfish flesh determined.

PROGRESS: 80/01 TO 80/12. Apparent and true amino acid availability values have been determined for the following feed ingredients commonly used in catfish feeds: corn, wheat middlings, rice bran, rice mill feed, soybean meal, peanut meal, cottonseed meal, meat and bone meal, and menhaden fish meal. Fingerling channel catfish appear to be more sensitive to the antinutritional factors present in soybean meal than poultry. Studies are currently being conducted to determine the adverse effects of trypsin inhibitors and flavones in soybean meal on catfish. Duckweed (Family Lemnaceae) was incorporated at 15 and 20% into isocaloric diets formulated to meet or exceed nutritional requirements of channel catfish. Diets containing duckweed performed as well as the control. Cottonseed meal was incorporated into isocaloric diets at 5, 10, 15, 20, and 25% of the basal diet. Growth suppression of channel catfish was noted at the 20 and 25% cottonseed meal levels. The procedure for canning tuna-style channel catfish was refined, further data on heat-processing developed, and work was initiated on a consumer acceptance study. Selection of catfish for weight gain, gain in dress out percentage, and decreased percent fat with 25% for high selection and 25% low selection was completed. Fish will be mated at 2 years of age to decrease age at maturity. A Micro-computer program designed to provide information for Management decision-making has been developed. This system computes daily feeding rates by pond and projects feeding days to harvest.

PUBLICATIONS: 80/01 TO 80/12

WILSON, E.P., ROBINSON, E.E. and POE, W.E. 1980. Amino Acid Supplementation of Practical Type Diets for Channel Catfish. Presented 9th Annual Fish Feed and Nutrition Workshop. Univ. of Washington, Seattle.

WILSON, E.P., POE, W.E. and ROBINSON, E.H. 1980. Apparent and True Amino Acid Availabilities of Common Feed Ingredients for Catfish Feeds. Presented 9th Annual Fish Feed and Nutrition Workshop. Univ. of Washington, Seattle.

WILSON, B.F., POBINSKY, E.H. and POE, W.E. 1980. Antinutritional Factors in Catfish Feeds. Presented 9th Annual Fish Feed and Nutrition Workshop, Univ. of Washington, Seattle.
WALDROP, J.E. and SMITH, R.D. 1980. An Economic Analysis of Producing Pond-Raised Catfish for Food in Mississippi: A January 1980 Update. Dept. of Ag. Economics Research Report No. 103, July.

006.057* CRIS0082872
WINTER FEEDING OF CHANNEL CATFISH IN MISSISSIPPI

ROBINETTE H F; BUSCH E; WALDROP J; WILDLIFE & FISBERIES SCI; MISSISSIPPI STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI. 39762.
Proj. No.: MIS-0851 Project Type: STATE
Agency ID: SAES Period: 15 NOV 80 To 30 SEP 83

OBJECTIVES: Evaluate growth rates, economic implications and water quality of fingerling and food-sized channel catfish winter feeding programs.

APPROACH: There will be four treatments (two experimental feeds two fish sizes) and two controls (no feed x two fish sizes) each replicated three times (18 .04 ha ponds). Fish will be fed as a percent of body weight depending upon water temperature. Fish weight gain, survival, feed conversion and body proximate analysis will be analyzed using a two-way ANOVA. Economic and water quality evaluations will be conducted.

PROGRESS: 80/11 TO 80/12. Project was initiated 15 Nov 1980. All ponds were stocked and feeding adjusted to water temperature is proceeding.

PUBLICATIONS: 80/11 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.058* CRIS0083555
PRACTICAL FEED FORMULATIONS AND FEEDING PRACTICES FOR CATFISH FARMING IN MS

BUSCH R L; TUCKER C S; ROBINETTE H F; DELTA BRANCH EXPERIMENT STA; MISSISSIPPI STATE UNIVERSITY, STONEVILLE, MISSISSIPPI. 38776.
Proj. No.: MIS-0852 Project Type: GRANT
Agency ID: CSFS Period: 18 FEB 81 To 28 FEB 83

OBJECTIVES: Evaluate the practical application of computer derived least cost ration formulations in catfish production ponds; compare experimental rations developed from the most current catfish nutrition information available to a standard commercial ration used throughout the industry; evaluate any effects of peanut meal as a feed ingredient or the shelf life of processed fish; evaluate diet formulation for winter feeding regimes in catfish production ponds.

APPROACH: Experimental rations will be formulated and compared to currently used commercial rations in both summer and winter feeding studies for channel catfish. Research will be conducted with both fingerling and market-size channel catfish cultured in .04/ha earthen ponds.

006.059 CRIS0081602
WATER QUALITY STOCKING RATES AND HARVESTING SYSTEMS FOR CATFISH

TUCKER C S; BUSCH E L; WALDROP J; DELTA BRANCH EXPERIMENT STA; MISSISSIPPI STATE UNIVERSITY, STONEVILLE, MISSISSIPPI. 38776.
Proj. No.: MIS-0842 Project Type: GRANT
Agency ID: CSFS Period: 01 JUN 80 To 30 JUN 82

OBJECTIVES: Estimate production function for stocking rates on methods in ponds; measure water quality factors, production method, diseases; identify factors that limit production; assess costs associated with above and compare these costs.

Compute net returns. Develop and publish recommendations.

APPROACH: Ponds at Stoneville will be stocked at three rates. Fish will be clean harvested at 1.2 pounds. Comparable ponds will be harvested by removing market-size fish. Scientists and producers will recommend production management practices for ponds.

PROGRESS: 80/06 TO 80/12. Work in the past 6 months has been of a preparative nature. Construction of the six 1.62 ha ponds is complete and ponds are now ready for use. Initial sampling of pond soils is completed and most of the materials required to support the proposed research have been obtained. Laboratory equipment necessary to conduct analyses of interest have been obtained and the water chemistry laboratory should be fully operational by March 1, 1981. The rights to 200,000 fingerling channel catfish have been acquired and fish should be on hand by mid-February 1981. Ponds will be stocked and research in progress by mid-March 1981.

PUBLICATIONS: 80/06 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.060 CRIS0071310
PRODUCTION OF MACROBRACHIUM ROSENBERGII (GIANT MALAYSIAN PRAWN IN NEVADA)

TAYLOR R L; VETERINARY MEDICINE; UNIVERSITY OF NEVADA, RENO, NEVADA. 89557.
Proj. No.: NEV00355 Project Type: STATE
Agency ID: SAES Period: 13 AUG 76 To 31 DEC 77

OBJECTIVES: Determine the feasibility of raising prawns in power plant effluents and/or geothermal waters in Nevada.

APPROACH: Obtain prawns, conduct liveability tests, prepare for production. Grow larvae in brackish water, prepare ponds and study pond water parameters. Stock ponds with juveniles, feed, maintain and harvest adults. Study market.

PROGRESS: 80/01 TO 80/12. Thirty five hundred new post larval prawns were stocked in a floating polypropylene net suspended in the main cooling ponds of an electric power production plant. The stocking rate was 10 per cubic meter. The survival rate at the end of a 180 day grow out period was 46% with an average prawn weight of 5 grams. Water temperatures during the test period varied from 20 degree C to 37 degree C

PUBLICATIONS: 80/01 TO 80/12
TAYLOR, R. E. L. 1980. A Feasibility Study on the Production of Macrobrachium rosenbergii (Giant Malaysian Prawn) in Nevada. Bulletin, College of Agriculture, Univ. of Nevada, Reno.

006.061 CRIS0083202
REARING BAIT FISH IN WESTERN NEVADA

TAYLOR R L; VETERINARY MEDICINE; UNIVERSITY OF NEVADA, RENO, NEVADA. 89557.
Proj. No.: NEV00388 Project Type: STATE
Agency ID: SAES Period: 01 OCT 78 To 01 OCT 83

OBJECTIVES: Determine the supply and demand for bait fish used in western Nevada waters. Develop techniques for culture of native minnows acceptable for use in these waters. Encourage development of private commercial operations for raising and selling the suitable species of bait fish.

APPROACH: Collection of adult fish will be made from local waters and a captive population established in the laboratory. Artificial and natural spawnings will be attempted. Egg and fry development stages will be identified and food preferences determined. Growth rates will be determined.

PROGRESS: 80/01 TO 80/12. Adult Lahontan Tui Chubs, *Siphateles bicolor obesus*, obtained from Walker Lake, Nevada were successfully spawned both artificially and naturally. Spawning mats made of Spanish Moss were a satisfactory egg substrate although the development of fungus on some eggs was a common problem. About 50% of chubs fed trout meal and screened brine shrimp flakes for the first 21 days survived. After 21 days mortality was minimal for chubs fed live brine shrimp naupliae. Survival of newly hatched fish raised in a semi-natural pond environment and not fed appeared to be as good as those raised in troughs and fed artificial diets.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.062* CRIS0028020
NATURAL SEED OYSTER BEDS OF THE DELAWARE BAY

HASKIN B B; OYSTER CULTURE; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ32500 Project Type: STATE
Agency ID: SAES Period: 01 OCT 62 To 01 JAN 99

OBJECTIVES: Develop information on and conduct research leading to the goal of disease-free oysters in the Delaware Bay area.

APPROACH: Conduct such field and laboratory studies on MSX in oyster populations as required. Advise the Delaware Bay authorities of the best management practices to preserve good seed beds and develop new beds.

PROGRESS: 80/01 TO 80/12. The oyster planters of Delaware Bay depend almost exclusively on the State-controlled natural seed beds of the upper Bay for their supply of seed oysters which are planted on privately-leased beds in the lower Bay. Under this project our laboratory provides basic information on the seed beds and recommendations for their management to the State Division of Fish, Game and Shell-fisheries. In 1980 over 400,000 bushels of seed oysters were removed from the beds in the regular spring planting season. Based on our recommendations, two of the Beds, Egg Island and the Ledge, and a major portion of New Beds, were closed to the taking of seed because of a preponderance of small oysters of the 1975 and 1979 year classes. Following the spring-early summer dredging, a moderate to light general set of 1980 year class oysters occurred on the seed beds. MSX disease mortalities in the 1980 planted stocks were unusually heavy in the summer, fall and early winter of 1980-81. Mortalities in oysters on the lower seed beds were 1/2 to 1/3 those on the planted grounds immediately below the boundary, the Southwest Line separating seed beds and leased bottom. Based on these data and those of the preceding 20 years establishing that similar differential mortalities between seed beds and planting grounds have been the general rule.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.063* CRIS0066259
SURF CLAM MANAGEMENT STUDIES

HASKIN B B; OYSTER CULTURE; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ32503 Project Type: STATE
Agency ID: SAES Period: 26 JUN 74 To 30 JUN 82

OBJECTIVES: Determine the capacity of inshore surf clam beds near Atlantic City to sustain increased commercial harvest because of the partial depletion of the large offshore beds.

APPROACH: Selected bed areas sampled in 1972 will be open to dredging and two 6-square mile areas including high density clam populations will be closed to commercial harvest. Monitoring of all beds will include settling intensity of larvae, juvenile mortality, juvenile growth, to determine if retaining brood stock is necessary to maintain recruitments.

PROGRESS: 80/01 TO 80/12. The surf clam resource off the coast of New Jersey lies both in State waters, inside the three-mile limit, and offshore in Federal waters. Under State and Federal financing the population in New Jersey waters has been under detailed study since 1972, that in Federal waters has had some attention in this project since 1978. New Jersey began its management of the State resource in January 1977 and has based its annual quota and its decisions on areas closed to harvest on the results of our annual inventories. The work in Federal waters has resulted in the closure of a 120-square-mile area off Atlantic City and similar, though smaller, areas off Maryland and Virginia. The closures in all cases have been designed to prevent wasteful harvest of small clams. Until 1976 the New Jersey inshore resource was in steady decline under harvest pressure with no significant recruitment. The 1976 year class of clams set heavily in the Atlantic City area and survived well. The population of this year class in an area extending roughly 20 miles along the coast and centered on Absecon Inlet has more than doubled the standing stock of clams in New Jersey waters between Shark River and Cape May Inlet. The same year class also set and survived in Federal waters. The 120-square-mile closed area off Atlantic City has a population which we estimate at 17 million bushels.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

006.064 CRIS0078907
OYSTER DRILL CONTROL BY HYDRAULIC DREDGING IN DELAWARE BAY

HASKIN B B; OYSTER CULTURE; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ32502 Project Type: STATE
Agency ID: SAES Period: 28 JUN 78 To 27 JUN 81

OBJECTIVES: Increase oyster production in Delaware Bay by reducing losses to predation by oyster drills in a cost-effective way.

APPROACH: Construct a hydraulic dredge; install it on a boat; adjust it for removal of oyster drills and associated materials, from the upper layer of oyster bottom; separate the drills from larger and smaller materials by a system of screen conveyers; destroy the drills; and return the associated materials to the bottom immediately so as to maintain stability to the oyster bottom.

006.065* CRIS0077773
ECOLOGY AND MANAGEMENT OF WALLEYE

FORNEY J L; NATURAL RESOURCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147331 Project Type: STATE
Agency ID: SAES Period: 30 MAR 79 To 30 SEP 82

OBJECTIVES: Define the role of interspecific competition and predation in governing walleye recruitment from an analysis of fish community structures.

APPROACH: Reproductive success of walleye as measured by abundance of young and age composition of the population will be compared with size distribution and species composition of fish communities in a wide spectrum of lakes. Information on community structure will be gathered primarily from the catch in gillnets and trawls. More specific information on the nature of interspecific competition and predation will be generated by following the fate of larval and fingerling walleye stocked in lakes with different densities and assemblages of potential predators or competitors. Role of walleye in restructuring fish communities will be assessed from pre- and post-surveys of lakes where walleye populations are established by stocking.

PROGRESS: 80/01 TO 80/12. Beginning with a strong year-class in 1962, the walleye population in Chautauqua Lake, New York expanded from an occasional adult to over 50,000 mature fish in 1978. Analysis of scale samples, tagging records and other data showed that recruitment stabilized while growth and survival of walleye declined during the period of population expansion. Recruitment was initially highly variable with three year classes contributing 91% of the adult stock from 1962-1973, but subsequent cohorts were more uniform in size. Average length of a 5-year old male decreased from 515 mm in 1966-1973 to 436 mm in 1980 while adult survival declined from near 100% to about 70%. As walleye stocks expanded numbers of adult muskellunge decreased in the 1970s to about one-fourth the levels which prevailed in earlier years. The timing of events suggests the increase in walleye may have contributed to the collapse of muskellunge but analysis of historical data did not reveal any evidence of direct interactions. Reduced growth and survival may limit further expansion of walleye stock and favor development of a new equilibrium with muskellunge.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.066* CRIS0067977
BIOLOGICAL, TECHNICAL, AND ECONOMIC STUDIES OF
CULTURED AQUATIC RESOURCES

NICKUM J G; NATURAL RESOURCES; CORNELL UNIVERSITY,
ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147319 Project Type: STATE
Agency ID: SAES Period: 12 MAY 75 To 31 DEC 80

OBJECTIVES: The Cornell Aquaculture Program include measurement and evaluation of changes in the effluent quality from oxidation ponds due to filtration by confined populations of daphnids and measurement and evaluation of yield of daphnids from confined populations receiving effluents from oxidation ponds.

APPROACH: Daphnid populations will be confined in partially submerged cages which will receive flows of algae laden water from algal culture systems and/or small oxidation ponds. The effects of variation in concentration of algae, velocity of flow, and cage depth will be tested at three different levels for each parameter. Changes in effluent water quality will be measured by comparing the quality of water entering the daphnid cages with that of the water that has flowed out of the cages. Daphnid populations will be harvested on a pre-determined schedule, dried and weighed to determine production.

PROGRESS: 80/01 TO 80/12. This project was initiated in August 1978 as an investigation of the impacts of manure fertilization on the water quality and production potential of New York fish ponds. The field season (April-October) of 1980 was a period of great activity on the project. Six experimental ponds were fertilized at three levels of manure (no manure, 2500 kg/ha and 12,300 kg/ha) and stocked with larval walleye, *Stizostedion vitreum*. The manure was effluent from an experimental methane digester. The physical and chemical response was monitored through analysis of nitrogen and phosphorus concentrations, light penetration, dissolved oxygen levels, water temperature, pH and alkalinity. The biological response was monitored by measuring production and consumption of oxygen by the phytoplankton community, chlorophyll concentration and form (a, b and c), zooplankton biomass and community structure, and fish growth. Fish survival was estimated. Attempts to model oxygen and ammonia levels, and to assess the variability in predicted values show that minimum oxygen levels can be predicted from manure load, temperature and chlorophyll values. Ammonia levels can be predicted from load, temperature, pH and chlorophyll. The research under this project has been transferred to the Agronomy Department, Cornell University.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

006.067* CRIS0075225
INTENSIVE CULTURE OF THE WALLEYE (PERCIDAE:
STIZOSTEDION VITREUM)

NICKUM J G; NATURAL RESOURCES; CORNELL UNIVERSITY,
ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147382 Project Type: STATE
Agency ID: SAES Period: 01 JAN 78 To 31 DEC 80

OBJECTIVES: Develop and production diets for walleyes based upon the nutrient content of walleye eggs and/or body tissues. Compare growth and survival of walleye fry and fingerlings fed experimental diets with growth and survival of fry and fingerlings fed live diets. Determine the combination of environmental conditions which obtains the highest survival and most rapid growth of walleye fry and fingerlings. Monitor any histological and/or chemical differences in the tissues of walleye fry and fingerlings reared on various diets. Evaluate the relative economic energy and nutrient efficiencies of intensive walleye culture versus extensive walleye culture.

APPROACH: Experimental diets will be developed in collaboration with the Tunison Laboratory of Fish Nutrition. All growth and survival tests will be conducted in triplicate in running water systems at temperatures between 10°C and 21°C. "Mini"-troughs of six-liter capacity will be used. Lots of 200 walleye fry or 30 walleye fingerlings will be used and feeding trials will be scheduled for 10 weeks. Fish will be fed at five minute intervals with automatic feeders. Five fish from each lot will be selected for histological and pathological analyses. Total costs in terms of nutrients, energy, and money will be determined and compared with those incurred in rearing walleyes under extensive conditions.

PROGRESS: 80/01 TO 80/12. Intensive culture of walleye through all stages of their early life history requires knowledge of the factors effecting the successful conversion of post hatch larvae to artificial or natural diets. Massive mortality of fry usually occurs as they fail to initiate feeding. This study has assessed the role of available energy in the yolk sac to larval development and the role of feeding initiation in increased survival of fry in cylindrical rearing units. Caloric energy deficits occur in fry at 7 days (20 degrees C) but no survival differences were detected in fish which initiated feeding at 2, 4, or 6 days of age. Death due to starvation occurred at 14 and 21 days for walleye fry held at 17 and 20 degrees C respectively. Survival and growth of juvenile walleye were strongly influenced by the shape of the rearing unit and direction of water flow within the unit. Significantly better results were obtained in hatching jars with an upwelling flow of water in comparison to troughs. Better performance of the cylindrical units could be attributed to two factors: improved food suspension time and reduced competition for food.

PUBLICATIONS: 80/01 TO 80/12
CORAZZA, L. 1980. Intensive Culture of Walleye: Factors Affecting the Ability of Juveniles to Utilize a Dry Diet. Ph.D. Thesis, Cornell Univ. 78 pp.
JAHNCKE, M. 1980. Selected Factors Influencing Mortality of Walleye Fry in Intensive Culture. M.S. Thesis, Cornell Univ. 45 pp.

006.068 CRIS0082309
INTENSIVE CULTURE OF CRAYFISH

YOUNGS W D; NATURAL RESOURCES; CORNELL UNIVERSITY,
ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147423 Project Type: HATCH
Agency ID: CSRS Period: 28 AUG 80 To 30 SEP 83

OBJECTIVES: Develop an intensive culture method for crayfish suitable for use in northeastern U.S. Growth, mortality and time of sexual maturity will be evaluated to assess the feasibility of intensive culture of crayfish.

APPROACH: Modular unit which isolates individual crayfish, allows reuse of water and occupies minimal space will be designed. Growth will be measured by weekly weighing of individual crayfish; mortality will be determined by weekly period. Feasibility will be determined on the basis of potential economic value taking into consideration growth and mortality of crayfish and the cost of building and operating a culture system.

PROGRESS: 80/01 TO 80/12. This is a new project which started in October, 1980. Intensive culture of crayfish has not been successfully attempted in the Northeast; most species of crayfish are very aggressive which results in mortality when crowding is attempted. The approach in this project is to develop a system whereby each individual can be confined with large numbers in a small space. The concept for such a system has been formed and construction of the components of the system has been started.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.069 CRIS0079S84
DEVELOPMENT OF INEXPENSIVE AQUACULTURE SYSTEMS FOR HOME (SUBSISTENCE-TYPE) CULTURE IN N. C.

HASSLER W W; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05448 Project Type: STATE
Agency ID: SAES Period: 01 JUL 79 To 30 SEP 82

OBJECTIVES: To develop inexpensive and efficient methods of fish culture for home consumption. To determine best species of fish and algae for home culture. To determine costs involved in home culture system.

APPROACH: Use translucent solar-algae tanks and use solar energy to grow algae which can be utilized by herbivorous fishes (tilapia). Determine methods of utilizing solar-algae tanks throughout year: outside with insulation; within greenhouse; outside with cold-tolerant species; outside with solar collectors. Determine production of different species in monoculture, polyculture, and disseasonal use.

PROGRESS: 80/01 TO 80/12. Blue tilapia (*Saratherodon aureus*) were grown to edible size (211 g) in backyard fish tanks in approximately 6 months. There was no significant difference in the growth rates of blue tilapia and hybrid tilapia. Rainbow trout stocked (41 g) fish were harvested at 309 g. Water temperatures were modified by using saran shades and tank placement during the summer. Plastic insulation and solar exposure were used to maintain winter temperatures. Wind-proof covers were also devised for the tanks. Water recycling was accomplished by floating trickling filters at the tank surface. Ammonia control was effected by using clinoptilolite in an improvised, air-lift filter.

PUBLICATIONS: 80/01 TO 80/12
NC PUBLICATIONS REPORTED THIS PERIOD.

006.070* CRIS0078543
AN EVALUATION OF STRIPED BASS X WHITE BASS HYBRIDS AND STRIPED BASS X WHITE PERCH HYBRIDS

KERRY J B; HUISS M T; KELLER K R; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05430 Project Type: STATE
Agency ID: SAES Period: 01 JAN 79 To 31 DEC 81

OBJECTIVES: To evaluate the potential of striped bass x white bass and striped bass x white perch hybrids for use in aquaculture and to disseminate acquired knowledge to interested individuals.

APPROACH: Hybrids will be cultured in 0.1 hectare ponds using both fresh and brackish (ca. 10 0/100) water sources. Two ponds will be used for cage culture experiments to evaluate hybrid response to limited space and crowding. The experiments will provide data concerning comparative survival, growth and adaptability of the two hybrids to pond and cage culture in both fresh and brackish water. Additionally, food preferences of the larval hybrids will be determined.

PROGRESS: 80/01 TO 80/12. Approximately 1.3 million larval striped bass x white bass and 0.6 million striped bass x white perch larvae were produced using artificial fertilization procedures, demonstrating for the second year that the hybrids can be readily produced using existing techniques. Most were placed into intensive culture troughs at the project site. The remainder were stocked in ponds at the Dennis Wildlife Center and the Orangeburg National Fish Hatchery in South Carolina for grow-out to fingerlings. Because culture ponds were not completed at the project site, fish were cultured under intensive conditions in the laboratory and in a series of 24-foot diameter (11,000 gallon capacity) plastic-lined pools. An important advance was development of a method to train larvae to accept dry diet at an earlier age. By presenting large concentrations of small particles of the dry food, and by keeping it in constant motion through vigorous aeration of the water, we were able to convert the larvae to dry diet at about 15 mm. Previously larvae did not convert until they were 40 mm long. Fingerling striped bass x white bass hybrids obtained from the Orangeburg NFH in January were grown in plastic-lined pools and in cages until September 1980. Mean weight when stocked was 8.1 g (range = 3.0 - 33.0 g). At harvest the fish weighed an average of 268 g (range = 32 - 522 g).

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.071* CRIS0073509
LIMNOLOGY OF FARM PONDS

MILLER J M; ZOOLOGY; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC03596 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 77 To 30 SEP 80

OBJECTIVES: Determine the important factors controlling quality and quantity of fish production in N.C. farm ponds. Develop a capability to diagnose and recommend treatment for various pond problems - fish disease, fish die-off, nuisance weeds, etc. Collaborate with others as necessary in publishing and revising guidelines for farm pond management as Ag. Extension Bulletins.

APPROACH: During the first year, determine the ranges of farm pond types in North Carolina and their important physico-chemical and biological factors influencing fish production. Begin intensive studies to determine the relationships between the above and fish production and pond "problems." This will include experimental manipulations in small enclosures in some ponds, food chain studies and a survey of fish parasites. Follow-up studies of fish stockings by the State will be performed.

PROGRESS: 77/07 TO 80/09. Ranks of the primary productivities of 3 study ponds in the Raleigh area were: L-26; Yates and A-2. Zooplankton was highest in Yates, while benthos was highest in L-6. Competition, measured as dietary overlap between size classes of fish, was highest in A-2, and least in L-6. Competition was most severe in mid-summer, suggesting growth depression. Turbidity depressed feeding rates of bluegill sunfish 50% but did not cause a shift in preferred prey size. Perceptual bias was not responsible for the size selection of prey; rather a hypothesis of behavioral preference was supported. Data collected from previous years was assembled as a basis for submitting a proposal to OWEI entitled "Effects of Low-Level Turbidity on Fishes". This proposal was accepted and a grant of \$126,108 was awarded 1 October 1979. A technique using radioactive

glycine uptake by fish scales was developed to determine short-term growth rates of fishes in relation to turbidity. A method was developed to separate the effects of biotic and abiotic particles on turbidity. A precipitation technique for manipulating turbidity in ponds was developed. A 50 channel, computer interfaced, scanner was purchased to continuously monitor relative humidity, water and air temperature, oxygen, wind speed and direction and light.

PUBLICATIONS: 77/07 TO 80/09

GARDNER, M.B. 1979. The Effects of Turbidity on Feeding Rates and Prey-Size Selection by the Bluegill Sunfish (*Leponis macrochirus*): a Test of a Foraging-Strategy Hypothesis. M.S. Thesis. Dept. of Zoology, NCSU.

006.072*

CRIS0072485

POTENTIAL HARVEST OF LAKE ERIE WHITE CRAPPIE FROM AN ADJOINING BORROW PIT

TRIPLETT J R; LECKIE F D; FISHERIES & WILDLIFE; CBIO AGRIC RES AND DEVL P CENTER, WOOSTER, OHIO. 44691.
Proj. No.: OBC00258 Project Type: STATE
Agency ID: SAES Period: 01 JAN 77 To 31 MAR 79

OBJECTIVES: Determine the potential for increasing accessibility and harvest of fish populations, particularly white crappie, from large bodies of water through fisheries in small adjoined bodies of water.

APPROACH: The study area will be mapped. Basic limnological parameters will be monitored in the borrow pit and the immediate bay area to detect differences or potential limiting factors. Mark and recapture studies, sonar scans, test netting and electrofishing will provide an estimate of migration into and out of the immediate bay area and the borrow pit. Fishing pressure and total harvest in both areas will be estimated by creel surveys. The population structure of white crappie will be determined and compared in both areas from fish sampling data. Management recommendations will be developed on the basis of the significance of migrations and possible causes.

PROGRESS: 77/01 TO 79/03. In 552 hours of sampling, a total of 938 adult fish (19 species) moved through a culvert connecting a borrow pit with Sandusky Bay. Of these, 506 (53.9%) were moving from the Bay into the borrow pit. White crappie (6.3%) and black crappie (4.1%) together represented a greater percentage of the total catch than all other species except gizzard shad and brown bullheads. Culvert current direction regulated the direction of fish movements; of 755 movements during discernible flow, 82.9% were counter current. Spawning activity appeared to determine which species, what size, and when movements occurred. In the borrow pit, larger, older fish of both crappie species were prevalent in the spring inshore trap sets, culvert movements, and the fishermen's creel, while smaller crappie (150mm or less) were abundant offshore and dominated the summer fish collections. Black crappie consistently showed up earlier than did white crappie in all sampling methods. This difference in the timing of seasonal activities between the two indicated that black crappie are active earlier in the spring, and suggested black crappie may spawn earlier than white crappie. The estimated net gain of adult white and black crappie moving into the borrow pit potentially represented 7.6% and 6.1% of each species harvest respectively.

PUBLICATIONS: 77/01 TO 79/03

NO PUBLICATIONS REPORTED THIS PERIOD.

006.073*

CRIS0079845

FEASIBILITY OF CAGED FISH CULTURE IN NORTH CENTRAL OKLAHOMA FARM PONDS

MAUGHAN O E; HOWMAN D B; LANGSTON UNIVERSITY, LANGSTON, OKLAHOMA. 73050.

Proj. No.: OXIX-8085-15-5

Project Type: 1890/T

Agency ID: CSRS

Period: 01 OCT 79 To 30 SEP 84

OBJECTIVES: Study production and cost of caged fish in small ponds in Central Oklahoma, investigate and test the feasibility of caged fish in a normal farm or ranch operation.

APPROACH: Channel catfish will be grown in cages and fed pellets containing 30-35% protein, and Tilapia will be grown in cages and fed pellets containing 25-30% protein. Oxygen and temperature will be measured daily at feeding time to develop a profile as if they relate to growth. Record as to marketing and home consumptions and cost will be kept to determine return on investment.

PROGRESS: 80/01 TO 80/12. Cage culture appears to be economically feasible in small (less than 2.0 ha) farm ponds and has potential for generating a small additional source of income (estimated to be \$744.00/ha) and/or producing low cost food for the farm family. Ponds that are clear (depth of visibility greater than 1.0 m) and shallow (depth less than 1.0 m over half of the pond) should probably not be used for cage fish culture unless aquatic vegetation control is implemented. Channel catfish fingerlings should be 150 to 200 mm in total length when stocked if a large proportion of marketable size fish are to be produced in one year in Oklahoma. Tilapia appear to stimulate channel catfish feeding and therefore increase production. The optimum ratio appears to be a very high ratio of catfish to tilapia. The optimum density of fish per cage appears to be about 400 fish per cubic meter with an anticipated harvest weight of 0.45 kg.

PUBLICATIONS: 80/01 TO 80/12

GEBBART, G.E. and MAUGHAN, C.E. 1980. Feasibility of Mixed Cage Culture of Tilapia and Channel Catfish. Inland Commercial Fisheries Association. 14 March 1980, Nashville, TN.

GEBBART, G.E. and MAUGHAN, C.E. 1980. Cage Fish Culture in Small Farm Ponds in Oklahoma. Oklahoma Academy of Science, November 14, 1980. Norman, Oklahoma.

006.074*

CRIS0068960

BIOLOGICAL FEASIBILITY OF INTENSIFIED OYSTER CULTURE

BREESE W P; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.

Proj. No.: ORE00338

Project Type: STATE

Agency ID: SAES

Period: 01 JUL 75 To 30 JUN 81

OBJECTIVES: Out-bay culture will investigate the biological and economic feasibility of pond or raceway culture under controlled conditions. This will yield data on the influence of parameters such as water volumes, currents and seeding density on oyster growth. Efforts will also be made to correlate changes in available natural food, as measured by dissolved and particulate organic carbon and nitrogen, with changes in oyster growth. These studies may also encourage investors by demonstrating the reduced threat to culture facilities from floods, winds and storms.

APPROACH: Hatchery-produced seed oysters will be placed on the bottom of commercial oyster growing grounds, on oyster growing trays and on experimental rafts. The growth and survival of these oysters will be monitored over a two-year period beginning in the spring of 1975. These data will provide a means of evaluating the relative efficiency and productivity of the various culture methods. Concurrent with the placement of seed oysters in the field, oysters from the same brood group will be held in an existing out-bay rearing pond provided with pumped seawater. The growth and survival of these oysters will be monitored for comparison with other rearing methods. Refinement of the out-bay culture method will be a continuing process.

PROGRESS: 80/01 TO 80/12. Cultchleee seed was again planted in Tillamook Bay. As we have had no ice or adverse weather to date, growth and survival data should be collected in the Spring of 1981. *Crassostrea rivularis* has been accepted by some of the growers and eyed larvae andeed are available from two commercial hatcheries. Monthly sampling of the Kumamoto oyster is complete. Three years of data shows this oyster to mature later in the year. As this oyster is a warm water spawner (25 degree C), this data agrees with our laboratory data which says low temperature delays sexual maturation but does not affect the rate of maturation. For the second year we have successfully spawned this oyster in late summer. Eyed larvae as a seed source is gaining popularity. A failure of domestic wild seed has increased the interest in hatchery seed. Techniques for handling eyed larvae are being perfected. Four hatcheries are now producing eyed larvae for sale. Communication. Held a workshop in Astoria for Oregon and Washington growers to explain the eyed larvae technique for obtaining oyster seed. Visited the interested growers and helped them with the technique of setting eyed larvae.

PUBLICATIONS: 80/01 TO 80/12

- LANNAN, J.E. 1980. Broodstock Management of *Crassostrea gigas* I. Genetic and Environmental Variation in the Larval Rearing System. *Aquaculture* 21:323-336.
- LANNAN, J.E., ROBINSON, A.M. and BREESE, W.P. 1980. Broodstock Management of *Crassostrea gigas* II. Broodstock Conditioning to Maximize Larval Survival. *Aquaculture* 21:337-345.
- LANNAN, J.E. 1980. Broodstock Management of *Crassostrea gigas* III. Selective Breeding for Improved Larval Survival. *Aquaculture* 21:347-351.
- LANNAN, J.E. 1980. Broodstock Management of *Crassostrea gigas* IV. Inbreeding and Larval Survival. *Aquaculture* 21:353-356.
- MURANAKA, M.S. 1980. Broodstock Management of the Pacific Oyster *Crassostrea gigas* (Thunberg), M.S. Thesis. Ore. State Univ., 55 pp.

006.075

CRIS0084301

MOLLUSCAN HATCHERY TECHNOLOGY

BREESE W P; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00913 Project Type: STATE
Agency ID: SAES Period: 01 JUL 81 To 30 JUN 84

OBJECTIVES: This project proposee to adapt the hatchery techniques developed for the Miyagi variety of *Crassostrea gigas* to selected oysters, clams and the sea mussel. Species chosen are Kumamoto oysters, gaper, cockle and razor clams and the sea mussel. This should result in hatchery techniques for most of these mollusks.

APPROACH: The above mentioned oysters, clams and mussel will be brought to the laboratory at or near their natural spawning cycle, conditioned if necessary and then induced to spawn. The resulting eggs will be fertilized and reared through the larval free swimming period. Variables will be temperature and salinity. Newly set seed will be reared to various sizes and then planted in several estuaries to determine techniques that exhibit the greatest survival and growth.

006.076*

CRIS0064796

CULTURE OF PACIFIC SALMON

LANNAN J E; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00163 Project Type: STATE
Agency ID: SAES Period: 01 JUL 73 To 30 DEC 84

OBJECTIVES: Determine the relationship between incubation density and fry quality in shallow gravel incubators.

APPROACH: Chum salmon eggs will be incubated at six densities ranging from 1000 to 10,000 eggs per square foot of gravel, with six replicates of each density. Emergence timing, size at emergence, yolk utilization and proximate tissue analysis will be compared between and within treatments (densities). The fry quality criteria will also be compared to natural fry. Samples from each treatment will be marked and released and the relationship between density and survival subsequently observed.

PROGRESS: 80/01 TO 80/12. Within the tested range of 1000 - 7000 eyed eggs/ft² gravel substrate (1.08 - 7.53 eggs/cm²), the optimum stocking density for chum salmon (*Oncorhynchus keta*) eggs in shallow matrix substrate incubators occurred at 3,000-4,000 eggs/ft². Premature fry, which predominated early emergence, showed greater variability in lipid content than fry at peak emergence. Cumulative premature fry emergence was lowest at 3000 - 4000 eggs/ft² and highest at 5000 - 7000 eggs/ft². Early emerging fry are considered to be of lesser quality than peak emerging fry because the observed increase in variation in lipid content (i.e. primary energy reserve) may lead to increased variation in survival during seaward migration. Neither survival (from egg stocking to emergence) nor the gross body composition (determined by proximate analysis) of emerging fry were affected by egg stocking density. Development indices decreased in a linear fashion throughout emergence but the slope and intercept of the line did not differ among egg stocking densities. The frequency of yolk sac abnormalities was negligible in all treatments. The water content of fry increased from early to late emergence while dry weights remained relatively constant. The implications of this observation are discussed. Application of these results depends on the relative importance of biological vs. economic optimization in a hatchery. 3,000-4,000 eggs/ft² favors high quality fry production, while 7,000 eggs/ft² minimizes the cost of producing each fry.

PUBLICATIONS: 80/01 TO 80/12

- KAPUSCINSKI, A. 1980. In Search of the Optimum Stocking Density for Chum Salmon (*Oncorhynchus keta*) Eggs in Shallow Matrix Substrate Incubators. M.S. Thesis. Oregon State Univ. Corvallis, Oregon. 36 pp.

006.077*

CRIS0083604

PERFORMANCE OF SALMONIDS: SMOLTIFICATION, STRESS AND FITNESS

SCHRECK C B; FISHERIES & WILDLIFE; OREGON STATE UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00908 Project Type: STATE
Agency ID: SAES Period: 02 FEB 81 To 30 JUN 86

OBJECTIVES: Increase percent return of anadromous salmonids by providing an understanding of the functional basis of parr-smolt transformation. Monitor clinical indicators of smoltification. Conduct tests of performance as indicators of smolt quality to signify effects of rearing conditions on development.

APPROACH: Analyze clinical criteria of smoltification, particularly those associated with the endocrine system. Specifically, determine effects of loading regimes on smolt performance criteria; determine effects of loading regimes on smolt-indicators; determine correlations of smolt-indicators and performance and determine effects of loading on food consumption and feed conversion efficiency and correlate nutritional status with smolt performance and smolt-indicators.

006.078*

CRIS0066734

STOCK DYNAMICS AND ASSESSMENT IN MARINE FISHERIES

TYLER A V; FISBERIES & WILDLIFE; OREGON STATE
UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: O5E00254 Project Type: STATE
Agency ID: SAES Period: 01 JUL 74 To 30 JUN 81

OBJECTIVES: Provide a revised statistical area map for landings of Oregon groundfish that will improve assessment of fish stocks and provide the basis for a standardized inter-state unit of fishing effort.

APPROACH: Compile and chart local distribution of recent Oregon landings of principal groundfish species from commercial log-book data of the Fish Commission of Oregon. Analyze and chart distribution of major assemblages of continental shelf fishes, including principal species landed, potentially exploitable species, and minor species. Analyses will be made with recurrent group, species-association coefficient methods. Based on the distribution of major assemblages of fishes, develop a proposal for revised statistical reporting areas that will be small enough to allow analysis of the status of individual stocks. This map will also provide the basis for a standardized inter-state unit of fishing effort.

PROGRESS: 80/01 TO 80/12. We propose that management concerns for continental shelf fishes must include not only yield maximization goals on target species (modified by social concerns to CY), but also fish assemblage maintenance goals. MSY oriented management has been shown with models to simplify fishery systems toward species with highest productivity rates. However, there is no assurance that simplified, high production portions of formerly species-rich assemblages can persist in ocean systems. Our analyses of research trawling surveys have indicated there are geographic fish-species assemblages. We conceptualize that each assemblage is part of a geographically definable natural production system of interacting organisms (a "community"). The "regular" species of the community having strong trophic linkages among themselves comprise an "assemblage production unit" (APU). The "regular" species are those that are present in every season. As a management technique for the APU, we propose that monitoring the transition states following controlled pulse fishing by the commercial dragger fleet may be a means of exploring and maintaining the viability of the APU's. These pulses could be applied simultaneously to a group of near-replicate APU's. The goal would be to find the limits of repetitive pulse fishing that would allow persistence of APU structure

PUBLICATIONS: 80/01 TO 80/12

HAYMAN, E.A., TYLER, A.V. and DENORY, R.L. 1980. A Comparison Between Cohort Analysis and Catch per Unit Effort Using Dover Sole (*Microstomus pacificus*) and English Sole (*Paraphrys vetulus*). *Trans. Am. Fish. Soc.* 109:35-53.

HAYMAN, E.A. and TYLER, A.V. 1980. Environment and Cohort Strength of Dover Sole (*Microstomus pacificus*) and English Sole (*Paraphrys vetulus*). *Trans. Am. Fish. Soc.* 109:54-70.

GABRIEL, W.L. and TYLER, A.V. 1980. Preliminary Analysis of Pacific Coast Demersal Fish Assemblages. *Marine Fisheries Review*. March-April: 83-88.

006.079*
FRESHWATER FOOD ANIMALS

CFIS0076533

MCGINTY A S; ANIMAL INDUSTRY; UNIVERSITY OF PUERTO
RICO, RIO PIEDRAS, PUERTO RICO. 00928.
Proj. No.: P100322 Project Type: BATCH
Agency ID: CSRS Period: 14 SEP 78 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals cultured for food: Nutrition, genetics and breeding and culture systems.

APPROACH: Experiments will be designed to determine practical feeds for *Tilapia* spp. under tropical conditions. Digestibility coefficients for these diets will be determined for each species. Development and evaluations of suitable breeding and

sexing techniques for mass production of *Tilapia* species and monosex hybrids. Determine optimum stocking densities and growth of *Tilapia* spp. in cage cultures and ponds utilizing supplementary feeding and/or pond fertilization. Flavor and texture of the fish (fresh and processed) will be determined by organoleptic tests.

PROGRESS: 80/01 TO 80/12. Six 1 x 3 floating cages were suspended in three 0.1 ha ponds and stocked with either 150, 300, 450, or 650 *Tilapia nilotica* fingerlings (75 to 125 mm/long) per cage. At least one of these densities was either fed a 30% protein sinking pellet at a rate of 4% total body weight daily, six days per week, or not fed. This preliminary study was conducted for 77 days at which time the fish from each cage were weighed and measured. Fish that were not fed merely maintained their initial stocking weight, regardless of density. Fish fed 4% daily gained 0.77, 0.70, 0.59, and 0.53 g/day in cages stocked with 150, 300, 450, and 600 fish/cage, respectively. This indicated *T. nilotica* fed a complete ration grew at a slower rate in cages when stocked at higher densities. The above preliminary study indicates the need to determine the optimum stocking density of *T. nilotica* in cages. The effects of pond size may also be important and needs to be studied in conjunction with density. An experiment will be conducted during 1981 to determine these effects. Cages will be suspended in ponds of either 0.70 ha or 0.16 ha and stocked with either 250, 500, 750, or 1000 fingerlings/cage. All fishes will be fed an equal percentage of the total body weight per cage.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

006.080*
ABATEMENT OF EUTROPHICATION RESULTING FROM INTENSIVE ANIMAL PRODUCTION

CFIS0064402

MEADE T L; ANIMAL SCIENCE; UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: RI00822 Project Type: STATE
Agency ID: SAES Period: 01 JUL 73 To 30 SEP 80

OBJECTIVES: Develop practical methods for: Removal of metabolites from fish culture water that render it unsuitable for re-use. Treatment of fish culture water to meet existing and projected standards for discharge. Removal and treatment of suspended solid wastes in fish culture water. Adaptation and/or modification of processes for treatment of fish culture water and solid waste in treatment of waste from intensive livestock and poultry production.

APPROACH: Primary treatment will involve physical screening and aerobic digestion. Secondary treatment will involve aerobic digestion of solids, denitrification by continuous microbial reduction and reoxygenation of effluent.

PROGRESS: 77/06 TO 80/09. Solids removal is one of the more difficult unit processes involved in water reuse systems for the culture of salmonids. Traditional settling basins effectively remove settleable solids but suspended solids are normally entrained in the associated biological filter where their buildup impairs nitrification efficiency and necessitates periodic cleaning. Alternate methods of solids removal were evaluated. Studies with a pulsed rapid sand filter indicated that a 12 cm. atracite coal bed over a 7.5 cm. sand bed resulted in a 66 percent removal of suspended solids at acceptable hydraulic loading rates. Studies with an inclined 40 mesh stainless steel static screen indicated that up to 38 percent of the suspended solids could be removed at a hydraulic loading rate of 122 liters/m²/minute. Combining a plate settler with an 80 mesh stainless steel screen resulted in a 71 percent removal rate when the influent contained 77 mg/l of suspended solids. The relatively poor results obtained lead to investigation of "in situ" solids digestion in a system using 10 o/oo salinity water. Solids concentration was reduced 97 percent. This work will be continued in freshwater systems.

PUBLICATIONS: 77/06 TO 80/09

LLOYD, S.W. 1980. Solids removal from fish culture systems. M.S. Thesis, University of Rhode Island, Kingston, RI 50 p.

006.081 CRIS0084296
INVESTIGATION OF "IN SITU" SOLIDS DIGESTION FOR SALMONID PRODUCTION

WEADE T I; WELKE F E; AQUACULTURE SCI & PATHOLOGY; UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.

Proj. No.: R100851 Project Type: HATCH
Agency ID: CSRS Period: 01 JUN 81 To 30 SEP 83

OBJECTIVES: To reduce the cost of water treatment in salmonid production by "in situ" solids digestion. To characterize the microbial processes involved in an intermediate salinity (10 o/oo) environment. To evaluate selective nutrient enrichment of fresh water to achieve "in situ" solids digestion. To insure that fish health is not impaired when "in situ" solids digestion is carried out in the culture system.

APPROACH: Solids production in a non-enriched fresh water environment will be determined and compared with published predictive factors. Recoverable solids will be determined in both intermediate salinity and selectively enriched fresh water environments to determine percent of "in situ" digestion occurring. Fish health will be determined by physiological, biochemical and pathological determination of appropriate parameters. Water quality will be monitored at appropriate intervals throughout the project.

006.082 CRIS0065044
ECONOMICS OF SALMONID AQUACULTURE IN NEW ENGLAND

GATES J M; RESOURCE ECONOMICS; UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.

Proj. No.: R100144 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 74 To 30 SEP 80

OBJECTIVES: Compile and evaluate cost data associated with construction and operation of the system to determine capital requirements and production costs. Evaluate potential economic gains for vertical integration in production (hatching-smolt production and grow out) systems as compared to separate of non-integrated systems. Project capital requirements and cost conditions to establish economically feasible commercial size operations and evaluate economics of integrated management of a joint commercial/sport fishery program based on a hatchery release program.

APPROACH: Study will be in 2 phases; economics of a pilot aquaculture system utilizing water re-use techniques would be analyzed. This would provide a firm data base for cost parameters; analysis of management measures for an integrated commercial/sport fishery program. Once capital requirements and production costs for the integrated system are known and evaluation will be made of the integrated and non-integrated system to determine any economic gains associated with each respective system. For analysis the integrated system will be broken down into two operations: hatching and smolt production; grow out. Capital requirements and production costs associated with each operation will be evaluated and projected to establish economically feasible full scale commercial operations.

PROGRESS: 80/01 TO 80/12. A polyperiodic or dynamic linear programming model was used which includes the age/size class structure of fish stocks. It also includes size specific "treatment" effects (such as thermal controls) on growth rates. It also includes optimum marketing and product possibilities. Decisions optimized over time include (1) the number of fish of each size to be cultured, (2) the temperature(s) at which to culture them, (3) the number of fish of each size to be harvested, (4) the

size dependent products to produce, and (5) the number of recruits to purchase. The model was applied to Atlantic salmon and to salmon culture in a water reuse system. Marginal returns to risk ranged from 5 to 237% depending on species, discount rate, and the sensitivity analysis assumptions. The marginal return to risk is after all costs, including the opportunity cost of capital (varied from 10% to 30%). It is a measure of pure profit or return to marginal risks associated with the enterprise.

PUBLICATIONS: 80/01 TO 80/12

GATES, J.M., MACDONALD, C.R. and POLLARD, B.J. 1980. Salmon Culture in Water Reuse Systems: An Economic Analysis. Contribution No. 1653, RI Agricultural Experiment Station, URI, Marine Technical Report 78.

POLLARD, B.J. 1980. Optimizing the Production of Atlantic Salmon in Water Reuse Systems, M.S. Thesis.

006.083 CRIS0081987
EQUIPMENT FOR MECHANIZATION OF PRODUCTION OF OYSTERS AND OTHER SHELLFISH

COLLIER J A; MCLAUGHLIN D M; EVERSOLE A G; AGRICULTURAL ENGINEERING; CLEMSON UNIVERSITY, CLEMSON, SOUTH CAROLINA. 29631.

Proj. No.: SC00457 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 80 To 30 SEP 83

OBJECTIVES: Evaluate mechanical equipment for harvesting and transplanting oysters. Conduct environmental impact study of a mechanical harvesting system. Investigate the feasibility of mechanically handling and harvesting hard clams in a tray/raft culture system. Develop equipment for deheading fresh market shrimp.

APPROACH: Evaluate the efficiency and yield of a mechanical oyster harvester in relation to several different harvest methods. Conduct a two year study to determine perturbations, if any, of mechanical harvesting on the environment and develop, if necessary, practices which would mitigate these perturbations. Develop a mechanized system for handling and harvesting tray/raft cultured hard clams. Three systems will be investigated for orienting and deheading shrimp from which a commercial machine will be developed.

PROGRESS: 80/07 TO 80/12. The mechanical oyster harvester was out of the water for repairs and maintenance during this period. Testing should begin in the Spring of 81. Physical properties data on shrimp were obtained and initial design work started for the shrimp dsheder. Location of the thickest part of the shrimp and its center of gravity were found. The two parameters are located at different positions along the longitudinal axis of the shrimp and this will be used to generate the necessary force to orient the shrimp for deheading.

PUBLICATIONS: 80/07 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.084 CRIS0068717
DEVELOPMENT AND EVALUATION OF OYSTER HARVESTING EQUIPMENT AND MARICULTURE SYSTEMS

COLLIER J A; WEBB B K; EVERSOLE A G; AGRICULTURAL ENGINEERING; CLEMSON UNIVERSITY, CLEMSON, SOUTH CAROLINA. 29631.

Proj. No.: SC00114 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 SEP 80

OBJECTIVES: Develop and evaluate mechanical equipment for harvesting oysters. Evaluate damage by mechanical harvesting systems to oyster beds, remaining oysters and other marine organisms. Investigate systems for shellfish production including spawning systems, seed stock production and grow-out systems, handling systems and seeding systems.

APPROACH: Physical data of oyster beds will be translated into design constraints to construct an oyster harvester. Field tests will be made for evaluating machine performance and monitoring effects on marine life. Engineering systems for planting shell, harvesting and transplanting seed oysters, materials handling and harvesting schedules will be developed. Computer models will be used for optimization.

PROGRESS: 75/07 TO 80/09. A mechanical oyster harvester has been developed and tested in South Carolina estuaries. An 11.5 meter steel hull house boat was salvaged and modified to carry the oyster harvester. This modification included extending the hull to 14 meters, mounting a winch and boom system to raise the head, constructing a conveyor system to handle the oysters and mounting three engines on the vessel. The most important consideration in developing a machine to harvest oysters is protection of the fragile shell matrix or bed on which the oysters grow. Therefore, an automatic system to control harvester force exerted on the bottom was developed that can precisely regulate the force exerted on the shell matrix through a varying depth range of 1 to 3 meters. The head can operate on bottom contours with pitch and roll angles of .35 radians. Harvest rates of 20 m³/hr were obtained with damage to the oysters and shell matrix equal to or less than that of hand harvesting.

PUBLICATIONS: 75/07 TO 80/09
NO PUBLICATIONS REPORTED THIS PERIOD.

006.085* CRIS0068635
STUDIES OF THE ECONOMICALLY IMPORTANT SPECIES:
MERCENARIA MERCENARIA AND MACROBRACHIUM ROSENBERGII

EVERSOLE A G; ENTOMOLOGY & ECONOMIC ZOOLOGY; CLEMSON UNIVERSITY, CLEMSON, SOUTH CAROLINA. 28631.
Proj. No.: SC00155 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 JUN 80

OBJECTIVES: Objectives of the Mercenaria phase are: Explore important biological and ecological aspects of rearing clams; investigate the extent and nature of natural clam populations; and provide environmental estuarine base-line data. Objectives of the Macrobrachium phase are: Investigate the effects of mirex on Macrobrachium; and investigate the feasibility of polyculturing Macrobrachium.

APPROACH: Approach of the Mercenaria phase includes: Evaluations of artificial seeding and growing programs; regular sampling and collection analysis of natural populations; and determination of biological, chemical and physical characteristics of clam habitats. Approach of the Macrobrachium phase includes: Monitoring the effects of exposure to mirex; and analyzing niche utilization in polyculture situations.

PROGRESS: 80/01 TO 80/06. Juvenile and postlarval Macrobrachium rosenbergii were exposed to mirex concentrations of 0.1, 10, 50, 150, 500 and 1000 ug/l, plus control, for 96 hours. Whole animal residue analysis indicated postlarvae and juveniles concentrated mirex, and mortality response appeared to follow residue levels. Postlarvae and juveniles exposed to 1000 ug/l accumulated mirex up to 513x and 88x control levels, respectively. Mirex residues in juveniles were greatest in nerve tissue with levels up to 250x control. Residue analysis of test water revealed a 10-fold decline in mirex concentrations over 96 hours. Residues were not detected in the water from control, 0.1, 10, 50, 100 and 150 ug/l treatments, and only 126 and 165 ug/l mirex was found remaining after 96 hours in water from 500 and 1000 ug/l mirex treatments, respectively. Three studies with hard clams, Mercenaria mercenaria, were initiated in 1980. Two studies were designed to determine growth of hard clams cultured in South Carolina, and a third to evaluate reproductive responses to increased density.

PUBLICATIONS: 80/01 TO 80/06

AAS, C.A. and EVERSOLE, A.G. 1980. Effect of mirex on postlarval Macrobrachium rosenbergii in different water hardnesses. Bull. S.C. Acad. Sci. 42:72.

AAS, C.A. 1980. Effects of mirex on Macrobrachium rosenbergii in various water hardnesses. M.S. Thesis. Clemson Univ. South Carolina. 34 p.

006.086 CRIS0081873
MANAGEMENT AND CULTURE OF MOLLUSCAN SPECIES

EVERSOLE A G; ENTOMOLOGY & ECONOMIC ZOOLOGY; CLEMSON UNIVERSITY, CLEMSON, SOUTH CAROLINA. 28631.
Proj. No.: SC00454 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 80 To 30 JUN 85

OBJECTIVES: Determine compensatory growth in stunted clams; describe relative and absolute growth of clams cultured in SC; determine the effectiveness of using aggregate complexes to increase recruitment and survival of clams; determine the feasibility of a proposed mariculture strategy for clams in SC and determine the extent and dynamics of natural populations of molluscan species in S.C.

APPROACH: Evaluation of the growth response by stunted clams to decreased density; statistical analysis of growth relationships of clams cultured in SC; evaluations of planting site preparations, different times of planting and different sizes of seed clams; and regular sampling and collection analysis of natural populations.

PROGRESS: 80/07 TO 80/12. In May, a research project was initiated to determine if hard clams, Mercenaria mercenaria, that had experienced reduced growth due to crowding would compensate with increased growth at lowered population density. Clams that had been raised at 280, 859, and 1,159 clams/m² were replanted at a stocking density of 290/m² in two tidal locations (intertidal and subtidal). Regular measurements of growth (shell length) revealed clams were compensating or adjusting to reduced density. Mortality was low and only a few empty shells (dead clams) exhibited signs of forced entry by decapod crustaceans. Rigid analysis is underway to determine if statistical inferences can be made about these preliminary observations. Two other phases of this project were initiated, one to evaluate reproductive responses to increased density and the other to determine growth characteristics of hard clams cultured in South Carolina. Data from these phases will be used to project clam growth and the affect of increased density on reproductive output.

PUBLICATIONS: 80/07 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.087 CRIS0067238
FISH PRODUCTION IN SOUTH DAKOTA FARM AND RANCH WATERS

SCALET C G; WODDE T C; FISHERY & WILDLIFE BIOLOGY; S DAKOTA STATE UNIVERSITY, BROOKINGS, SOUTH DAKOTA. 57007.

Proj. No.: SD00712 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 JUN 80

OBJECTIVES: Develop techniques for the enhancement of fish production in South Dakota. Study areas will include east river farm ponds and marshes and west river stock tanks. The final goal of this work will be to provide the farmers and ranchers of the State with a bulletin describing to them the best fish production procedures for their particular aquatic systems. Both the recreational and commercial aspects of fish production will be studied.

APPROACH: Farm pond and stock tank studies will involve the determination of the success of various stocking combinations and stocking ratios. This will include the success of stocking in relation to the physical, chemical, and biological attributes of these waters. Marsh studies will include the determination of species composition, food, population structure, and production of native marsh

fishes. Work will follow concerning the production of introduced forms, including stocking ratios, and their effects upon the natural communities of these marshes. Recapture techniques of these introduced forms will also be studied.

PROGRESS: 80/01 TO 80/06. The potential for genetic alteration in body composition and growth traits was examined in 365 day-old rainbow trout (*Salmo gairdneri*) through the estimation of heritabilities, phenotypic standard deviations, and genetic correlations. Percent moisture, percent protein on a wet weight basis, and the growth traits: standard length, weight, and *K* yielded heritabilities of 0.48 + .223, 0.73 + .316, 0.93 + .331, 0.99 + .338, and 0.54 + .221 respectively. Genetic alteration of percent protein on a wet weight basis may be accomplished effectively through selection directed toward weight. Inbreeding (at 4 levels) in rainbow trout was evaluated in relation to an altered environment (upper lethal temperature 29 C). In all cases inbreds were less resistant to lethal temperature than were respective outbred families. Inbred fish were 82% less resistant to lethal temperature as compared to the respective outbred family at 50% inbreeding and 19% less resistant at 25% inbreeding. Work continued on the evaluation of pondstocked fish combinations. Initial indications showed excellent growth. New work was initiated concerning the culture of channel catfish (*Ictalurus punctatus*) and rainbow trout in dugout ponds. The fish were stocked at various stocking rates in approximately 30 dugouts.

PUBLICATIONS: 80/01 TO 80/06

- KCTH, R.M. 1980. Food Habits and Growth of Rainbow Trout in a Prairie Pond. M.S. Thesis. South Dakota State University, Brookings. 55 pp.
- MANGIARDI, J.L. 1979. Inbreeding in Rainbow Trout (*Salmo gairdneri*): Analysis of Lethal Temperature Tolerance. M.S. Thesis. South Dakota State University, Brookings. 40 pp.
- PARTBLOW, G.W. 1979. Expectation of Genetic Alteration of Muscle Composition and Growth Traits in Rainbow Trout (*Salmo Gairdneri*). M.S. Thesis. South Dakota State University, Brookings. 57 pp.

006.088* CRIS0081599
SOUTH DAKOTA FARM AND RANCH FISHERIES

SCALET C G; MODDE I C; WILDLIFE & FISHERIES SCI; S DAKOTA STATE UNIVERSITY, BROOKINGS, SOUTH DAKOTA. 57007.
Proj. No.: SD00300 Project Type: BATCB
Agency ID: CSRS Period: 01 JUN 80 To 30 JUN 83

OBJECTIVES: determine the feasibility of culturing annual crops of channel catfish and rainbow trout in eastern South Dakota dugouts; determine the forage species which produce the greatest growth rates and harvestable biomass of largemouth bass in South Dakota ponds and determine the panfish species which, when stocked with largemouth bass, is least susceptible to overpopulation.

APPROACH: Ponds and dugouts will be stocked with a variety of fish species. Stocking rates, fish species, artificial feeding and other variables will be utilized to ascertain both sport and commercial value of selected South Dakota pondfish populations.

PROGRESS: 80/06 TO 80/12. Sixteen dugout ponds in eastcentral South Dakota were stocked with fingerling channel catfish (*Ictalurus punctatus*) at stocking rates of 309, 618, 1235, and 1853/ha. After one growing season average weights for catfish at the various stocking rates were 180, 193, 173, and 105 g, respectively. Survival rates were 54, 34, 66, and 51%. Taste tests resulted in all fish rating as fair or better. Twenty-one dugouts were stocked with rainbow trout (*Salmo gairdneri*) at stocking rates of 200, 400, 600, 800/ha. Survival rates for the whole growing season were poor, however, growth and survival for approximately the first 2 months of the study were excellent. Average length for the initial 2 month period was 188 mm TL (135-239 mm range); average weight was 79 g (27-170 g range). A taste

panel rated all but one group of fish as at least fair to good. Analysis of data concerning the stocking of 80 South Dakota ponds with a number of different species compositions is being completed. Initial results indicate significant differences in first year growth of largemouth bass (*Micropterus salmoides*) and black bullheads (*I. melus*) between southern and northern quadrats. No difference in the first year growth rates of largemouth bass were observed among stocking combinations. First year survival of game species was 67.5% for black bullheads, 50.8% for largemouth bass, and 28.7% for bluegill (*Lepomis macrochirus*).

PUBLICATIONS: 80/06 TO 80/12

- MODDE, T.C. 1980. Evaluation of Fish Stocking Combinations in South Dakota Ponds. South Dakota Dept. Game, Fish and Parks. Prog. Rept. 80-9. 22 pp.
- MODDE, T.C. 1980. State Stocking Policies for Small Warmwater Impoundments. Fisheries 5:13-17.
- MODDE, T.C. and STONE, C.C. 1980. Growth and Biomass of Largemouth Bass (*Micropterus salmoides*) in a Western South Dakota Stock Pond. Proc. S.D. Acad. Sci. 59:138-146.
- SCALET, C.G. 1980. Endangered and Threatened Fishes of South Dakota. South Dakota State Univ. Coop. Ext. Serv. ESS 27B. 7 pp.

006.089* CRIS0028152
FISHERIES UNIT

APPLGATE R L; WILDLIFE MANAGEMENT; S DAKOTA STATE UNIVERSITY, BROOKINGS, SOUTH DAKOTA. 57007.
Proj. No.: SD00914 Project Type: STATE
Agency ID: SAES Period: 17 JAN 67 To 01 JAN 99

OBJECTIVES: Research various problems of fish and aquatic habitat in South Dakota.

APPROACH: Partial contribution by University to M/U between U and Cooperative Fishery Unit between U. S. Sport Fisheries and Wildlife and S. D. Department of Game, Fish, & Parks. Work program varies according to the annual agreement of the coordinating committee.

PROGRESS: 80/01 TO 80/12. The study concerning fish interactions in a power plant cooling reservoir continued. The estimated standing crop of the 4 major forage fish species was 28.1 kg/ha. The forage fish population was dominated by age-groups I and II. Impingement of forage fishes was primarily restricted to young-of-the-year and highest impingement rates usually occurred in the evening. Muskellunge (*Esox maquinongy*) were most vulnerable to impingement during the first 2 months after their introduction. The growth rate of muskellunge in the reservoir (Age-II, 753 mm average; Age-I, 465 mm average) was higher than all reports for the species in North America. Alimentary canal development of muskellunge was studied with relation to invertebrate food sources. The most selected for food organism during both day and night was *Moina brachiata*. *Cyclops vernalis* was also selected for during night. Muskellunge selected against *Asplanchna sieboldi*, *Potamocypis* sp., and *Daphnia* sp. Food organisms collected from the foregut of fry collected at 2300 hours were significantly larger, but not more numerous, than those in the foregut of fry collected at 1300 hours. As the fry grew and the mouth diameter increased, the sizes of food organisms increased. Fry initially selected for the first and second instars of *M. brachiata* and against the later instars and adults; by day 23 they selected for adults and against immature instars.

PUBLICATIONS: 80/01 TO 80/12

- EBNDA, R.S. 1979. Analysis of Catch Data for 1968 Through 1976 for Nine Fish Landings in Kenya Waters of Lake Victoria. J. Fish Biol. 15:385-387.
- EBNDA, R.S. 1979. Occurrence of *Argulus appendiculatus* Wilson, 1907 (*Branchiura*) in Indiana. Indiana Acad. Sci. 85:344.
- ROSEN, R.A. and BALES, D.C. 1980. Occurrence of Scarred Paddlefish in the Missouri River, South Dakota-Nebraska. Prog. Fish-Cult. 40(2):82-85.

WAHL, J.F. 1980. Forage Fish Populations and Growth of Muskellunge in a South Dakota Power Plant Cooling Reservoir. M.S. Thesis. South Dakota State University, Brookings. 71 p.
SLOANE, G.E. 1980. Macroscopic Benthos Populations in a South Dakota Power Plant Cooling Reservoir. M.S. Thesis. South Dakota State University, Brookings. 67 p.

006.090*

CRIS0071695

FRESHWATER FICD ANIMALS

WILSON J L; FORESTRY & WILDLIFE; UNIVERSITY OF TENNESSEE, KNOXVILLE, TENNESSEE. 37916.
Proj. No.: TEN00491 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for Freshwater animals cultured for food.

APPROACH: Standard methods will be employed to determine the effects of steroids and selected marking techniques (branding, tagging, mutilation) on survival and growth of catfish. Polycultural methods using food fishes such as catfish, sunfish hybrids, etc., will be compared to monocultural practices as relating to growth and total production.

PROGRESS: 80/01 TO 80/12. Experimentation evaluating the feasibility of polyculturing channel catfish and tilapia in a high-density, flow-through system was completed. Growth and condition of catfish were significantly reduced in all polyculture treatments as compared to monoculture treatment. Correlation of species densities (3:1, 6:1, 12:1 tilapia/catfish) and growth of catfish resulted in a significant negative relationship. Tilapia growth and condition were unaffected except at the highest stocking density. Water quality parameters were similar between the treatments, except for dissolved oxygen levels which at times were lower in the polyculture treatments. A terramycin-resistant strain of *Edwardsiella tarda* was isolated from infected fish; this is the first report of this strain in channel catfish. Preliminary work was restricted to examine the feasibility of using freshwater mussels as a food source. Replicate samples using the washboard variety of mussel are being examined for composition, microbial profile, and quality of surrounding water.

PUBLICATIONS: 80/01 TO 80/12

EILTON, F. and WILSON, J.L. 1980. Terramycin-resistant *Edwardsiella tarda* in Channel Catfish. *Prog. Fish Culturist* 42(3):159.
EILTON, F. 1980. Effects of Tilapia Densities on Growth of Channel Catfish in Flow-through Polyculture. M.S. Thesis, 29 pp. The University of Tennessee, Knoxville.

006.091*

CRIS0074335

CULTURE AND MANAGEMENT OF SELECTED GAME FISHES

WILSON J L; FORESTRY & WILDLIFE; UNIVERSITY OF TENNESSEE, KNOXVILLE, TENNESSEE. 37916.
Proj. No.: TEN00521 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 77 To 30 SEP 81

OBJECTIVES: Develop new management techniques and cultural methods for improving yields of game fishes in Tennessee waters by: Evaluating the feasibility of using selected non-native (exotic) species and/or hybrid fishes, and improved fish habitat management practices.

APPROACH: Ponds, raceways, and other holding facilities will be constructed to evaluate the potential of such fish as grass carp, mirror or other carps, tilapia, striped bass, hybrid sunfish, hybrid catfish, and other non-native species. Monospecific culture of selected fishes will be compared to polycultural techniques to determine production (kg/hectare). The use of different stocking rates, fertilization practices, and supplemental feeds will be evaluated as management practices. Culture techniques for hybrid sunfish and other selected

species will be determined and their potential for use in pond environments will be assessed. New management techniques for improving yields in game fish populations by habitat manipulation will be assessed. Research problems would include the evaluation of the effects of aquatic vegetation control on fish production; the effects of aquatic pesticides on yield of game fishes in ponds, streams, and reservoirs; the identification and control of fish parasites and diseases in game fishes; and the evaluation of biological agents as biofilters of waste materials in aquatic systems.

PROGRESS: 80/01 TO 80/12. Data collection for two pond studies were completed and the data are being analyzed. In one study, over 250 Florida largemouth bass have been tagged and released in two different impoundments. All were weighed and measured; scales were removed to determine age composition of the population. In the second study, fingerling striped bass were stocked in two small impoundments to determine survival and growth. To date, 47 young-of-year and yearlings have been collected; indications are that survival is directly related to fingerling size and data of stocking. In a two-year investigation to determine food habits, movements, and general life history of striped bass, approximately 400 fish have been collected. Preliminary analyses indicate young-of-year striped bass utilize zoo plankton, principally midge larvae, as the primary source of food for some time subsequent to stocking. There is evidence of similar food habits for white bass, leading to the assumption of interspecific competition. A study has been initiated to evaluate the effects of fish attractors in Norris Lake.

PUBLICATIONS: 80/01 TO 80/12

WINTON, J.W. 1980. Bioenergetics of Sauger in Watts Bar Reservoir, Tennessee. M.S. Thesis. The University of Tennessee, Knoxville. 75 pp.
WADDLE, B.R., COUTANT, C.C. and WILSON, J.L. 1980. Summer Habitat Selection by Striped Bass, *Morone saxatilis*, in Cherokee Reservoir, Tennessee, 1977. *Ornl Env. Sci. Publ. No. 1360*. 195 pp.

006.092*

CRIS0080188

SHRIMP MATURATION, REPRODUCTION, DEVELOPMENT, NUTRITION, INTENSIVE-EXTENSIVE CULTURE AND MARICULTURE

LAWRENCE A; TEXAS A&M UNIVERSITY, CORPUS CHRISTI, TEXAS. 78406.
Proj. No.: TEX06325 Project Type: STATE
Agency ID: SAES Period: 01 OCT 79 To 30 SEP 83

OBJECTIVES: Obtain basic and applied knowledge required for development of penaeid shrimp mariculture as a successful industry. This includes reproduction in captivity, development of satisfactory dried prepared feeds and improvement of shrimp production from intensive and extensive culture.

APPROACH: Shrimp reproduction of natural populations will be biochemically and nutritionally characterized. Nutritional, environmental and cultural requirements for reproduction in captivity will be studied. By comparing reproduction obtained in captivity to baseline reproductive data from natural populations and evaluating laboratory experiments, the understanding of reproduction and basis for reproduction in captivity will be obtained. Shrimp nutrition will be evaluated by determining food conversion ratios, % assimilation values, growth rates, % mortalities, organ indices and biochemical changes to different dried prepared foods. Improvement of shrimp production from intensive (tank) and extensive (pond) culture will be from nutritional, salinity, temperature and polyculture studies.

PROGRESS: 80/01 TO 80/12. General objective of this project is to obtain technology with knowledge and understanding of basic biological principles necessary to establish shrimp mariculture as a new agricultural crop in Texas. Accomplishments for last year were: Construction of maturation/reproduction

facility at Corpus Christi; Maturation with spawning of fertile eggs of three species of marine shrimp, *Penaeus vannamei*, *P. stylirostris* and *P. setiferus*; Evaluation of lipid requirement in marine shrimp maturation/reproduction; Seedstock supply of marine shrimp is most limiting to establishment of shrimp mariculture in Texas. The preceding represent significant steps in removing this obstacle. Overwintering of broodstock in ponds receiving heated effluent. Overwintering of broodstock is a necessity for a guaranteed source of seedstock and future genetic/domestication studies. Determination of chill tolerance of brine shrimp larvae and importance of cryoprotectants and viability of marine shrimp frozen to -16 degrees C. The preceding represents a step toward cryopreservation of marine shrimp seedstock which will be required to guarantee seedstock supply at minimum cost. Determination of osmoregulation of juvenile and mature marine shrimp. Knowledge of osmoregulatory ability of marine shrimp is needed since sea water along Texas coast is variable.

PUBLICATIONS: 80/01 TO 80/12

MIDDLEMITCHELL, B.S., MISSLER, S.F., HINES, H.B., MCVAY, J.P., BROWN, A., WARD, D.G. and LAWRENCE, A.L. 1980. Metabolic Profiles of Penaeid Shrimp: Dietary Lipids and Ovarian Maturation. *Journal of Chromatography*, 195:359-368

BAUST, J.G. and LAWRENCE, A.L. 1980. Ontogenetic Variability of Chill Tolerance in Larval *Artemia salina* II. Single Type Cryoprotectants. *Aquaculture*, 20:305-311.

BAUST, J.G. and LAWRENCE, A.L. 1980. Ontogenetic Variability of Chill Tolerance in Larval *Artemia salina* I. Dual Type Cryoprotectants. *Aquaculture*, 20:313-321.

CASTILLE J.F., F.L. and LAWRENCE, A.L. 1980. The Effect of Salinity on the Osmotic, Sodium and Chloride Concentrations in the Bembolypt of the Euryhaline Shrimp of the Genus *Penaeus*. *Comparative Biochemistry and Physiology*.

006.093 CRIS0083168
CULTURE OF AQUATIC ORGANISMS AND EVALUATION OF ENVIRONMENTAL CONDITIONS AT STEAM ELECTRIC PLANTS

STRAWN K; ALDRICH D V; NEILL W B; FISHERIES & WILDLIFE; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.

Proj. No.: TEX06462 Project Type: STATE
Agency ID: SAES Period: 01 OCT 80 To 31 DEC 83

OBJECTIVES: Determine which species are best suited for culture at specific sites and if they can be cultured commercially. Compare polyculture with monoculture and culture of mixed-age organisms with those of uniform age. Assess the potential of various culture systems for use at power plants. Investigate problems such as gas supersaturation in discharge water. Determine occurrence, abundance and distribution of wild species in areas influenced by a power plant and apply this information to culture.

APPROACH: Penaeid shrimp, blue crabs, various fishes and other appropriate organisms will be cultured in ponds and cages using intake and heated discharge waters. Commercial species will be emphasized. Environmental conditions at each research site will determine the species used. Ponds (0.1 hectare), cages, net pens and cooling ponds will be investigated as culture systems. Surveys of natural populations will be conducted and occurrence and abundance of organisms related with environmental factors.

PROGRESS: 80/01 TO 80/12. Mariculture experiments were performed in heated brackish effluent of power plant. Blue crabs were grown in individual cages for soft shelled crab production. Expenses were high. Time between molts will have to be shortened for this method to be economic. Crabs were susceptible to gas bubble disease when kept in gas saturated water. *Fundulus grandis* (locally called mud minnows) were evaluated for salt water hait. Production was as high as 882 Kg/ha and wholesale price was about \$14.30/Kg. Culture of this species looks promising. The blue shrimp (*penaeus stylirostris*) was stocked July 17 and

18 and harvested December 6-7. Production was as high as 1244 Kg/ha with a wholesale value of about \$5.50/Kg. Because of slower growth and reduced survival, economic returns did not increase appreciably as stocking density was raised from 5 to 10 to 15 shrimp per square meter. Plans, for future experiments, are to use a shrimp species that has a better survival and growth at high stocking densities. Behavior studies of channel catfish cultured in variable depth cages indicated that the fish avoid both the surface and deepest water in cages. Water depths occupied by the water column increased with cage depth. Studies in the cooling reservoir of this plant showed good production of largemouth bass in conjunction with an expanding blue tilapia population.

PUBLICATIONS: 80/01 TO 80/12

CHAMBERLAIN, G.W., NEILL, W.B., ROMANOWSKY, P., STRAWN, K. 1980. Vertical Responses of Atlantic Croaker to Gas Super-saturation and Temperature Changes. *Trans. Amer. Fish. Soc.* 109:737-750.

OJEDA, G.M. and STRAWN, K. In press. Comparison of Wire and Net Cages for the Culture of Black Drum (*Pogonias chromis*). *Proc. of the 11th Ann. Meeting World Maricult. Soc.*

OJEDA, J., ALDRICH, D.V. and STRAWN, K. In press. Staggered Stocking of *Penaeus stylirostris* in Brackish Water Ponds Receiving Power Plant Cooling Water. *Proc. 11th Ann. Meeting World Maricult. Soc.*

ROMANOWSKY, P. and STRAWN, K. 1979. Vertical Distribution of Caged Estuarine Fish in Thermal Effluent Subject to Gas Supersaturation. *Proc. 33rd Ann. Conf. Southeastern Assoc. Fish. and Wildlife Agencies.* 33:466-483.

RCSBERG, K.S. and STRAWN, K. In press. Comparative Growth and Survival of Brown Shrimp Cultured with Florida Pompano, Black Drum, and Striped Mullet. *Proc. 11th Ann. World Maricult Soc.*

006.094* CRIS0064257
FRESHWATER SHRIMP OF THE GENUS *MACROBRACHIUM* WITH SPECIAL EMPHASIS ON CULTURE

BRICE R W; WILDLIFE & FISHERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06052 Project Type: RATCH
Agency ID: CSRS Period: 13 JUL 73 To 31 DEC 80

OBJECTIVES: Develop & improve production & management systems for freshwater shrimp cultured for food & bait in Texas. Conduct field studies on natural history and ecology of freshwater shrimp to better understand their nutritional and environmental requirements.

APPROACH: Laboratory and field observations will be coordinated in studying nutritional and environmental requirements of *Macrobrachium* under culture conditions. Survival and growth will be indices most considered in evaluating treatments.

PROGRESS: 80/01 TO 80/12. Studies undertaken within this project were highly varied in nature, in part because very little information on the culture of freshwater shrimp has been developed. Electrophoretic patterns of several species of freshwater shrimp were elaborated and the genetic implications of them addressed in one study. The basic nutritional requirements and nutritional physiology of *Macrobrachium rosenbergii* with respect to protein were outlined, giving rise to information on the protein-energy requirements of that species. The feasibility of rearing freshwater shrimp with tilapia was demonstrated. The responses of freshwater shrimp to degraded water quality was also addressed in an attempt to determine the limits within which this organism can live and grow.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

006.095* CRIS0071939
FISH POPULATION AND PRODUCTION IN POND AND LAKE
IMPOUNDMENTS

NOBLE R L; TIER J G; WILDLIFE & FISBERIES SCI; TEXAS
A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06206 Project Type: STATE
Agency ID: SAES Period: 01 DEC 76 To 31 DEC 80

OBJECTIVES: Determine variations in fish population parameters in existing and planned floodwater retarding structures. Relate variations in fish population parameters to variations in management practices and biological, limnological and structural differences among reservoirs. Test and evaluate selected structural modifications and periodic management practices which will enhance fish production in floodwater retarding structure reservoirs.

APPROACH: Fish population characteristics of selected reservoirs will be measured and correlated with physical, chemical and biological characteristics of the reservoirs. Selected management techniques will be experimentally evaluated.

PROGRESS: 80/01 TO 80/12. Farm and ranch ponds provide the potential for substantial food production and recreation close to rural residences. Florida largemouth bass have been widely stocked into Texas waters, with little known of their ecological requirements and interactions with native northern largemouth bass. Research on these two subspecies indicated that Florida bass were more susceptible to cold shock, which can occur at the time of stocking, than are northern bass. Intergradation between the subspecies occurs when stocked together, but rates of intergradation vary with pond characteristics, particularly water clarity. Intergradation has occurred within several hatchery stocks in Texas and the genetic integrity of fish stocked throughout the state likely has frequently been mistaken. Studies of floodwater retarding structures indicated that channel catfish populations were largely related to physical conditions, whereas biological conditions were most important to largemouth bass. Summer drawdown of floodwater retarding structures can be used to increase water clarity of turbid lakes without long-lasting direct effects on fish populations. Two new studies on larger impoundments were initiated during 1980. In Lake Conroe, baseline data were collected for evaluation of effects of vegetation control to be initiated in early 1981.

PUBLICATIONS: 80/01 TO 80/12
PATE, M.W. 1980. Intergradation Between Two Subspecies of Largemouth Bass, *Micropterus salmoides*, in Texas. M.S. Thesis, Texas A and M University, College Station, 64 pp.

006.096* CRIS0061207
FRESHWATER FOD ANIMALS

STICKNEY R E; STRAWN K; COBE E E; WILDLIFE &
FISBERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION,
TEXAS. 77843.
Proj. No.: TEX02831 Project Type: BACHELOR
Agency ID: CSRS Period: 01 OCT 76 To 30 SEP 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals cultured for food, including: Nutrition, genetics and breeding, water quality, diseases, and culture systems. Develop and improve products and processing methods that will enhance marketability and insure quality of cultured freshwater food animals.

APPROACH: Various methods will be utilized to meet the objectives of the overall S-38 project in the several cooperating institutions. The thrust of the Texas Agricultural Experiment Station will be on channel catfish, Tilapia and freshwater shrimp, with emphasis being placed on objectives I above, especially nutrition, water quality and culture systems.

PROGRESS: 80/01 TO 80/12. Lipid energy requirements of channel catfish fry were evaluated with semipurified diets over the period from onset of feeding until the fish reached several grams in weight. The data obtained will be utilized to aid in the preparation of fry feeds specifically developed for channel catfish. It is anticipated that the protein: energy ratio will be adjusted as food particle size is increased during the initial year of life. Semipurified diets with varying lipid sources and percentages revealed no significant differences in channel catfish fingerling growth over the lipid range from 6 to 14% at a mean temperature of 22 degrees C, though fish fed 10% lipid were slightly larger in mean size at the end of the 20 week experiment. Fatty acid composition revealed that there were no significantly different patterns among diets with the same lipid source, but there were differences among lipid sources with respect to final fatty acid composition. Polyculture studies with freshwater shrimp and tilapia revealed some depressed growth when the two were stocked together, but in general, feeding on the basis of estimated fish biomass will yield a secondary shrimp crop, without the need to provide shrimp feed. Overwintering of large numbers of tilapia is being conducted to determine if the technique is feasible for use in central Texas and to provide fish for a study of second year growth potential of this fish. Plastic and fiberglass covered ponds as well as indoor overwintering facilities are being compared.

PUBLICATIONS: 80/01 TO 80/12
HENDERSON-ARZAPALO, A., STICKNEY, R.R. and LEWIS, D.B. 1980. Immune Hypersensitivity in Intensively Cultured Tilapia Species. *Trans. Am. Fish. Soc.* 109:244-247.
YINGST III, W.L. and STICKNEY, R.R. 1980. Growth and Survival of Caged Channel Catfish (*Ictalurus punctatus*) fingerlings on Diets Containing Various Lipids. *Prog. Fish-Cult.* 42:24-26.
BURNS, R.P. and STICKNEY, R.R. 1980. Growth of Tilapia aurea in Ponds Receiving Poultry Wastes. *Aquaculture* 20:117-121.
CUENCO, M.L. and STICKNEY, R.R. 1980. Reliability of an Electrode and a Water Analysis Kit for Determination of Ammonia in Aquaculture Systems. *Trans. Am. Fish. Soc.* 109:571-576
MCGEACHIN, R.B. 1980. Production of Tilapia aurea in Simulated Lagoons Receiving Laying Hen Wastes. Ph.D. Dissertation, Texas A&M University, 71 pp.

006.097* CRIS0060593
EFFECTS ON SELECTED ORGANISMS OF WATER PASSING
THROUGH THE CEDAR BAYOU GENERATING STATION

STRAWN K; ALDRICH D V; NEILL W E; WILDLIFE &
FISBERIES SCI; TEXAS A&M UNIVERSITY, COLLEGE STATION,
TEXAS. 77843.
Proj. No.: TEX01869 Project Type: STATE
Agency ID: SAES Period: 01 APR 71 To 01 JUN 80

OBJECTIVES: Determine the suitability of electric power plant cooling water for growth, food conversion, and survival of selected species of crustaceans and fishes in cages, ponds, and temperature-controlled tanks.

APPROACH: Animals will be held in cages in front of the plant intake and in the discharge canal; in fish ponds located near the start of the discharge canal; and in aquaria in a laboratory to be built near the fish ponds. After the construction of the cooling pond, animals will be kept in cages in its first and last compartments and occurrence and distribution of selected organisms in the cooling pond will be determined. Temperatures in the aquaria will span the range of temperatures usually occurring in Trinity Bay. The influence of the effluent on phytoplankters both in the field and in culture will also be determined.

PROGRESS: 79/01 TO 79/12. Species most suited for commercial production in the vast quantities of water pumped by the Cedar Bayou Generating Station are being identified and raised to evaluate their potential. Blue shrimp (*Penaeus stylirostris*) survived low salinities (2% or less for over half of

the culture period) associated with heavy rain falls during the Summer of 1979, but survival and production were down. Quality of harvested shrimp was excellent. Staggered stocking of postlarvae appeared superior to a single stocking. Mud minnows (*Fundulus grandis*) were raised for marine live bait. Local fish performed better than a pond-raised stock from Alabama. Some spawning occurred all summer. Polyculture of black drum (*Pogonias chromis*) and striped mullet (*Mugil cephalus*) was superior to monoculture. New pens are better than cages for black drum culture, because they are cheaper to construct and less labor intensive.

PUBLICATIONS: 79/01 TO 79/12

BRANCB, M. and STRAWN, K. 1979. Analysis of feeding relationship among estuarine fishes raised in polyculture in ponds receiving thermal effluents. Power Plant Waste Heat Utilization in Aquaculture Workshop II. Allanheld, Osmun and Co.

CHUNG, K.S. and STRAWN, K. 1979. Heat tolerance of free-living estuarine animals to predict their survival in heated effluents. Proc. 31st Ann. Conf. Southeastern Assoc. Wildlife Agencies. pp. 514-518.

GIBBARD, G.L. 1979. Report on survival, growth, and behavior of selected estuarine organisms cultured in tanks receiving heated effluent from a power plant near Baytown, Texas. M.S. Thesis. Texas A and M Univ. College Station

BUFF, M.E. 1979. Growth and survival of selected marine and estuarine organisms employed as water quality monitors and cultured at various temperatures and light intensities in flow-through systems utilizing power-plant effluent.

006.098 CRIS0080100
CAGE CULTURE OF TILAPIA IN THE VIRGIN ISLANDS

RAKOCY J E; NAIR A; ADMINISTRATION; COLL OF VIRGIN ISLANDS, ST CROIX, VIRGIN ISLANDS. 00850.
Proj. No.: VI00024 Project Type: HATCB
Agency ID: CSRS Period: 01 OCT 79 To 30 SEP 84

OBJECTIVES: Develop practical cage culture methods of tilapia fish production suitable to the freshwater resources of the Virgin Islands. Evaluate the acceptability of tilapia as a food fish by the local populace.

APPROACH: Various tilapia species and their hybrids will be evaluated under similar growing conditions for use in freshwater cage culture production systems. Imported commercial pelleted fish feed will be compared to themselves and other animal feeds for cage culture use. Feeds comprised of locally produced ingredients will be formulated and evaluated for tilapia culture in cages. Stocking densities, the use of sliding feeding-rate schedules, and the evaluation of monosex cultures obtained by mechanical grading or hand sexing of tilapia (separation of sexes by observing sexually dimorphic external characteristics.) will be investigated for fish production in cages under Virgin Islands pond conditions. Fish produced in cage culture research will be evaluated by taste panels and sold to the public. Acceptability of tilapia as a food fish will be evaluated by questionnaires and the actual marketability of the fish when compared to locally caught salt water species.

PROGRESS: 80/01 TO 80/12. An experiment, presently in its twelfth month, was conducted to evaluate three commercial feeds, each of which was fed to caged tilapia according to three feeding rate schedules. The feeds were floating catfish pellets from Purina (#5140) and Sunshine Mills (Tupelo, MS) and sinking crumbles (Tilapia Finisher) from Central Soya (San Juan, PR). The protein content was 32% for Purina and Sunshine and 30% for Central Soya. The treatments were replicated three times with a stocking rate of 200 fish/m³. The feeding rate schedules were 3% of body weight throughout the experiment, 5% for 2 months followed by reductions to 4,3,2 and 1% at monthly intervals (time slide) and thereafter maintained at 1%, and 5% to a mean weight of 60 g followed by reductions to 3% up to 100 g, 2% up to

150 g and 1% up to harvest (weight slide). The fish were fed once per day, 6 days per week, for 270 feeding days. After 6 months, the Central Soya treatments were discontinued because feed was lost through the cage sides during feeding, resulting in low growth rates. Analysis of the data after 11 months indicates that more growth was obtained with Purina. Mean weights for Purina were 269 g (3%), 246 g (time slide) and 301 g (weight slide) compared to respective mean weights of 229, 220 and 225 g for Sunshine. The cage mesh, (6-mm Vexar) partially clogged with algae and prevented adequate water circulation, contributing to low dissolved oxygen levels and growth rates, which generally averaged less than 1 g/day.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

006.099 CRIS0076162
FRESHWATER FOOD ANIMALS

RAKOCY J E; NAIR A; ADMINISTRATION; VIRGIN ISLANDS AGRIC EXPT STAT, KINGSBILL ST CROIX, VIRGIN ISLANDS. 00850.

Proj. No.: VI00021 Project Type: BATCB
Agency ID: CSRS Period: 14 JUL 78 To 30 JUN 81

OBJECTIVES: Develop and improve production and management systems for freshwater animals cultured for food.

APPROACH: Tilapia (*Sarotherodon* sp.) will be cultured in both static and recirculated water systems utilizing circular plastic pools (3.7 m X .9 m) as experimental units. These units will be evaluated as production facilities for fingerling fish and as grow-out facilities for market-sized fish available for human consumption. The study will evaluate such variables as fish species utilized, stocking density, use of available feeds and animal manures as nutrient sources, and the use of simple water recirculation systems as applicable to the grow-out units. Total fish production, per cent fish survival, feed conversions and pertinent water quality parameters will be monitored. Fingerling production research will study the effects of brood fish necessary to maximize production. All research will be coordinated toward the development of an integrated plan of optimal tilapia production in small modular fish culture systems.

PROGRESS: 80/01 TO 80/12. A research facility was established for the study of recirculating fish culture-hydroponic systems and tilapia fingerling production in small pools. A fenced site, (320' x 120') was leveled and water lines, drain lines and electrical receptacles were installed. A field laboratory was upgraded to include six electric meters for monitoring power consumption by the recirculating systems. A total of 34 circular swimming pools have been erected and six recirculating systems are being constructed. A small prototype recirculating system was constructed and is being evaluated.

PUBLICATIONS: 80/01 TO 80/12

NAIR, A. 1981. Fish Culture and Hydroponics in the Virgin Islands. Bull. Annu. Agri. Food Fair Virgin Islands 11:87-88.

006.100 CRIS0063835
CAGE CULTURE OF FISH IN THE VIRGIN ISLANDS UTILIZING TERTIARY TREATED WATER

PADDA D S; SANDS F B; BUSCH R I; AGRICULTURAL EXPER. STATION; VIRGIN ISLANDS AGRIC EXPT STAT, KINGSBILL ST CROIX, VIRGIN ISLANDS. 00850.

Proj. No.: VI00009 Project Type: HATCH
Agency ID: CSRS Period: 04 JUN 73 To 30 SEP 79

OBJECTIVES: Develop a practical system of cage culture for Tilapia aurea; and determine feasibility of cage culture of Tilapia as a productive farm enterprise.

APPROACH: Rates of gain, cost of production and returns will be determined for four different feeding regimens and different stocking rates.

PROGRESS: 73/06 TO 79/09. Cage culture research was initially conducted in four 0.4-ha ponds that were constructed for this project. Before any significant research results were obtained, the ponds had to be abandoned because the treatment plant supplying tertiary treated wastewater to the ponds shut down for 3 years for repairs. An alternate facility, a 1-ha watershed pond, was located in 1977. A total of 41 cages and 2 rafts were established in this pond to study the culture of tilapia. Support facilities, including a water quality lab, were gradually developed. Four experiments and one marketing study were conducted. Tilapia (*Tilapia aurea*) in aquaria were fed catfish feed, chicken feed or coconut meal. Catfish feed produced the greatest growth while coconut meal produced the least growth. Tilapia fed at three rates in raceways, supplied by tertiary treated wastewater, exhibited the best growth and feed conversion at rates of 2 and 3% of body wt., but growth rates were low, 0.6 and 0.8 g/fish/day, respectively. Tilapia in 0.5 m³ cages were fed catfish feed at rates ranging from 1 to 5%. Feed costs at the 2 and 3% rates were the most economical and amounted to 62 and 84 cents/kg of fish production, respectively. The growth of *T. aurea* and *T. mossambica* were compared. Greater growth and survival were exhibited by *T. mossambica* at the 0 (control), 1 and 2% feeding rates while the growth and feed conversion of *T. aurea* was superior at the 3 and 4% rates.

PUBLICATIONS: 73/06 TO 79/09

- HUSCH, R. L. 1978. Freshwater aquaculture - a possibility for the Virgin Islands. Bull. Annu. Agri. Food Fair Virgin Islands. 8:61-64.
HUSCH, R. L. 1979. A prospectus for cage culture of freshwater fish in the U.S. Virgin Islands. Bull. Annu. Agri. Food Fair Virgin Islands. 9:41-44.
HUSCH, R. L. 1980. Marketing tilapia in the Virgin Islands. Bull. Annu. Agri. Food Fair Virgin Islands. 10:17-19.
ST. ALMEE, D. 1976. Growth of *Tilapia aurea* (L.) on selected feeding regimes. M. S. Thesis. Fairleigh Dickerson Univ. 32 p.

006.101 CRIS0065679
RESPONSE OF FISHES AND AQUATIC SYSTEMS TO ELBCTRIC SHOCK AND CAPTURE TECHNOLOGY

LACKEY R T; FISHERIES & WILDLIFE; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.
Proj. No.: VA-0202361 Project Type: STATE
Agency ID: SAES Period: 01 JUL 74 To 30 SEP 79

OBJECTIVES: Evaluate the effects of electronarcosis on physiological processes in fishes; examine electroshocking efficiency as a collecting tool in fisheries management practices; and develop decision making methodologies to be used in alternative management strategies.

APPROACH: Physiological evaluations of electrically-anesthetically-and handle-stressed fish, primarily using hemal parameters; laboratory and field studies employing various species and habitat types subjected to collecting procedures, and computer simulation of selected fisheries to test management strategies.

PROGRESS: 80/01 TO 80/12. No progress report this period.

PUBLICATIONS: 80/01 TO 80/12

- SAUL, G.E. 1980. Effects of Repetitive Electroshocking on Fish Populations in Experimental Raceways and a Small Headwater Stream in Southern West Virginia. Ph.D. Thesis. Va. Poly. Inst. and State Univ., Blacksburg. 180 pp.

006.102* CRIS0062572
DEVELOP OF AQUACULTURE SYSTEMS FOR COOL WATER FISH SPECIES

CALBERT B E; FCCD SCIENCE; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.
Proj. No.: WIS01953 Project Type: STATE
Agency ID: SAES Period: 01 SEP 72 To 30 AUG 81

OBJECTIVES: Maintain a facility for fish growing operations and research as a service unit. Improve the reproductive efficiency of cool water species of fish to be used in aquaculture. Improve the acceptability and nutritive value of formulated feeds used in aquaculture. Improve methods of yellow perch fingerling production.

APPROACH: The aquaculture research facility at 6080 McKee Road, Madison, WI and the outside ponds on the UW Experimental Farms will be maintained and operated to provide research facilities and fish to be used in aquaculture research. Selective breeding of yellow perch and other cool water species will be used to improve the strains of fish and adapt them to aquaculture operations. Studies on the preservation of fish sperm, ova, and fertilized eggs by cryobiological methods will be made. Various types of protein sources will be investigated for incorporation into formulated diets used in fish growing operations. The care, management and productivity of outside ponds for fingerling production will be investigated.

PROGRESS: 79/01 TO 79/12. Project emphasis over the past 4 years has been on developing methods of commercially culturing yellow perch indoors in closed water-recycling systems. Research has shown that this type of culture is technically feasible, through the application of sanitary engineering principles but is too capital intensive for commercial development. Project emphasis has been shifted to pond, raceway and cage culture, both for commercial applications and wild fisheries enhancement. The project has also worked extensively on diet development, control of reproduction, cryopreservation of sperm, and fingerling production of coolwater species of fish. Dietary recommendations regarding coolwater fish production have been made available through the National Coolwater Fish Diet Steering Committee. Methods for controlling reproduction in coolwater fish have been developed and applied to improve the predictability of spawning. Sperm from yellow perch, northern pike and walleye have been frozen, stored and later used to fertilize eggs. Such research will aid in improving the efficiency and profitability of fish rearing operations, whether they be for commercial purposes or fishery enhancement.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

7. Harvesting and Handling

007.001* CRIS0075875
CULTURE SYSTEMS FOR YEAR-ROUND MARKETING OF FISH FROM WATERSHED PONDS

SMITHERMAN R O; MCCOY E W; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
Proj. No.: ALA00496 Project Type: BATCH
Agency ID: CSRS Period: 01 APR 79 To 30 SEP 83

OBJECTIVES: Develop techniques for producing, harvesting, and marketing aquacultural crops from watershed ponds throughout the year.

APPROACH: Channel catfish, tilapia, silver carp, and rainbow trout will be produced in watershed ponds up to 8.9 ha. Partial harvesting with cages, drop nets and corral seines will be evaluated to extend the marketing season and to improve cash flow.

PROGRESS: 80/01 TO 80/12. *Tilapia aurea* fingerlings cultured in cages at stocking rates of 400, 800, 1200, and 1600/m³ for 92 days gained an average of 127, 124, 114, and 100 grams, respectively. The weight of fish in a cage was more important than the number; growth was reduced as the standing crop exceeded approximately 100 kilograms/m³. *Tilapia* in cages were fed a standard ration. One treatment received the daily allotment in one feeding; the other treatment had its daily ration divided into two feedings per day. After two months, fish fed once per day gained an average of 129 grams, those fed twice per day gained 149 grams, an increase of 16% due to feeding frequency. Blue tilapia (*T. aurea*) and golden hybrids (*T. hornorum* x *T. mossambica*) were cultured in cages. At harvest, male golden hybrids averaged 435 grams, while male blue tilapia averaged 288 grams. Female golden hybrids averaged 173 grams and female blue tilapia were 254 grams. Male golden hybrids and both male and female blue tilapia were 100% marketable (total length 19 cm) but only 67% of the golden hybrid females were marketable.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

007.002*
PRAWN AQUACULTURAL ENGINEERING

CRIS0068896

WANG J K; AGEI ENGINEERING; UNIVERSITY OF HAWAII, HONOLULU, HAWAII. 96822.

Proj. No.: BAW00524 Project Type: BATCB
Agency ID: CSRS Period: 01 JUL 75 To 30 SEP 81

OBJECTIVES: Develop a harvesting system, including equipment and strategy, for the continuous production of prawn in Hawaii. Further investigate and evaluate high density nursery culture. Develop a post-harvest handling system for live prawn for both local and export market. Develop an engineering-economic analysis model to evaluate alternative prawn production systems.

APPROACH: Prototype harvesting equipment will be field tested and a suitable harvesting strategy developed. Experiments will be carried out to determine the effects of density and size on nursery mortality rates and growth rates. Storage and transportation of live animal under low temperature will be tested in the laboratory. An engineering economic analysis of prawn production using nursery stocking strategy and inventory pond will be performed to determine optimum harvesting strategy and facility requirements.

PROGRESS: 80/01 TO 80/12. A simple net reel was designed and fabricated. It mounts on a standard three point hitch and is powered by the tractor hydraulics. Using the reel, one man can pick up or set a prawn harvesting seine for a 40 m wide pond in 5-10 minutes. The net reel is being field tested by local prawn farmers. Prawn physical dimensions of engineering significance, such as overall length, tail length, orbit length, height, width, and mass are being collected and analyzed. Relationships of various dimensions to orbit length and mass will be determined. Live transport of prawn was investigated. Life support was limited to bubbling air in water and temperature control. The initial 18 liter of water per 1 kg prawn was not changed or filtered. Dissolved oxygen was above 7.0 ppm and temperature 16 to 18 degrees C. No mortalities were experienced in the first 20 hours. Two replications did not have a mortality for 114 hours. If the initial mortality was not removed, the mortality rate increased rapidly. Conditioning and selection of prawn before transport appear significant to the length of transport allowed.

PUBLICATIONS: 80/01 TO 80/12

WANG, J.K. and WILLIAMSON, M.F. 1980. Aquacultural Engineering in Fresh Water Prawn Production. ASAE Transactions 23(5):1318-1321, 1325.

KNEALE, D.C. and WANG, J.K. 1979. A Laboratory Investigation of *Macrobrachium rosenbergii* Nursery Production. Proc. of the World Mariculture Society 10:359-368.

007.003
POST-HARVEST HANDLING AND PROCESSING OF MACROBRACHIUM PRAWNS

CRIS0073715

NIP W; MOY J B; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: BAW00576-S Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 SEP 80

OBJECTIVES: Define the quality of fresh and cooked prawns in terms of physical, chemical, bacteriological and organoleptic attributes. Assess the effect of various processing techniques (freezing, holding, packaging, storage and thawing) on the quality of the frozen prawns. Determine and recommend a set of handling, holding and processing conditions in terms of acceptable quality of frozen prawns for long term storage.

APPROACH: Zero-time control samples will be analyzed in terms of texture, pH, trimethylamine, collagen, and salt content, bacterial count and taste score. Prawns will be processed, stored and analyzed for the various quality attributes. Optimum conditions for processing, packaging and storing of frozen prawns will be determined based on the above results.

PROGRESS: 77/07 TO 80/12. Various postharvest handling and freezing procedures for the freshwater prawn, *Macrobrachium rosenbergii* were tested. Results of the frozen storage stability studies (6 mos) suggested that prawns may be chilled up to 48 hrs, then frozen and still maintain acceptable quality; the quality of prawns held under chilled conditions 48 hrs after thawing was still acceptable; post-blanching chilled storage may not be a practical prefreezing technique for commercial preservation and marketing of frozen prawns; and prawns can be frozen either in air or in brine at -18 degrees C, packaged in polymlar bags with or without vacuum, or frozen in ice-blocks, and still maintain acceptable quality. Effect of purging on quality factors and cost-effectiveness were also tested. No significant difference (p less than or equal to 0.05) was found between the purged prawns and the control in their muscle's pH, ammonia content, soluble/insoluble collagen ratio, and peak height/plateau height ratio. However, the decrease in pH and peak height/plateau height ratio, and the increase in ammonia content and soluble/insoluble collagen with ice-chilled time were highly significant (p less than or equal to 0.01), indicating a gradual quality degradation when stored on ice. Postharvest purging helped to improve the appearance of the prawn but its cost-effectiveness based on economic feasibility analysis was doubtful.

PUBLICATIONS: 77/07 TO 80/12

NIP, W.K. and MOY, J.B. 1979. Effect of Freezing Methods on the Quality of the Prawn *macrobrachium rosenbergii*. Proc. of World Maricul. Soc. 10:761-768.

007.004*
DEVELOPMENT OF OPTIMUM SUSTAINED YIELD OF FISHES IN FARM PONDS

CRIS0079383

KLAASSEN B E; BIOLOGY; KANSAS STATE UNIVERSITY, MANHATTAN, KANSAS. 66506.

Proj. No.: KAN00118 Project Type: STATE
Agency ID: SAES Period: 01 JUL 79 To 30 JUN 82

OBJECTIVES: Develop and manage methods to achieve a higher usable yield of largemouth bass and bluegill by evaluating the protected range size limit and total weight limit as a method to prevent over-harvest of bass and maintain high quality bass yield, testing different levels of bluegill harvest to determine the level which will yield the optimum size structure. Develop low level supplemental feeding programs which will yield desired amounts of channel catfish at minimum cost.

APPROACH: Farm ponds with populations of largemouth bass and bluegill will be used. The bass harvest will be regulated by following a 30 cm to 38 cm protected range size limit along with a 22 kg/ha/yr weight limit. Bluegill will be harvested at three levels: 11, 34, and 90 kg/ha/yr. Results will be evaluated by

the size structure of fish harvested, population structure of fish in pond (by electrofishing), reproductive success. Some ponds will be stocked only with channel catfish at a rate of 250/ha plus the number of one pound fish desired by the pond owners. They will be fed at amount 3% of body wt/day. Feed adjustments will be made based on calculated growth. The quota by number will be harvested each year and intermediate replacements stocked. Evaluated by size of fish harvested, cost/pound of fish harvested.

PROGRESS: 80/01 TO 80/12. One phase of this project deals with evaluating the population structure of largemouth bass and bluegill in nine ponds subjected to three different levels of bluegill harvest. The bass harvest was the same level in all ponds. The study was initiated during the Summer of 1979 so only the ponds with old established populations were harvested. All fish harvested were measured to determine size structure of the catch. Also the pond populations were sampled and the size structure determined. It is too early in the study to present results. The other phase of the project involves low level supplemental feeding of channel catfish in six additional ponds. Three harvest goals were set (100, 150, and 200 fish per pond). Calculated amounts of feed were fed three times per week. The harvest goals were not quite reached in the ponds. The fish harvested in most ponds averaged over one pound each. The feed conversion (wt. fed/net wt. harvested) ranged from 1.27 to 2.39.

PUBLICATIONS: 80/01 TO 80/12

NILSON, E.E. and KLAASSEN, B.E. 1980. Aquatic Pest Control; Commercial Pesticide Applicator Certification and Recertification Study Manual. Cooperative Extension Service, Kansas State Univ., Manhattan, 16 pp.

007.005* CRIS0084700
MECHANIZATION OF CRAWFISH HARVESTING AND PRODUCTION

EDLING R J; AGRIC ENGINEERING; LOUISIANA STATE UNIVERSITY, EATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB02184 Project Type: STATE
Agency ID: SAES Period: 01 AUG 81 To 30 JUN 84

OBJECTIVES: Develop one or more methods to mechanically harvest crawfish. Mechanize and develop aeration, water management and other systems for crawfish production.

APPROACH: The development of one or more mechanical harvesters and other mechanical devices will relate to practical application needs. The primary harvesting method to be pursued is formulated around a relatively expensive baited trap. The trap design permits easy entrance but makes exit difficult. The added entrance-exit design requirements and the stronger construction needed for mechanical handling make the trap relatively expensive. The expense is defrayed by highly efficient use, characterized by frequent movement. A large number of trap placements per unit area and the frequent movement of the traps will be feasible with a mechanical carrier. The carrier will be self propelled and programmed with timers to remain stationary for given time periods and to move given distances. A device will be made to lower, raise and invert the trap for emptying. Crawfish will be deposited in an inclined pipe through which they will be transported by a stream of water to the end of the wide-span carrier. A linear move irrigator may serve as a carrier and would also be used to aerate the water.

007.006* CRIS0082871
MANAGEMENT TECHNIQUES FOR INCREASING CRAWFISH PRODUCTION

AVAILT J W; FORESTRY & WILDLIFE MANAGEMENT; LOUISIANA STATE UNIVERSITY, EATON ROUGE, LOUISIANA. 70803.

Proj. No.: LAB02133 Project Type: STATE
Agency ID: SAES Period: 01 NOV 80 To 30 SEP 85

OBJECTIVES: Develop better methods of harvesting crawfish. Develop forage/feeding schemes to maximize crawfish yields. Multiple crop crawfish with rice, soybeans and other crops on the same lands. Improve methods of maintaining optimum water quality.

APPROACH: Most of the research will be carried out in replicated Louisiana Agricultural Experimental ponds using field-plot techniques. Outfield research will be conducted in commercial ponds. Pesticide research will be conducted in the field and in the lab.

PROGRESS: 80/01 TO 80/12. During reporting period research continued on: improved methods of harvesting crawfish; evaluation of artificial baits for harvesting crawfish; and evaluation of two varieties of rice, Saturo and LaBelle with and without fertilizer, as forages for crawfish. Such research established under LAB01192 which was terminated 31 Oct 1980.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

007.007* CRIS0067268
ENVIRONMENTAL EFFECTS ON PRODUCTIVITY OF CRAWFISH IN POND HABITATS, PHASE I, II

KODDY L R; DAVIS C E; BIOLOGY; SOUTHERN UNIVERSITY, BATON ROUGE, LOUISIANA. 70813.
Proj. No.: LA.X-PR-0001-8-15-66

Agency ID: CSRS Project Type: GRANT
Period: 29 OCT 74 To 28 OCT 79

OBJECTIVES: Determine the type and amount of food that will yield the best production. Determine the most efficient harvesting method in small ponds. Investigate an early and extended crayfish season in small ponds.

APPROACH: Literature and cooperating personnel will supplement our selection of food types and amount during the feeding season. Standard oets, seines, modified traps and oets will be used. The possible use of chemicals and electric devices will be investigated. Systematic regulation of water will be maintained, to determine the possibility of increase and decrease of water level on an extended season. Statistical analysis will be made.

PROGRESS: 79/01 TO 79/12. Feeding: Data obtained from the crayfish project indicated that feeding and fertilizing had great impact on productivity. Feed with a high protein percentage favored productivity, consequently, fish pellets are highly recommended in the feeding regime. Harvesting: Four different traps were constructed and placed in water depth of 120, 90, 60 and 30 cm respectively. The total weight of each catch per trap was recorded. On the basis of results obtained, Type I trap with 1.5cm mesh wire construction, barrel shape design, 70cm long, 30cm wide with two funnel openings at the bottom is recommended for utilization from January through June. Dual Crop of Crayfish and Fish: 205 fingerlings of hybrid buffalo fish were added to each of the two crayfish ponds. Rice was planted in each pond. None of the fish reached market size over this phase of the investigation but the preliminary results indicate that it is feasible to rear crayfish and these fish in the same pond. Cost Yield Ratio: Based upon average crayfish price, net profits of \$85.82 in Pond I and \$338.83 in Pond II were realized, thereby indicating the feasibility of commercial crayfish production under small pond conditions.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

007.008* CRIS0064935
DISTRIBUTION, ABUNDANCE AND ECOLOGY OF ASCOPYLLUM NOBOSUM (1) LE JOIS

VADAS R L; BOTANY & PLANT PATECLOGY; UNIVEERSITY OF
MAINE, ORONO, MAINE. 04469.
Proj. No.: ME08459 Project Type: HATCH
Agency ID: CSRS Period: 13 FEB 74 To 30 SEP 82

OBJECTIVHS: Determine: Distribution and abundance
patterne of *A. nodosum* in Main, growth, reproductive,
age and biomass patterne on expoeed, eemi-exposed and
sheltered shoree; biomasee of *Fucus* spp., value of
aerial photography and infrared film for *A. nodosum*
surveys; methods to enhance colonization of *A.*
nodosum; harveetable yielde of *A. nodosum*.

APPROACH: Permant and radnomy selected sites will be
utilized to survey the algal resource and study
growth patterns. Samples will be taken eeoasionally.
Experimental studies on colonization will be
conducted in situ and in simulated tide cycles in
running eeawater tanke.

PROGRESS: 80/01 TO 80/12. Four study areas were
established in 1980 making a total of eix in two
major areas (Northeast and Southeast) of the coaet.
The percent cover and biomasee of *Ascophyllum* and
Fucus spp. were determined in belt transects and in
10 x 100 cm quadrats, respectively. Samples were
etratified by intertidal height. Biomase and growth
and density of plante and apical growing points were
measured to determine growth and productivity
potentials. Reproductive output wae measured in Fall
1980 for plante at the six sites. Data measurements
are nearly complete for these sites (through Fall
1980). Computer programming and analyeis will be
initiated in spring 1981. Field colonization studies
involving *Ascophyllum* during 1980 were not
euccessful. Only a few recruits developed (to 2-5 mm)
from approximately 130 experimental plots involving
millions of fertilized eggs. Some promising leade
will be followed up during 1981. Colonization
experiments in running eeawater from these same egge
ebowed excellent growth and survival for 1 to 2
monthe until adversely affected by sedimentation.

PUBLICATIONS: 80/01 TO 80/12

- LARSON, H.F., VADAS, R.L. and KESER, M. 1980.
Feeding and Nutritional Ecology of the Sea Urchin
Strongylocentrotus brachiaciensis in Maine, USA.
Mar. Biol. 58:49-62.
KESER, M., VADAS, R.L. and LARSON, H.F. 1981.
Regrowth of *Ascophyllum nodosum* and *Fucus*
vesiculosus Under Harvesting Regimes in Maine,
USA. Bot. Mar. 24:29-38.

007.009 CRIS0073941
FACTORS AFFECTING THE TEXTURE OF SEAFOODS

HAMANN D D; LANIER T C; FOOD SCIENCE; N CAROLINA
STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC02111 Project Type: HATCH
Agency ID: CSRS Period: 01 NOV 77 To 30 SEP 82

OBJECTIVES: Investigate factors affecting the texture
of products made from mechanically deboned fish
tissue, collect texture data on several species and
commercial handling procedures develop methods for
improving texture, and develop products from N. C.
coast species that have commercial potential.

APPROACH: Atlantic croaker and other species will be
studied to determine the effect of harvesting,
handling and processing conditions on protein
denaturation and resulting poor texture. Major muscle
proteins will be separated into sarcoplasmic protein
and individual myofibrillar protein such as myosin
and actin to study their roles in gel formation,
water binding, etc. Enzyme activity during heating
and resulting protein changes will be determined.
Results will be applied to development or improvement
of specific products.

PROGRESS: 80/01 TO 80/12. An alkaline protease found
in mechanically deboned fish has been shown to be
derived from both muscle tissue and visceral
contamination and to cause texture breakdown during
thermal processing of fish gels. Alkaline protease
was partially purified from both muscle and liver
tissue (both enzymes being cytoplasmic in nature and
heat stable). The muscle protease is a sulfhydryl

protease and does not require Ca^{++} for its
activity while the liver enzyme(s) is Ca^{++}
activated. Several Atlantic fish species have been
examined with respect to the textural properties of
gels prepared from the washed and unwashed minces.
Processing factors which affect the textural
characteristics of fish gels include processing
temperature/time, pressure, method of comminution,
additives (egg, egg and whey albumine, various
starches and hydrocolloids), method of forming, and
frozen storage. Several simulated shellfish meats
have been successfully fabricated based on washed
mince (surimi) such as shrimp, clam strips and
scallops. Work is processing to develop appropriate
electrophoretic, isoelectric focusing and/or
immuno-electrophoretic techniques for the
determination of species composition of minced fish
and surimi blocks.

PUBLICATIONS: 80/01 TO 80/12

- LIN, T.S., SU, H.K. and LANIER, T.C. 1980.
Characterization of Fish Muscle Protease Using
Radio-labeled Protein Substrates. J. Food Sci.
45(4):1036-1039.
LIN, T.S. and LANIER, T.C. 1980. Properties of an
Alkaline Protease from the Skeletal Muscle of
Atlantic Croaker. J. Food Biochem. 4:17-28.

007.010 CRIS0075507
DEVELOPMENT OF IMPROVED HANDLING, SHIPPING/STORAGE
AND MARKETING PRACTICES FOR FISHERY PRODUCTS

LANIER T C; FOOD SCIENCE; N CAROLINA STATE
UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC02113 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 78 To 30 SEP 83

OBJECTIVES: Describe the factors which contribute to
loss of quality in fresh and frozen raw seafoods,
develop and test rapid methods of quality assessment
and evaluate new handling, packaging,
storage/shipment and marketing techniques for their
potential in improving market life and quality of
these products.

APPROACH: North Carolina seafood species will be
studied to determine how handling, processing and
storage methods may be imposed to minimize quality
deterioration due to bacterial and autolytic
processes. Gross and specific enzyme assays will be
used to identify the source and mode of action of
degradative enzyme systems. Various packaging and
storage regimes, involving both refrigerator and
freezer temperatures, will be tested in combination
with various prestorage treatments (sanitizers,
antioxidants, etc.) to improve market life of fishery
products.

PROGRESS: 80/01 TO 80/12. Freeze thaw handling as a
means of merchandising prepackaged fish appears to be
feasible from both a technical and marketing
standpoint. Previous supermarket sales tests
demonstrated the acceptability of chilled fish
labeled "previously-frozen." Vacuum-packaged fish
previously frozen for 100 days at -20 degrees C,
thawed and held chilled were found to have a eatable
life equal to that of fresh fish from the same lot
stored chilled in an identical manner. Shelf-life
studies of fresh and previously-frozen grey trout are
continuing in order to evaluate modified atmosphere
packaging, various pre-dips and thorough washing prior
to packaging as means of extending the life. Analyses
will include: changes in the microbial flora on the
surface, changes in gaseous composition within the
package. A second consumer test will compare sales of
prepackaged (modified atmosphere) fresh and
previously-frozen fish (eo-labeled) with that of
vacuum packaged frozen fish.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

007.011 CRIS0067349
FISHERIES EQUIPMENT AND GEAR DEVELOPMENT

MOTTE G A; BILLIER A J; FISHERIES & MARINE TECH;
UNIVERSITY OF RHODE ISLAND, KINGSTON, BRIDGE ISLAND.
02881.

Proj. No.: R100750 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 JUN 80

OBJECTIVES: Gain an in-depth understanding of the hydrodynamic and mechanical behavior patterns of trawling equipment and gear in its fishing environment. Keep fishermen that are engaged in appropriate operations informed of experimental results and obtain their assistance in providing field trials data.

APPROACH: Develop facilities and equipment capability, both laboratory and shipboard, for the study of fishing gear and its associated equipment. Conduct full-scale instrumented trials on selected components of the total trawl system in order to identify the contribution of component variation to the fishing attitude and performance of the system. Conduct tank tests with scale model of trawls in collaboration with local "highline" skippers. These tests will be conducted by applying known hydrodynamic scaling laws and used as a general gear design medium.

PROGRESS: 75/07 TO 79/09. Fishing trawls were tested in several ways using a test tank as well as conducting instrumented tests at sea in attempts to improve fish catch by improving trawl gear. The research resulted in 1) the development of a towing tank with appropriate instrumentation; 2) the discovery of otterboard physical characteristics which would enable improved design; 3) otterboard design modifications which improved net spreading ability and increased fish catches; 4) establishing techniques for evaluating towing capability of fishing vessels associated with trawl gear.

PUBLICATIONS: 75/07 TO 79/09
NO PUBLICATIONS REPORTED THIS PERIOD.

007.012* CRIS0081987
EQUIPMENT FOR MECHANIZATION OF PRODUCTION OF OYSTERS
AND OTHER SHELLFISH

COLLIER J A; MCLAUGHLIN D M; EVERSOLE A G; AGRICULTURAL
ENGINEERING; CLEMSON UNIVERSITY, CLEMSON, SOUTH
CAROLINA. 29631.

Proj. No.: SC00457 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 80 To 30 SEP 83

OBJECTIVES: Evaluate mechanical equipment for harvesting and transplanting oysters. Conduct environmental impact study of a mechanical harvesting system. Investigate the feasibility of mechanically handling and harvesting hard clams in a tray/raft culture system. Develop equipment for deheading fresh market shrimp.

APPROACH: Evaluate the efficiency and yield of a mechanical oyster harvester in relation to several different harvest methods. Conduct a two year study to determine perturbations, if any, of mechanical harvesting on the environment and develop, if necessary, practices which would mitigate these perturbations. Develop a mechanized system for handling and harvesting tray/raft cultured hard clams. Three systems will be investigated for orienting and deheading shrimp from which a commercial machine will be developed.

PROGRESS: 80/07 TO 80/12. The mechanical oyster harvester was out of the water for repairs and maintenance during this period. Testing should begin in the Spring of 81. Physical properties data on shrimp were obtained and initial design work started for the shrimp deheader. Location of the thickest part of the shrimp and its center of gravity were found. The two parameters are located at different positions along the longitudinal axis of the shrimp and this will be used to generate the necessary force to orient the shrimp for deheading.

PUBLICATIONS: 80/07 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

007.013* CRIS0068717
DEVELOPMENT AND EVALUATION OF OYSTER HARVESTING
EQUIPMENT AND MARICULTURE SYSTEMS

COLLIER J A; WEBB B K; EVERSOLE A G; AGRICULTURAL
ENGINEERING; CLEMSON UNIVERSITY, CLEMSON, SOUTH
CAROLINA. 29631.

Proj. No.: SC00114 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 SEP 80

OBJECTIVES: Develop and evaluate mechanical equipment for harvesting oysters. Evaluate damage by mechanical harvesting systems to oyster beds, remaining oysters and other marine organisms. Investigate systems for shellfish production including spawning systems, seed stock production and grow-out systems, handling systems and feeding systems.

APPROACH: Physical data of oyster beds will be translated into design constraints to construct an oyster harvester. Field tests will be made for evaluating machine performance and monitoring effects on marine life. Engineering systems for planting shell, harvesting and transplanting seed oysters, materials handling and harvesting schedules will be developed. Computer models will be used for optimization.

PROGRESS: 75/07 TO 80/09. A mechanical oyster harvester has been developed and tested in South Carolina estuaries. An 11.5 meter steel hull house boat was salvaged and modified to carry the oyster harvester. This modification included extending the hull to 14 meters, mounting a winch and boom system to raise the head, constructing a conveyor system to handle the oysters and mounting three engines on the vessel. The most important consideration in developing a machine to harvest oysters is protection of the fragile shell matrix or bed on which the oysters grow. Therefore, an automatic system to control harvester force exerted on the bottom was developed that can precisely regulate the force exerted on the shell matrix through a varying depth range of 1 to 3 meters. The head can operate on bottom contours with pitch and roll angles of .35 radians. Harvest rates of 20 m³/hr were obtained with damage to the oysters and shell matrix equal to or less than that of hand harvesting.

PUBLICATIONS: 75/07 TO 80/09
NO PUBLICATIONS REPORTED THIS PERIOD.

007.014 CRIS0064807
MICROBIOLOGICAL ASPECTS TO SHELLFISH SANITATION AND
QUALITY

VANDERZANT C; RAY S M; ANIMAL SCIENCE; TEXAS A&M
UNIVERSITY, COLLEGE STATION, TEXAS. 77843.

Proj. No.: TEX06054 Project Type: HATCH
Agency ID: CSRS Period: 07 JAN 74 To 30 SEP 80

OBJECTIVES: Determine the level and seasonal distribution of *Vibrio parahaemolyticus* in freshly harvested oysters, clams and mussels. The effect of processing and handling procedures in wholesale and retail operations on *V. parahaemolyticus* also will be studied. Data on environmental and water characteristics will be used to examine possible relations between microbiological quality of seafoods and environmental characteristics.

APPROACH: Oysters, clams and mussels from Galveston Bay and waters and sediment from these areas will be examined for microbiological parameters (*V. parahaemolyticus*, coliforms, fecal coliforms, etc.).

PROGRESS: 74/01 TO 80/01. *Vibrio parahaemolyticus* is a potential pathogen transmitted to humans by consumption of contaminated seafoods. *V. parahaemolyticus* was present in low concentrations in about 60% of oysters, water and sediment of the Gulf of Mexico. No seasonal distribution of this organism was noted. There was no significant relationship

between levels of *V. parahaemolyticus* and other bacteriological or environmental parameters. No increases in *V. parahaemolyticus* concentrations of seafood occurred when good processing practices were applied. Most seafood isolates of *V. parahaemolyticus* belonged to serotype O5: K17 and differed from typical clinical isolates. Few were hemolytic (Kanagawa-positive). Kanagawa-positive and Kanagawa-negative strains of *V. parahaemolyticus* were examined for enterotoxigenicity, enteropathogenicity, drug resistance and plasmid DNA content. No significant relationship existed between cultural characteristics and indices of pathogenicity. Only 3 of 31 strains, all patient isolates, contained plasmid DNA with molecular weights of 24 or 60 million daltons.

PUBLICATIONS: 74/01 TO 80/01
NO PUBLICATIONS REPORTED THIS PERIOD.

007.015 CRIS0056948
IMPROVING SURFACE WATER CONDITIONS THROUGH CONTROL
AND DISPOSAL OF AQUATIC VEGETATION

BRUBN B D; LIVERMORE D F; KEGEL R G; AGEI
ENGINEERING; UNIVERSITY OF WISCONSIN, MADISON,
WISCONSIN. 53706.
Proj. No.: WIS05032 Project Type: STATE
Agency ID: SAES Period: 01 JUL 68 To 30 JUN 78

OBJECTIVES: Increase aquatic vegetation harvesting equipment capacity, reduce harvesting costs, and develop methods and procedures for utilizing aquatic vegetation.

APPROACH: New theories of harvesting methods are being investigated. Laboratory studies are being made of new types of functional components of harvesting equipment. Prototypes of promising equipment are being constructed and tested in the lake. Processing of aquatic vegetation is being investigated to determine its feeding value after processing and methods of increasing palatability.

PROGRESS: 79/01 TO 79/12. High-speed aquatic plant cutters were built and tested to determine requirements. Two low-capital harvesting systems involving stationary removal equipment and in-water transport of cut vegetation were monitored.

PUBLICATIONS: 79/01 TO 79/12
KEGEL, R.G. and LIVERMORE, D.F. 1979. Reducing Capital Investment in Aquatic Plant Harvesting Systems. Proceedings 2/79, Institute for Environmental Studies, U. of Wis.-Madison.
LIVERMORE, D.F. and KEGEL, R.G. 1979. Mechanical Harvesting of Aquatic Plants: An Assessment of the State of the Art. Proceedings 2/79, Institute for Environmental Studies, U. of Wis.-Madison.

007.016 CRIS0083616
METHODS OF MODIFIED-ATMOSPHERE PRESERVATION OF
REFRIGERATED FRESH FISH

LINDSAY R C; DEIBEL R E; FOOD SCIENCE; UNIVERSITY OF
WISCONSIN, MADISON, WISCONSIN. 53706.
Proj. No.: WIS05171 Project Type: STATE
Agency ID: SAES Period: 01 JUL 80 To 31 JUL 82

OBJECTIVES: To investigate the modified-atmosphere packaging of fresh fish with special emphasis on the behavior of *Clostridium botulinum* Type E in conditions of short-term, high abuse temperatures. To investigate the behavior of *C. botulinum* Type E in long-term storage under refrigeration conditions with particular reference to the effects and influences of sorbic acid and varying atmospheres. To develop practical and effective methods for assessing the potential shelflife of modified-atmosphere packaged fresh fish.

APPROACH: Fresh and saltwater species of fish will be obtained from commercial sources, and packaged in a range of modified-atmospheres, including carbon dioxide mixtures. Samples will be inoculated with mixed-strain *C. botulinum* spores and held under a

range of conditions, including temperature abuses (60 degree - 90 degree F) up to 72 hours. Toxigenesis will be determined by mouse bioassays. Methods will be evaluated for assuring safety from *C. botulinum*, and will include carbon dioxide atmospheres, chemical preservation with potassium sorbate, and other food-approved additives. Microbiological and chemical indices for quality will be evaluated for application to preserved fish.

8. Processing and Product Development

008.001* CRIS0058561
FRESHWATER FOOD ANIMALS

LOVELL R T; MCCCY E W; FISHERIES & ALLIED
AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA.
36830.

Proj. No.: ALA00630 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 71 To 30 SEP 81

OBJECTIVES: Evaluate economics of production, processing, and marketing of freshwater food animals. Develop and improve products and processing methods that will enhance marketability and insure quality of cultured freshwater food animals.

APPROACH: Mechanically deboned flesh from various fishes will be evaluated with regard to yield, quality, and storage stability. Waste from fish processing will be evaluated chemically and biologically, and technology will be developed for economic waste utilization. Methods will be tested for control of geosmin related off-flavor in pond raised fish. Costs and returns associated with production of food fish in various culture systems will be assessed. Identify and evaluate alternative marketing and distribution systems for fish with respect to market expansion, consumer reactions, and optimizing income to producers and processors.

PROGRESS: 80/01 TO 80/12. 59 collections of catfish processing waste (head, skin, viscera) from the major processing plants and representing production ponds from Ala., Miss. and Ark. were analyzed for a-BHC, heptachlor, DDE, DDT, Dieldrin, endrin and toxaphene. All samples contained toxaphene. All samples contained toxaphene; the range was 0.06 to 3.6 mg/kg. DDE and DDT was found in most; the range of DDE was 0.01 to 0.56 mg/kg and the range of DDT was 0.01 to 0.58 mg/kg. None of the pesticide concentration in any sample exceeded the levels allowed in human foods, indicating the waste should be safe to use in commercial fish feeds. 35 off-flavored catfish collected from processing plants in Mississippi during April-June 1980 were evaluated by a trained sensory panel for quality and intensity of off-flavor. Only six of the samples had the distinct geosmin flavor which was formerly thought to be the major off-flavor in pond raised catfish. The most prominent flavor was "fecal" (sewage or manure); other were "rancid", "paint", "diesel", and "algae". Extracts from each fish were sent to the Southern Regional Research Center (USDA - AR) for compound identification.

PUBLICATIONS: 80/01 TO 80/12
LOVELL, R.T. 1980. Utilization of Catfish Processing Waste. Auburn Univ. Agri. Exp. Sta. Bull. S 21. 19 p.
LOVELL, R.T. 1980. S-83 Annual Report: Freshwater Food Animals. So. Coop. Ser. Sp. Rep., June, 1980. 20 pp.
LOVELL, R.T. 1980. Effects of Feeding Full-Fat Soybean Meal on Growth and Flesh Quality in Catfish. Aquaculture 6(3):39.
LOVELL, R.T. 1980. Nutritional Value of Fish. Aquaculture 6(5) 45.

008.002 CRIS0066589
PIGMENTS OF MEAT AND FISH PRODUCTS (OFF-COLORS IN TUNA)

BROWN W D; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-FST-3011-MH Project Type: BATCB
Agency ID: CSRS Period: 30 SEP 74 To 30 SEP 78

OBJECTIVES: Determine factors involved in development of off-colors in tuna fish.

APPROACH: Determine the extent of influence of post-mortem levels of organic phosphate compounds on oxidation rate of myoglobin. Evaluate the extent of contribution of oxidation to the darker colors of some species of fish, especially when frozen. Determine if organic peroxides produced during storage of fish are involved in greenish reactions with myoglobins. Develop new color stabilizers for canned fish pet food products to replace nitrite in the event the use of nitrite should be banned. Develop new assay for free ribose inasmuch as the latter compound has been shown to be involved in an important deteriorative browning reaction in precooked skipjack tuna; evaluate means of inhibiting this browning reaction, e.g. by dipping fish prior to freezing in inhibitor solution.

PROGRESS: 74/09 TO 79/09. A method was developed for determining relative and absolute concentrations of myoglobin pigment derivatives in meats and fish, both untreated and treated with atmospheres containing carbon monoxide. A study was made to determine the fate of (14C) carbon monoxide in cooked or stored ground beef samples. Following exposure of meat samples to labeled CO, samples were either stored or cooked for varying periods of time. Aqueous and fat extracts were made and the amounts of radioactivity in these fractions and in the residues were determined. Activity in the aqueous fraction was due entirely to carboxymyoglobin; that in the lipid fraction was insignificant. During storage, CO was lost with a half-life of about 3 days. Maximum loss from cooked patties was about 85%. The use of low levels of CO may prevent the discoloration noted when red meats are stored in elevated levels of CO(2). Microbiological and color shelf lives of ground beef patties exposed to a 1% carbon monoxide, 50% carbon dioxide (balance air) atmosphere were significantly increased compared to controls held in air at 2 degrees C. Accompanying studies were made of the uptake of carbon monoxide by myoglobin in beef patties exposed to a 1% CO atmosphere, and the subsequent loss of carbon monoxide when samples are placed in an air atmosphere under fluorescent illumination. The half-life for the loss of carbon monoxide from such samples was found to be about 2 days.

PUBLICATIONS: 74/09 TO 79/09

WATTS, D.A., WOLFE, S.K. and BROWN, W.D. 1978. Fate of (14C) carbon monoxide in cooked or stored ground beef samples. Journal of Agricultural and Food Chemistry 26(1):210-214.

WOLFE, S.K., WATTS, D.A. and BROWN, W.D. 1978. Analysis of myoglobin derivatives in meat or fish samples using absorption spectrophotometry. Journal of Agricultural and Food Chemistry 26(1):217-219.

GEE, D.L. and BROWN, W.D. 1978. Stability of carboxymyoglobin in refrigerated ground beef. Journal of Agricultural and Food Chemistry 26(1):273-274.

GEE, D.L. and BROWN, W.D. 1978. Extension of shelf life in refrigerated ground beef stored under an atmosphere containing carbon dioxide and carbon monoxide. Journal of Agricultural and Food Chemistry 26(1):274-276.

BROWN W D; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-FST-3865-B Project Type: BATCB
Agency ID: CSRS Period: 01 OCT 79 To 30 SEP 84

OBJECTIVES: Provide new or altered technology resulting in improved quality in seafood products, including the production of more appealing products for the consumer and those in which nutrient retention is maximized. Provide means of improved and extended distribution of fresh and frozen seafoods via new and alternate methods of handling and processing. Develop new marine food products. Collect basic biochemical data on protein, lipid and other constituents of aquatic animals.

APPROACH: Apply innovative technological procedures to a variety of seafood products and determine the resulting quality of such products by chemical, microbiological and sensory analyses. Pursue detailed studies of the effects of modified atmosphere storage on seafood products, including investigation of the effectiveness of high levels of carbon dioxide in such systems. Determine structure and properties of myoglobins and other pigments from a variety of aquatic animals; examine lipid composition and oxidation in seafoods; and investigate deleterious chemical and microbiological changes in fish.

PROGRESS: 80/01 TO 80/12. Rockfish fillets and salmon steaks were held in atmospheres containing 20% or 40% carbon dioxide. Controls were stored in air. At intervals of refrigerated storage up to 14 days, samples were removed for sensory, chemical, and microbiological analyses. Samples held in air were judged by panelists to have stronger aromas than others held under carbon dioxide at either level. The higher level of carbon dioxide was more effective. Storage under carbon dioxide was effective in reducing the formation of trimethylamine and ammonia, and markedly inhibited microbial growth. Bismine production by *Proteus morganii*, *Proteus vulgaris* and *Bafoia alvei* cultures isolated from spoiled skipjack tuna was measured under twelve environmental conditions. The highest histamine concentrations were found at 19 degrees C. and 30 degrees C; no histamine was formed at 1 degree C. *Proteus* organisms at first formed high levels of histamine, much of which was subsequently destroyed. The concentration of histamine in tuna products may depend on an equilibrium between histamine production and destruction. Amino acid sequences of the soluble tryptic peptides of yellowfin tuna myoglobin, comprising 60% of the total residues, were determined; the amino terminus is acetylated.

PUBLICATIONS: 80/01 TO 80/12

RICE, R.H., WATTS, D.A. and BROWN, W.D. 1979. Sequences of the Soluble Tryptic Peptides from Myoglobin of Yellowfin Tuna (*Thunnus albacares*). Comparative Biochemistry and Physiology 62B(4):481-487.

BROWN, W.D., ALBRIGHT, M., WATTS, D.A., BEYER, B., SPRUCE, B. and PRICE, R.J. 1980. Modified Atmosphere Storage of Rockfish (*Sebastes niotatus*) and Silver Salmon (*Oncorhynchus kisutch*). Journal of Food Science 45(1):93-96.

ARNOLD, S.H., PRICE, R.J. and BROWN, W.D. 1980. Histamine Formation by Bacteria Isolated from Skipjack Tuna, *Katsuwonus pelamis*. Bulletin of the Japanese Society of Scientific Fisheries 46(8):991-995.

008.004 CRIS0072763
BIOCONVERSION OF CHITIN WASTES

CARROD P A; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-FST-3523-B Project Type: HATCH
Agency ID: CSRS Period: 23 MAY 77 To 30 DEC 81

OBJECTIVES: Design and economically analyze a process for the bioconversion of shell fish chitin wastes to single-cell protein. The specific goals are: Select a microorganism which secretes an active extracellular

chitinase system and characterize the kinetics of chitin hydrolysis. Optimize chitinase production with selected microorganisms; determine conversion rate of chitin degradation products into yeast single-cell protein; design a process for enzymatic chitin hydrolysis and bioconversion to protein and economically analyze the process with respect to application to the California seafood industry.

APPROACH: Fermentations will be conducted in a well-stirred instrumented fermentor. Organisms will be compared for extracellular chitinolytic activity on shrimp shell and colloidal chitin. Yeasts will be selected on the basis of growth rate and acceptable amino acid distribution for a feed supplement. Conventional engineering and economic principles will be used for the design and feasibility study.

PROGRESS: 80/01 TO 80/12. A process for bioconversion of shellfish processing chitin waste is being designed. Experimental aspects just completed are determination of optimum conditions for microbial chitinase production and for pretreatment of waste to render the chitin accessible to enzymatic hydrolysis. Enzyme production was studied in shaken flasks and fermentors using response surface methodology to define the temperature and pH which yield highest enzyme activity in solution and the associated enzyme and cell mass yield factors. Waste pretreatment includes grinding for increase of surface area, alkaline wash to remove protein, and mild acid treatment to remove carbonate. A computer program for design of the fermentation equipment has been modified for use in this project. With experimental results now available, the complete process of enzyme production, chitin pretreatment and hydrolysis, and hydrolysate conversion to single-cell protein will be designed and analyzed economically.

PUBLICATIONS: 80/01 TO 80/12

YOUNG, M.E., CARROD, P.A. and BELL, E.L. 1980. Estimation of Diffusion Coefficients of Proteins. Biotechnology and Bioengineering 22:947-955.

008.005* CRIS0066814
THE USE OF SELECTED AQUATIC ORGANISMS FOR PURPOSES OF AQUACULTURE (FOOD PRODUCTION)

KNIGHT A W; LAND, AIR & WATER RESOURCES; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-LAW-3350-B Project Type: BATCB
Agency ID: CSRS Period: 05 NOV 74 To 30 SEP 80

OBJECTIVES: Determine the tolerance, growth dynamics, food preference, egg hatchability of selected pest organisms. Utilize existing pest organisms such as tadpole shrimp and cladophora algae for beneficial purposes such as low cost protein source.

APPROACH: Initially information will be obtained relating to the environmental needs of the organisms under consideration. Later we will manage environmental factors in order to maximize the production of the potential protein material for purposes of either a domestic animal food (i.e., chicken or catfish food) or a protein supplement for humans.

PROGRESS: 80/01 TO 80/12. Preparation of manuscripts resulting from our work with the Malaysian prawn (*Macrobrachium rosenbergii*) continues. These manuscripts focus on physiological aspects of our research and will be submitted to scientific journals in the near future. Research to better understand the laboratory culture of the grass shrimp (*Crangon*) is progressing well. This shrimp is a key food item for striped bass and sturgeon. Those culturing the sturgeon in the laboratory have indicated a need for food that is also under culture and therefore readily available to feed fish. Our research to determine the environmental needs of the shrimp has increased our capabilities to successfully culture this shrimp in the laboratory. Recently we have included the Atlantic clam (*Corbicula*) in our culture operations. This clam exhibits potential as a filter feeder to remove undesirable particulate matter from aquaculture systems. In addition, the clam has demonstrated an

ability to accumulate toxic materials such as heavy metals and organic materials. Clams, it is felt, will serve as excellent monitoring organisms in aquaculture systems. We are experimenting with methods of placing the clams in aquatic systems and their retrieval for tissue burden determination.

PUBLICATIONS: 80/01 TO 80/12

STEPHENSON, M.J. and KNIGHT, A.W. 1980. Growth, Respiration and Caloric Content of Larvae of the Prawn *Macrobrachium rosenbergii*. Comparative Biochemistry and Physiology 66A(3):385-391.
NAGAMINE, C., KNIGHT, A.W., NAGAMINE, C., KNIGHT, A.W., MAGGENTI, A. AND PAXMAN, G. 1980. Effects of Androgenic Gland Ablation on Male Primary and Secondary Sexual Characteristics in the Malaysian Prawn, *Macrobrachium rosenbergii* with First Evident of Induced

008.006 CRIS0044032
SEYING SEAFOOD PRODUCTS WITH SOLAR ENERGY

DENG J C; BAIRD C D; BERRY R E; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: 7092-20530-002A(2)

Project Type: COOPERATIVE AGREEMENT
Agency ID: AFS Period: 09 NOV 77 To 30 JUN 81

OBJECTIVES: Develop and study low cost solar dryers for drying seafood and mullet roe. Develop optimum conditions and study effects of collector material and configuration, radiation rate, air flow, on quality of products. Determine need for heat storage and potential energy savings.

APPROACH: Develop dryers designed of simple, inexpensive materials to use direct solar radiation and solar heated air (indirect). Compare natural convection with forced air. Prepare dried mullet roe, minced fish cake and fish fillets (white and dark flesh). Compare drying of fresh fish and roe, with products previously cured with salt. Compare temperatures and air velocities vs. quality of products. Develop optimum conditions for retention of quality and basic information for developing design and drying system for commercialization.

PROGRESS: 80/01 TO 81/06. Temperatures to dry mullet roe were developed for a direct insolation greenhouse type drier with inside temperatures of 100 to 110°F during winter. During summer, excessive temperatures were reached. An acceptable product was obtained at 88, 98 and 113°F with dewpoints of 43, 53 and 68°F, but the higher the temperature the more rapid the rate of product browning. From these results one can determine how long and at what moisture content to dry mullet roe before it becomes unacceptable. Feasibility was determined for modifying a flat plate solar collector to reach sufficient temperatures to make an acceptable smoked product without use of supplementary heat. A sufficient temperature (160°F) could be obtained during peak insolation, but an excessively large collector would be required for a commercially useable amount of smoked mullet.

PUBLICATIONS: 80/01 TO 81/06

NO PUBLICATIONS REPORTED THIS PERIOD.

008.007 CRIS0071104
FOOD PRODUCT DEVELOPMENT FROM FLORIDA UNDERUTILIZED FISH SPECIES

DENG J C; FOOD SCIENCE; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-FS-01789 Project Type: BATCB
Agency ID: CSRS Period: 13 AUG 76 To 30 JUN 81

OBJECTIVES: Develop new products, minced fish products, intermediate moisture mullet roe, and canned fish; evaluate quality and investigate storage stability of the new products.

APPROACH: Several Florida underutilized fish species, either alone or mixed, will be investigated to determine the quality and subsequent storage stability of minced fish products. The improved

method for processing mullet roe and the salt content, water activity and darkening problem related to the intermediate moisture mullet roe will be studied. The processing of various canned fish products, the quality and subsequent storage stability of the products will be studied.

PROGRESS: 80/01 TO 80/12. Fish patties were prepared from mixing minced light color fish (sheephead) flesh with various concentrations of sodium alginate (NaAlg), tripolyphosphate (TPP), and salt (NaCl). The overall trend indicated that as the NaAlg. level was increased, the breaking force (firmness) decreased. At 0.10% NaAlg. as the NaCl level was increased, it was necessary to decrease the TPP concentration in order to attain the same breaking force. As the NaAlg. level was increased at a constant TPP level, the breaking force increased. At NaAlg. levels 0.10% the trend begins to change so that in some instances it was necessary to increase the TPP to a maximum point and then decrease it in order to maintain the same breaking force. Consequently at a fixed NaAlg. and a constant TPP level, two levels of NaCl would produce the same breaking force. Also, if the NaAlg. and TPP levels remained constant, then an increase in NaCl would first cause a decrease in breaking force and then a slight increase. The trend toward an increase in breaking force became less apparent at the higher NaAlg. levels. Effect of washing temperature on fish muscle proteins in the washing treatment of minced fish mullet was studied.

PUBLICATIONS: 80/01 TO 80/12

- BSU, W.H., DENG, J.C. and CORNELL, J.A. 1980. Effect of Salting Time, Dehydration Temperature and Dehydration Time on Quality of Intermediate Moisture Mullet Roe. *J. Food Sci.* 45:102.
BSU, W.H. and DENG, J.C. 1980. Processing of Cured Mullet Roe. *J. Food Sci.* 45:97.
DENG, J.C. 1981. Effect of Temperatures on Fish Muscle Alkaline, Protease Interaction and Texture Quality. *J. Food Sci.* 46:62.
DENG, J.C. and TOMASZEWSKI, F.T. 1980. Effect of Alginate, Tripolyphosphate and Sodium Chloride on Quality of Minced Fish Flesh Croaker. *Proceedings of Int. Conf. on Fish Sci. and Tech.* Aberdeen, Scotland.

008.008

CRIS0065717

SMOKING OF SEAFOOD AND POULTRY

KOEBURGER J A; OBLINGER J L; FOOD SCIENCE; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-PS-01763 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 76 To 30 JUN 81

OBJECTIVES: Investigate the effects of brining, smoking and storage on the chemical, microbial and sensory attributes of selected seafood and poultry products.

APPROACH: The effects of brine concentration, brining time, smoking times and temperature will be studied as to their effects on quality attributes of selected seafood and poultry products.

PROGRESS: 80/01 TO 80/12. Effects of brine concentration (0-6%), intensity of smoking (1.5 or 3.0 hr), method of cooking (baked, broiled or fried) and frozen storage on the acceptance of cold smoked mullet fillets were determined. A twenty member sensory panel indicated that fillets soaked in 4% brine for 30 min, smoked for 1.5 hr at 48C and deep fat fried were an acceptable product. Frozen storage of the smoked fillets for two weeks or of the whole fish for six weeks prior to smoking had no significant effect on acceptance of the product. Panel members gave the product a "very good" rating and indicated they would purchase it if available.

PUBLICATIONS: 80/01 TO 80/12

- KOEBUEGER, J.A. and OTWELL, W.S. 1980. Florida Smokies: A Fried Cold Smoked Fillet Produced From Roe Mullet. *Proc. Trop. and Subtrop. Fish Conf.* 5:54-61.

OTWELL, W.S., KCEBURGER, J.A. and DEGNER, F.L. 1980. Low-Temperature Smoking Technique Opens Route for New Fish Products. *Food Prod. Develop.* 14:16-18.

008.009

CFIS0068170

BIOLOGICALLY ACTIVE AMINES IN FOOD

EITENMILLER R R; KCEBLE P E; FOOD SCIENCE; UNIVERSITY OF GEORGIA, ATHENS, GEORGIA. 30602.
Proj. No.: GEO00514-HM Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 75 To 30 JUN 80

OBJECTIVES: Determine phenylethylamine concentrations in fermented foods and quantitate other biologically active amines in foods which have not previously been studied. Study more fully tyramine formation in fermented sausage products and determine factors influencing the formation of tyrosine decarboxylase during sausage production. Study factors leading to histamine formation in fish muscle and identify histidine decarboxylating microorganisms in the muscle microflora.

APPROACH: Identification and quantitation of amines will be done with ion-exchange techniques, gas chromatography, and TLC. Assay of amino acid decarboxylase activity will be carried out using radioisotopic techniques. Factors affecting production of amino acid decarboxylases in food products will be studied.

PROGRESS: 75/07 TO 80/06. An assay method based upon high pressure liquid chromatography and paired in chromatography was developed for assay of tryptamine, and phenethyl amine in food products. The procedure is more sensitive and faster than most quantitative procedures for biologically active amine analysis. Factors influencing tyramine formation and the presence of tyrosine decarboxylase activity in natural microflora and starter (*Pediococcus cerevisiae*) fermented sausages were determined. The study indicated that the natural meat microflora developed during the aging of salted meat can develop tyrosine decarboxylase activity necessary for rapid conversion of tyrosine to tyramine. The use of a started culture such as *P. cerevisiae* appears to decrease the possibility of development of a microflora during fermentation that would possess both tyrosine decarboxylase activity and proteolytic activity necessary to produce fermented sausages with potentially hazardous tyramine concentration. Histamine formation by *Proteus morganii* in tuna muscle was studied to determine factors influencing histamine formation in tuna. Inoculated tuna muscle supported high histamine development when stored at ambient temperature (24 degrees) or at 30 degrees C. At these temperatures, histamine development was greater than 500 mg/100 g muscle after 24 hr of storage. A corresponding decrease occurred in free histidine in the muscle. Little histamine occurred in tuna fish inoculated with *P. morganii* and stored at 15 degrees C.

PUBLICATIONS: 75/07 TO 80/06

NO PUBLICATIONS REPORTED THIS PERIOD.

008.010

CRIS0082931

LOW-TEMPERATURE STORAGE OF FRESHWATER PRAWN, *MACROBRACHIUM ROSENBERGII*

NIP W; MOY J H; FOOD SCI & HUMAN NUTRITION; UNIVERSITY OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW00577-H Project Type: BATCH
Agency ID: CSRS Period: 01 OCT 80 To 30 SEP 83

OBJECTIVES: Develop appropriate techniques to preserve the quality of ice-chilled *M. rosenbergii*. The freshwater prawn, *M. rosenbergii* becomes mush after three days of ice-chilled storage. The cause(s) of this mushiness are not known.

APPROACH: Preserve the quality of freshwater prawn includes: Measuring the post-harvest quality changes in *M. rosenbergii* under ice-chilled condition; characterizing the collagenolytic activity of prawn hepatopancreas and its enzymes; characterizing the

proteolytic and collagenolytic microorganisms associated with *M. rosenbergii* and measuring the effects of food additives on the shelf-life of ice-chilled *M. rosenbergii*.

PROGRESS: 80/10 TO 80/12. This is a new project concerning the investigation of the causes of mushiness in the freshwater prawn and the effects of food additives on the quality factors of prawn during ice-chilled storage. Data collected to date showed that prawn muscle's of pH, ammonia, soluble protein and indole increased significantly during ice-chilled storage of the whole and deheaded prawns.

PUBLICATIONS: 80/10 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

008.011 CRIS0071426
HISTAMINE/HONEYCOMBING IN SKIPJACK TUNA

FRANK H A; NIP W; NIP W; FOOD SCIENCE & TECHNOLOGY;
UNIVERSITY OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW00573 Project Type: STATE
Agency ID: SAES Period: 01 JUL 76 To 30 SEP 81

OBJECTIVES: Develop methodology for measuring decomposition in skipjack tuna (*Katsuwonus pelamis*). Learn the conditions of handling causing high histamine and/or honeycombing.

APPROACH: Suitable analytical methods for histamine, histidine and honeycomb in skipjack will be selected and developed. These are fluorescence, thinlayer and high pressure liquid chromatography. Appropriate samples indicative of methods of handling will be analyzed. These will include times and temperatures.

PROGRESS: 80/01 TO 80/12. A study was completed on the effect of low-temperature (30 to 50 degrees F) incubation on histamine formation, honeycombing and quality deterioration in skipjack tuna. A study was completed on the effect of low-temperature (30 to 50 degrees F) incubation on microbial growth and histidine decarboxylation in skipjack tuna. A study was completed on the quantitative relationship between collagen breakdown and honeycombing in skipjack tuna. A nomograph was prepared to show the relationship of time-temperature-histamine in skipjack tuna under controlled conditions in the 70-100 degrees F range. A paper, "Bacterial histamine formation in skipjack tuna," was presented at the annual meeting of the Pacific Fisheries Technologists, March 16-19, 1980, in Astoria, Oregon. Tuna Research Workshop V was sponsored on December 11-12, 1980, in Honolulu to present a final report on the progress made on this project. A paper "Histamine formation and honeycombing during decomposition of skipjack tuna (*Katsuwonus pelamis*) at elevated temperatures," has been submitted for publication in Marine Fisheries Review. Additional manuscripts are being prepared for publication.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

008.012* CRIS0073715
POST-HARVEST HANDLING AND PROCESSING OF MACROBRACHIUM
PRAWNS

NIP W; MOY J H; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY
OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW00576-S Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 SEP 80

OBJECTIVES: Define the quality of fresh and cooked prawns in terms of physical, chemical, bacteriological and organoleptic attributes. Assess the effect of various processing techniques (freezing, holding, packaging, storage and thawing) on the quality of the frozen prawns. Determine and recommend a set of handling, holding and processing conditions in terms of acceptable quality of frozen prawns for long term storage.

APPROACH: Zero-time control samples will be analyzed in terms of texture, pH, trimethylamine, collagen, and salt content, bacterial count and taste score. Prawns will be processed, stored and analyzed for the various quality attributes. Optimum conditions for processing, packaging and storing of frozen prawns will be determined based on the above results.

PROGRESS: 77/07 TO 80/12. Various postharvest handling and freezing procedures for the freshwater prawn, *Macrobrachium rosenbergii* were tested. Results of the frozen storage stability studies (6 mos) suggested that prawns may be chilled up to 48 hrs, then frozen and still maintain acceptable quality; the quality of prawns held under chilled conditions 48 hrs after thawing was still acceptable; post-blanching chilled storage may not be a practical prefreezing technique for commercial preservation and marketing of frozen prawns; and prawns can be frozen either in air or in brine at -18 degrees C, packaged in polymylar bags with or without vacuum, or frozen in ice-blocks, and still maintain acceptable quality. Effect of purging on quality factors and cost-effectiveness were also tested. No significant difference (p less than or equal to 0.05) was found between the purged prawns and the control in their muscle's pH, ammonia content, soluble/insoluble collagen ratio, and peak height/plateau height ratio. However, the decrease in pH and peak height/plateau height ratio, and the increase in ammonia content and soluble/insoluble collagen with ice-chilled time were highly significant (p less than or equal to 0.01), indicating a gradual quality degradation when stored on ice. Postharvest purging helped to improve the appearance of the prawn but its cost-effectiveness based on economic feasibility analysis was doubtful.

PUBLICATIONS: 77/07 TO 80/12
NIP, W.I. and MOY, J.H. 1979. Effect of Freezing Methods on the Quality of the Prawn *macrobrachium rosenbergii*. Proc. of World Maricul. Soc. 10:761-765.

008.013 CRIS0066181
PREFLAVORED CHANNEL CATFISH

CAUL J F; FOOD & NUTRITION; KANSAS STATE UNIVERSITY,
MANHATTAN, KANSAS. 66506.
Proj. No.: KAN00919 Project Type: STATE
Agency ID: SAES Period: 01 JUL 74 To 30 JUN 78

OBJECTIVES: Explore the effects of conventional home cookery on the flavor of whole channel catfish preflavored with three commercial flavorants (e.g., onion, liquid smoke, garlic) when the treated fish are fresh; have been held in a household refrigerator 2-3 days; have been frozen in a household freezer, stored 1-2 months, then thawed before cooking.

APPROACH: Farm-raised channel catfish, 1/2-1 pound, will be preflavored by adding known quantities of flavorant(s) to their aquarium water. After being dressed and cooked, preflavored catfish and controls will be examined by flavor profile panel. Preflavoring treatments, cookery and examinations will be repeated at least once; at least two concentrations or two exposure times of each flavorant will be used. Research will be reported as a master's thesis.

PROGRESS: 74/06 TO 78/07. Prior work having shown the feasibility of preflavoring channel catfish in laboratory aquariums, experiments were conducted to explore the effects of conventional home cookery on the flavor of whole channel catfish preflavored with a commercially available liquid smoke flavorant. An experienced taste panel found that the flavor was retained in fish stored in home-type refrigerator for 1-3 days or in a commercial freezer up to 10 weeks; the dressed fish, 167-349 grams, were cooked plain by microwave or breaded, by frying. Details are given in Master's Thesis of Jo Karen Clithero, "Preflavoring Channel Catfish," 1975.

PUBLICATIONS: 74/06 TO 78/07

NO PUBLICATIONS REPORTED THIS PERIOD.

008.014 CRIS0073631
OPERATING PARAMETERS OF LAGOONS FOR DISPOSAL OR
UTILIZATION OF DAIRY FARM AND PROCESSING PLANT WASTE

GOUGE F B; WHITE C H; DAIRY SCIENCE; LOUISIANA STATE
UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB01955 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 77 To 30 SEP 82

OBJECTIVES: Improve scientific guidelines for management of oxidation lagoons through evaluation of the operational characteristics as measured by chemical and bacteriological qualities of the effluents. Determine effect, if any, of including aquatic plants in dairy cattle rations on the properties of milk produced. Evaluate lagooning as a means of whey disposal.

APPROACH: Plans are to use the existing LSU dairy farm lagoons together with new lagoons to be built to measure effects of operational procedures on quality of effluents. Duckweed grown on these ponds will be included in dairy cattle rations and the milk produced will be analyzed to determine effects on composition. The work with whey will be accomplished by use of 2 existing used 200 gal. capacity milk vats for lagoon simulation. Reduced lactose whey will be used for these oxidation studies.

PROGRESS: 80/01 TO 80/12. Objectives: To study the operating parameters of a mechanically aerated lagoon for disposal of dairy plant wastes. Accomplishments: A mechanically aerated lagoon (182.9 m x 60.9 m x 2.4 m) which was used for disposal of dairy plant wastes was utilized in this study. Lagoon aeration was by the use of four surface aerators. Lagoon samples were taken at depths of .15 m and 1.52 m in five lagoon locations at monthly intervals for fifteen sampling periods. The samples taken at each depth were composited for analyses. Additional samples were taken at a .15 depth at the entrance to a lagoon settling area and from the lagoon effluent. Lagoon sample analyses included BOD, COD, total suspended solids (TSS), and dissolved oxygen (DO). The average values (mg/L) for BOD, COD, TSS and DO for the .15 m composite sample were 111, 520, 260, and 2.5, respectively and for the 1.52 m composite sample the average values (mg/L) were 119, 589, 328, and 2.3, respectively. The average BOD value (mg/L) for the lagoon effluent was 99. Significance and/or Application: The effluent from the aerated lagoon in this investigation exceeded the permitted BOD daily average (234 lbs.) 9 times in the 15 month period. During one three month period, the daily maximum BOD values were exceeded 7 times. A secondary treatment for the lagoon effluent is needed in order to meet state and federal regulations.

PUBLICATIONS: 80/01 TO 80/12
GIBSON, J.E. and GOUGE, R.E. 1980. Yeasts that Utilize Lactose in Sweet Whey. *La. Agriculture* 23(3):22.

008.015 CRIS0075300
FLAVOR DIFFERENCES OF MECHANICALLY- AND
HAND-PROCESSED CRAB MEATS

BIEDE S L; RUTLEDGE J E; FOOD SCIENCE; LOUISIANA
STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB01981 Project Type: STATE
Agency ID: SAES Period: 01 MAY 78 To 30 APR 82

OBJECTIVES: Study the influence of handling procedure of flavor retention in mechanically-processed crab meat. Assess organoleptic and gross compositional differences between hand- and mechanically-processed crab meats. Relate gas chromatographic patterns to flavor scores of crab meats. Assess the composition and importance of the volatile flavors in crab meats. Develop a method or methods for the flavor enhancement of mechanically-processed crab meat.

APPROACH: Hand- and mechanically-picked Blue crab meat will be assessed for organoleptic and chemical differences. Flavor components lost will be characterized using combined gas chromatography and mass spectrometry, amino acid analysis and electrophoresis. Mechanically-picked meats will be treated with flavor enhancers to improve the flavor.

PROGRESS: 80/01 TO 80/12. Isolation and characterization of protein losses resulting from the mechanical processing of Blue crab meat utilizing electrophoresis revealed significant differences in quantity and make-up of the protein fractions. Preliminary data have revealed the loss of the hemolymph with mechanical processing. This appears to be a significant portion of the protein losses. Further work is being undertaken to determine the feasibility of using cooler stressed Blue crabs for mechanical processing. Comparisons are being made between the processing of fresh, brine frozen and stressed blue crabs, as well as the electrophoretic patterns of the salt and water extractable proteins, to determine the effects of cooler stress.

PUBLICATIONS: 80/01 TO 80/12
BIEDE, S.L., RUTLEDGE, J.E. and CALLAHAN, C.A. 1980. Flavor Differences in Blue Crab Meats. *Scientific Information Bulletin* No. 46. Takeda Inc.
BIEDE, S.L., RUTLEDGE, J.E., BENDRY, P.L. and CALLAHAN, C.A. 1980. Effects of Mechanical Processing on Crab Meat. *La Agric.* 23:14-17.

008.016* CRIS0072940
FORMULATION OF FOODS FOR AQUATIC ANIMALS OF ECONOMIC IMPORTANCE

MEYERS S F; FOOD SCIENCE; LOUISIANA STATE UNIVERSITY,
BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB01918 Project Type: STATE
Agency ID: SAES Period: 01 JUN 77 To 31 DEC 81

OBJECTIVES: Formulation of nutritionally-balanced diets for various stages of shrimp and prawn growth, especially for larval and juvenile development. Included will be species of marine shrimp (*Penaeus*), freshwater prawn (*Macrobrachium*) and crawfish (*Procambarus*). Use of agricultural and fisheries wastes or byproducts in least-cost grow-out rations for crustacean aquaculture.

APPROACH: Diets and formulations developed and prepared in the Department of Food Science will be tested in cooperative on-going programs with aquaculturists at various sites in this country. Projected areas of continued investigation will include analyses of attractants in diets to enhance chemoreceptor response, studies of modified starches and water stability of flake/extruded diets, microbial degradation of cellulosic-fiber substrates and diet development for protein-deficient areas, effect of diet on organoleptic qualities of the cultivated animal crop, and transfer of dietary carotenoid pigment to internal/external parts of the fish or crustacea.

PROGRESS: 80/01 TO 80/12. Application of the tropical fish *Trichogaster leeri* as an assay animal for evaluation of carotenoids and carotenoid-containing dietary ingredients has been demonstrated. Methods of analyses for measurement of fin and integument sites of accumulation of the main repository pigment have been developed and are being used to assay astaxanthin-rich substrates, such as crawfish wastes, and isolated pigments in flake and extruded formulations for aquatic animals. Oregon Moist Pellet (OMP) diets, fortified with 20% crawfish waste puree, have yielded significant flesh coloration of rainbow trout as well as coho salmon. Binders used as water stability agents in larval bullfrog (*Rana catesbeiana*) diets have been evaluated in terms of growth and food conversion as well as features of the hydrocolloids themselves. Levels of solids present and features of the dietary ingredients are related to binder performance. The wide application of alginate products is noted in flake and extruded dietary preparations where loss of water-soluble components is critical. A variety of gums have been

tested as binding-matrix agents for adult bullfrogs. Moist and semi-moist dietary preparations have been shown to possess desirable binding characteristics and water stability for as long as 24 hours. Feeding tests have produced useful information on the feeding response and behavior of bullfrogs.

PUBLICATIONS: 80/01 TO 80/12

MEYERS, S.P., CULLEY JR., D.D., MARSCBALL, D.G. and MARSHALL, G.A. 1980. Evaluation of Binders in Larval Bullfrog Diets. J. Aquaculture 1:20-28.
FEY, M. and MEYERS, S.P. 1980. Evaluation of Carotenoid-Fortified Flake Diets with the Pearl Gorerami Trichogaster leeri. J. Aquaculture 1:15-19.
MEYERS, S.F. 1980. Water-Stable Extruded Diets and Feeding of Invertebrates. J. Aquaculture 1:44-46.
LIAO, A. 1980. Fabrication of Amphibian Diets Using Louisiana Shrimp and Crawfish Wastes with Selected Binders. M.S. Thesis. La. State Univ., Baton Rouge. 76 pp.

**008.017 CRIS0072943
RECOVERY AND UTILIZATION OF SHRIMP AND CRAWFISH
PROCESSING BYPRODUCTS**

MEYERS S P; FOOD SCIENCE; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB01917 Project Type: STATE
Agency ID: SAES Period: 01 JUN 77 To 01 JUN 82

OBJECTIVES: Develop cooperative studies with the Louisiana shrimp canning industry in waste stream abatement, material recovery and ultimate utilization of proteinaceous "waste" materials in food products. Correlated investigations will include analyses of crawfish processing wastes, especially recovery of food-grade meat for product development.

APPROACH: Initial investigations of shrimp processing operations in the New Orleans area will focus on waste stream abatement and recovery and use of nutritionally-valuable materials present in discharges and as processed meals. Area of proposed investigation include such aspects as effluent stream flow rates, amounts of dissolved proteins and suspended meat particles in these streams, and composition of the extracted materials. Attention must be given to utilization of extracted materials for feed and food purposes, evaluation of the effectiveness of these preparations compared with comparable commercially available preparations, and measurement of the effectiveness of particle removal from the effluent streams expressed as BOD reduction. Projected studies also involve investigation of the biochemical composition of the blanch stream, including protein levels, specific amino acids, amino sugars, and other potentially nutritionally-valuable components.

PROGRESS: 80/01 TO 80/12. Research efforts were directed toward recovery and concentration of astaxanthin pigments from heat-processed body fragments remaining after removal of the tail muscle from Louisiana crawfish. Millions of pounds of this byproduct, comprising over 75% of the crustacean, have been heretofore discarded annually as wastes. Use of the unextracted fresh frozen crawfish meal at a 20% level in the Oregon Moist Pellet (CMP) diet, has elicited desirable pink flesh coloration in rainbow trout. More than a six-fold increase in pigment concentration i.e., from 0.72 to 4.2 mg/g wet weight was recorded for test fish after a 60-day growth period. Large scale tests with pen-reared coho salmon in the Pacific Northwest have shown comparable results. Pigment concentrations as high as 153 µg/g substrate, using solvent extraction techniques are noted. An astaxanthin/oil concentrate (151 mg/100 g oil) has been developed by a batch-type system of extraction of crawfish waste with heated soybean oil. Characteristics of this oil recovery procedure, in terms of extraction stages and pigment concentration, suggest a wide application for the material in aquacultural diets in which astaxanthin fortification or supplementation is desirable. Storage studies have demonstrated the beneficial use of antioxidants in maintaining pigment quality.

PUBLICATIONS: 80/01 TO 80/12

BSING, S. 1980. Development of a Shrimp Sausage Product from Gulf Shrimp Cannery Byproduct. M.S. Thesis. LA State Univ., Baton Rouge. 82 pp.

**008.018 CRIS0009816
HANDLING AND PROCESSING OF FISH AND SHELLFISH**

RUTLEDGE J E; GRODNER R; RAO E; FOOD SCIENCE & TECHNOLOGY; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB00849 Project Type: STATE
Agency ID: SAES Period: 01 DEC 58 To 01 DEC 81

OBJECTIVES: Perform research on the best methods of harvesting, collecting, processing, packing, preserving, labeling, and distributing fish and shellfish. Work in packing plants to institute good manufacturing practices, quality assurance laboratories, and investigate the critical control points during the manufacture of fishery products. Monitor the microbiological, physical, chemical and organoleptic safety status of Gulf fish and shellfish on a routine basis to protect the consumer and industry.

APPROACH: Study the physical and biochemical mechanisms involved in deterioration of these products so that procedures may be developed to reduce the rate of decomposition and the formation of undesirable compounds in the foods. Rapid methods of testing will be developed to enable the producers and packers to evaluate the products prior to packing, and before the onset of initial spoilage. Tests will include the qualitative and quantitative measurement of pathogenic microorganisms, those that are an index of pollution, ammonia, trimethylamine, lactic acid, volatile acids, sulphhydryl groups, indols, amino N, etc., for the purpose of augmenting existing objective measurements. The reliability and predictability of the abbreviated tests will be compared to AOAC methods, and the data will be subjected to statistical analyses for sources of sample and technique, and products variation.

PROGRESS: 80/01 TO 80/12. Crawfish: The effect of cooking, vacuum packaging and the presence or absence of hepatopancreatic tissue on the development of oxidative rancidity in frozen crawfish were studied. Two-thiobarbituric acid (TEA) values were determined every two months during the course of the study. There was a steady increase in TEA values in all cases with the progress of storage time. Both cooking and the presence of fat (hepatopancreatic tissue) on the tailmeat accelerated the production of malonaldehydes as indicated by the TEA test. Vacuum packaging significantly (p less than 0.01) lowered the TEA values as did the absence of fat. Crabs: The effect of various cooking temperatures and time periods were evaluated in relation to color changes in blue crabs. These changes were also compared to the internal body temperatures in the crabs during cooking. The rate of color development was found to be dependent on time and temperature of exposure. Crabs placed in water at 100 degrees C had a mean "a" value of 15.27 on the Hunter scale after only 30 seconds of exposure. Values on the "a" scale 15 and above were considered typical of the red-orange color of cooked crabs. However, at this time and temperature exposures the crabs had an internal body temperature on only 16 degrees C thus, still showing effects of refrigerated storage. Longer exposures did not greatly enhance the color. Hence, crabs cooked in boiling water for thirty second appear generally the same as one cooked for sixteen minutes.

PUBLICATIONS: 80/01 TO 80/12

AME, A.S. and RUTLEDGE, J.E. 1980. Oxidative Rancidity in Whole-Glazed Frozen Crawfish. Proceedings of the 50th Annual Tropical and Sub-Tropical Fisheries Technological Conference of the Americas.
HIMELBLUM, B.B. 1980. Heat Penetration, Shell Color Changes, and Meat Yields of Crabs, Crawfish, and Shrimp Under Various Cooking Conditions. M.S. Thesis, La. State Univ., Baton Rouge.

008.019

CRIS0082922

EVALUATION OF THE STABILITY AND EDIBLE QUALITY OF FRESH WATER SHRIMP

HWANG D; HCME ECONCMICS; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB02131 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 80 To 30 SEP 83

OBJECTIVES: In order to evaluate edible quality and stability of fresh water shrimp as compared to marine shrimp, following items will be studied:
Compositional data of the fresh water shrimp. How compositional changes are related to the edible quality of the shrimp. How deterioration of the edible quality can be controlled.

APPROACH: Total lipid, to total free fatty acids and fatty acid composition will be determined for both fresh water and marine shrimp. The following parameters will be evaluated as a function of type of storage time: The extent of oxidation of polyunsaturated fatty acids as estimated by TBA value and conjugated diene, acceptability as determined by sensory evaluation.

PROGRESS: 80/10 TO 80/12. Approximately 13.6 kg. of sample (fresh water shrimp) were obtained from the LSU aquaculture farm. A portion of sample was immediately extracted by Folch method in order to determine lipid composition of fresh tissues. The rest of sample was vacuum packed and stored at -15C in the Food Science Department for subsequent analysis.

PUBLICATIONS: 80/10 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

008.020

CRIS0045605

RECOVERY AND CONVERSION OF CATFISH PROCESSING WASTE INTO VALUABLE FEED SUPPLEMENTS

FREEMAN D W; USDA-ARS SOUTHERN REG RES CENTER, NEW ORLEANS, LOUISIANA. 70179.
Proj. No.: 7102-20532-001 Project Type: INHOUSE
Agency ID: ARS Period: 29 AUG 79 To 28 AUG 82

OBJECTIVES: Assess, modify and/or develop methods to recover processing waste from catfish farmers/processors and upgrade into valuable and nutritious feed supplements, both moist and dried; characterize and evaluate feed supplements for optimum end uses and assess energy and equipment requirements for the processes.

APPROACH: Evaluate catfish waste (heads, viscera and skin) in laboratory tests, using a sequence of process steps appropriate for commercially feasible rendering or food processing to convert each type of waste to valuable oil and feed supplements. Characterize chemical composition and properties of each supplement to help determine whether separate processing of each type waste would be beneficial. Apply appropriate processing steps in pilot-scale tests to prepare several alternate by-products from catfish waste in sufficient quantities for evaluation in animal and fish feeds and/or pet foods. Estimate equipment and energy requirements and value-in-use for the various potential feed supplements.

PROGRESS: 80/01 TO 80/12. Catfish processing waste dehydration techniques were investigated on a pilot-plant scale. Proximate analyses and material balances were established for traditional dry rendering and formic acid-activated silage. In pilot-plant tests, chopped or ground waste (100-lb) was dry rendered (atmospheric) and pressed to yield 26 lb meal (55% protein) and 10 lb oil. Silage samples were successfully concentrated to 52% solids in a jacketed Green kettle operated under vacuum. Efforts to further dry the concentrate to less than 10% moisture in a vacuum tray dryer were disappointing. Efforts were made to find a substitute enzyme activator. A mixture of phosphoric and acetic acids (1:1) was found best; however, no substitute has proven as effective as 0.5% formic acid for the fastest rate of autolysis. Samples of concentrated silage were sent to several pet food manufacturers

for informal palatability testing.

PUBLICATIONS: 80/01 TO 80/12

BRYAN, W.L., FREEMAN, D.W. and GKACI, A.V. 1980. Potential By-products from Catfish Processing Waste. Proceeding 1979 Miss. Catfish Processors Workshop.
ERYAN, W.L. and FREEMAN, D.W. 1980. Treatment of Catfish Processing Waste for Animal or Catfish Feeds. Proceeding the Annual Catfish Farmers of America Research Workshop.

008.021

CRIS0045121

PRELIMINARY COSTS OF CATFISH PROCESSING WASTE UTILIZATION

FREEMAN D W; DECOSSAS K M; SPADARO J J; USDA-ARS SOUTHERN REG RES CENTER, NEW ORLEANS, LOUISIANA. 70179.

Proj. No.: 7102-20530-002 Project Type: INHOUSE
Agency ID: ARS Period: 06 OCT 78 To 30 SEP 79

OBJECTIVES: Determine rates of waste production and compare the costs of disposal with alternate means of waste utilization for several large catfish processing plants. (TO-1).

APPROACH: Establish field contacts and visit several large processing plants in Arkansas, Mississippi, and Alabama to confirm how these processors dispose of their wastes. Obtain or estimate the costs of disposal and obtain or estimate the rates of waste production. Prepare preliminary capital investment and processing costs for alternate methods of converting these wastes into usable products.

PROGRESS: 78/10 TO 79/09. Visits were made to three catfish processing plants in the Mississippi Delta and methods of waste disposal were evaluated in two of them. Cifal collection, essentially the same in both plants, consists of automatically conveying the heads, viscera, and skin from the eviscerating table, skinner, and washer to a common discharge, where the mixture is screened from the wastewater and collected in a holding bin. The offal from one plant, 6 million lbs annually, is discharged in bulk into trucks that haul it in 20,000-lb. loadsto a poultry rendering plant where it is blended in limited amounts with chicken waste to produce chicken feed. The renderer pay 1-2 cents/lb for the offal, which is about the cost to the processor for transporting it. The offal from the second plant, 4.5 million lbs. annually, is discharged into reusable 1500-2000-lb. capacity plastic containers, iced, and shipped, 20 containers per refrigerated trailer truck, to a cat food processor. The cat food processor pays 4 1/2 cents/lb. for the offal at destination, which covers all expenses to the catfish processor (labor, ice, stationary refrigeration of trailer track during 2-day loading period, and transport costs) and 1/2 cent/lb. profit. A rendering plant of the poultry type is under construction at the third catfish processing plant visited, to which admission was not gained.

PUBLICATIONS: 78/10 TO 79/09
NO PUBLICATIONS REPORTED THIS PERIOD.

008.022

CRIS0067371

HUMAN NUTRITION IMPROVEMENT

DEHAAS B; SLABYJ B M; BIOCHEMISTRY; UNIVERSITY OF MAINE, ORONO, MAINE. 04469.

Proj. No.: ME08025 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 74 To 30 SEP 83

OBJECTIVES: Improve the nutritional status of people by appropriate dietary modification. Department of Food Science will process seafoods, i.e., squid, quahog, periwinkle, sardines, clams, oysters, shrimp, lobster. Processing will include canning, freezing, frying and pickling and appropriate samples will be taken to reveal nutritional changes due to processing and storage. Analyses will include proximate composition, mineral content and processing and storage. Aliquot samples will be provided to the

Department of Biochemistry.

APPROACH: The Department of Biochemistry will study the effect of processing on the nutritional value of the proteins by determination of the PER (AOAC) and chemical score at several steps in the processing. Diet composition will conform to NE-73 (Revised) protocol. Cooperation with MD (amino acid analyses), NJ (tryptophan) and RI (mineral and cholesterol analysis) and VT (lysine availability) is planned.

PROGRESS: 79/10 TO 80/09. The FE and PER of squid mantle protein were determined on raw, blanched, canned in brine, canned in oil, and on the two canned products after 6 months and after 12 months of storage at room temperature. The FE of raw squid was lower than any of the processed forms and was significantly lower than all of the processed forms (p less than 0.05) except the 0 time canned in oil treatment. The PER of the canned in oil product stored for 6 months and the canned in brine product stored for 12 months were significantly lower than the PER of blanched squid (p less than 0.05) and the PER of canned in oil product at 0 storage time (p less than 0.05). Although there was a decline in the PER of the squid canned in oil it was not significant. The lowered PER of the squid canned in oil for 6 months (p less than 0.01) appears to be an anomaly as the PER after 12 months storage is nearly that of the freshly canned product. Storage of canned squid at room temperature for up to 12 months does not seriously decrease the protein value of the product. No major changes in proximate composition due to storage were noticed in either canned product, although lipid content of the brine packed mantles appeared to decrease and that of the oil pack appeared to increase. Evidence from the analysis of fatty acid composition of the lipids indicated that soy bean oil permeated the squid mantle in the oil pack. Mineral composition during storage changed only slightly.

PUBLICATIONS: 79/10 TO 80/09
NO PUBLICATIONS REPORTED THIS PERIOD.

008.023 CRIS0080721
THE EFFECT OF FROZEN STORAGE ON TEXTURAL QUALITY OF LOBSTER MEAT

SLAEYJ B M; TRUE R B; FOOD SCIENCE; UNIVERSITY OF MAINE, CROMO, MAINE. 04469.
Proj. No.: ME08594 Project Type: SIATE
Agency ID: SAES Period: 01 OCT 79 TO 30 SEP 82

OBJECTIVES: Determine shelf life of blanched lobster meat sealed under vacuum and stored at -18 and -29°C; determine relationship between texture, extractable protein and structural changes (Scanning EM) that are taking place in stored frozen lobster muscle.

APPROACH: Lobsters will be blanched 70 seconds in 3% brine at 90.5°C. Picked meat as well as entire claw and tail sections will be sealed in cans under vacuum, frozen at -37°C and stored at -18 and -29°C for up to 15 months. At 3 months, at 3 months intervals samples will be removed, examined for extractable protein, and texture of raw and cooked (15 min in 2% brine) muscle using Warner-Bratzler shear*. Duplicate samples will be prepared by critical point drying or freeze drying for examination with scanning EM. In addition, thin sections will be extracted with chloroform:methanol (2:1) prior to preparation for EM examination. Lipids will be extracted and separated into phospholipids and neutral lipids and their fatty acids determined. Electrophoresis of myofibrillar protein, treated with SDS**, on polyacrylamide gel will be performed. Formaldehyde and dimethylamine content will be determined. Sensory evaluation will be restricted to critical experiments. *Shear force measurement, **Sodium-dodecylsulfate-polyacrylamide gel.

PROGRESS: 80/01 TO 80/12. Lobster tails sealed with and without vacuum, and held in frozen storage are now being removed for analyses.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

008.024 CRIS0069547
SHEAR PROPERTIES OF FROZEN FISH FILLET BLOCKS

WHEATON F W; AGRIC ENGINEERING; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MD-E-053 Project Type: HATCH
Agency ID: CSSES Period: 02 MAR 76 TO 30 SEP 80

OBJECTIVES: Determine the shear properties of frozen fish fillet pieces. Determine effect of shearing on conformation of the resulting cut surface.

APPROACH: Frozen fish blocks will be sawed to sample size with band saws. By use of an Inetrom machine and/or a guillotine cutter the fish sample pieces will be sheared and the force necessary to cut the samples recorded. Sample thickness, cutting speed, sample temperature when cut, knife geometry, fish muscle fibre direction and possibly fish species will be variables investigated and related to peak force necessary to cut the sample. The conformation of the sheared sample will be investigated to determine the effect shearing action has on squareness of corners and other critical parameters.

PROGRESS: 76/01 TO 80/09. Samples of frozen cod fillet blocks having different thicknesses and fillet orientations were sheared using a guillotine shearing device at -12.2 degrees, -17.8 degrees and -23 degrees C. knife bevel angles of 10 degrees, 20 degrees, and 30 degrees and cutting speeds of 2.5, 7.5 and 12.5 cm/sec were used. Peak shearing force, shearing energy and surface damage of front and rear slices were measured. Regression equations were developed to relate individually peak shearing force, shearing energy, and surface damage for front and rear surfaces with the variables of temperature, block thickness, knife bevel angle and knife velocity. One set of equations was developed for shearing perpendicular to the muscle fiber and one set for shearing parallel to the muscle fiber. Blocks can be sheared but damage to the sheared piece is unacceptable except for 1.27 cm thick block sheared at -12.2 degrees C using a 10 degree knife bevel angle. Thus, shearing does not appear to be a feasible method for cutting frozen fish blocks into fish portions, and fish sticks. An alternative approach should be tried for reducing the fish "sawdust" loss. Product development research could produce a salable product from the "sawdust."

PUBLICATIONS: 76/01 TO 80/09
VENKATRAMANI, T.A. 1978. Shear Properties of Frozen Cod Fillet Blocks. M.S. Thesis. University of Maryland, College Park, 137 pp.

008.025 CRIS0069928
WATER QUALITY CHANGES IN OYSTER PROCESSING

WHEATON F W; INGLING A L; AGRIC ENGINEERING; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MD-ED-052 Project Type: SIATE
Agency ID: SAES Period: 01 JAN 76 TO 30 AUG 80

OBJECTIVES: Compare cleaning efficiency as a function of operating parameters for a spray washing system, a brush washing system and a tumble washing system for oyster shellstock. Determine water requirements for washing oyster shellstock in a spray washer, a brush washer and a tumble washer. Determine quality of water discharged from a spray washer, a brush washer and a tumble washer when washing oyster shellstock, and the extent of treatment required for the effluent to meet discharge guidelines or regulations.

APPROACH: A high pressure spray washer, a rotary brush washer, and a tumble washer will be used to wash oyster shellstock. Each will be tested to determine optimum operating conditions and cleaning efficiency. Water use rate and the quality of effluent will be determined for each washer. Effluent quality parameters will be compared with discharge

regulations to determine extent of treatment required to meet guidelines.

PROGRESS: 76/01 TO 80/08. Three oyster shellstock washers have been designed, constructed and tested. Testing was done to determine each washer's cleaning efficiency and to determine the quantity and quality of water discharged during washing. The following results have been determined: The spray and brush washer do an acceptable job of washing oyster shellstock. The tumbler severely damages the oyster meats and is unacceptable for commercial operations. The brush washer removes more fouling organisms than does the spray washer. If shellstock must be washed prior to shucking, water requirements and effluent volumes for oyster processing plants will increase. Washer effluent will require only disinfection and, in some cases a reduction in pH, before discharge to meet all EPA and Maryland discharge limitations. Regression equations were developed to relate brush and spray washer cleaning efficiency to water pressure, water flow rate, oyster feed rate and, for the brush washer, brush speed.

PUBLICATIONS: 76/01 TO 80/08

- WHEATON, F.W., CBANG, S. and INGLING, A.L. 1979. Effluent Water Quality Discharged From Three Oyster Shellstock Washers. Technical Report 54. Maryland Water Resources Research Center, University of Maryland, College Park.
- CHANG, S.C. 1979. Evaluation of Three Oyster Shellstock Washers Including Effluent Water Quality. M.S. Thesis. University of Maryland, College Park. 161 pp.
- WHEATON, F.W. and CBANG, S. 1980. Evaluation of Three Oyster Shellstock Washers. Commercial Fisheries News 13(4):3. Department of Natural Resources, Annapolis, Maryland.
- WHEATON, F.W. and CBANG, S. 1979. Effluent Water Quality From Three Oyster Washers. Accepted for Publication in Commercial Fisheries News. Department of Natural Resources, Annapolis, Maryland.
- CHANG, S., WHEATON, F.W. and INGLING, A.L. 1978. Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers. Paper No. 78-5038, American Society of Agricultural Engineers, St. Joseph, Michigan.

00E.026 CEIS0082531
ENZYMATIC CONTROL OF QUALITY FACTORS IN MARINE FOODS

BULTIN B O; COLLEGE OF FISH & NATURAL RES.;
UNIVERSITY OF MASSACHUSETTS, AMBERST, MASSACHUSETTS.
01002.
Proj. No.: MAS00493 Project Type: HATCB
Agency ID: CSRS Period: 01 OCT 80 To 30 SEP 85

OBJECTIVES: To characterize the enzymes and lipids involved in the membrane lipid oxidation system of fish muscle. To determine the importance of this system in lipid oxidation in stored fish tissue. To determine the mechanism of the inhibitory action of phospholipase on this lipid oxidation. To determine the characteristics of the soluble and insoluble enzyme systems responsible for the conversion of trimethylamine oxide to dimethylamine and formaldehyde. To determine the effect of temperature on these and other important enzymic systems in marine foods.

APPROACH: Plan to examine in detail some of the enzyme systems in fish which adversely affect the flavor and textural properties of the material. The major perturbation to be studied is the effect of temperature.

008.027 CEIS0084064
MANUFACTURE OF PROCESSED MEAT AND/OR FISH PRODUCTS
WITH UNDERUTILIZED MARINE SPECIES

BUCK E M; FOOD SCIENCE & NUTRITION; UNIVERSITY OF
MASSACHUSETTS, AMBERST, MASSACHUSETTS. 01002.
Proj. No.: MAS00510 Project Type: HATCB
Agency ID: CSRS Period: 01 OCT 81 To 30 SEP 86

OBJECTIVES: Develop the process necessary to produce a hot-dog like product which is acceptable to consumers using washed, minced and red hake. Determine the feasibility of recovering and re-using protein from fish flesh wash water. Measure the effect of saberizing versus regular skinning on quality of finished product. Develop processes for the manufacture of other products, especially seafood (crab, etc.) type products. Develop the process of blending surimi with other underutilized species such as squid, or other meats such as chicken, beef or pork.

APPROACH: The entire project is thought of as involving several phases of research, the final phase of which would involve the use of underutilized marine species for the development of analogs for crab, shrimp, and lobster products all of which are becoming increasingly more expensive and less available.

008.028 CEIS0055478
FUR ANIMAL STUDIES (MINK)

AULERICH R J; ANIMAL SCIENCE; MICHIGAN STATE
UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: MICL0103E Project Type: HATCB
Agency ID: CSRS Period: 21 AUG 69 To 30 SEP 83

OBJECTIVES: Investigate the use of underutilized species of Great Lakes fish for animal feed. Study the mechanisms of action of PCBs in relation to their toxic effects on reproduction and the cell mediated immune system of mink and ferrets. Continue ongoing studies of the "early kit loss" problem in mink. Determine the significance of the cytoplasmic droplet frequently observed on the tail of spermatozoa from certain mink.

APPROACH: The performance of mink fed Great Lakes fish and fish products will be evaluated and mink tissues analyzed the PCBs. ¹⁴C labeled compounds will be used to determine placental milk transfer of PCBs PBB. A lymphocyte culturing technique will be used to measure the integrity of the animals' immune system. The role of trace minerals, particularly copper, in the "early kit loss" problem will be studied through mink feeding experiments. Minkbreeding trials involving males producing spermatozoa that contain cytoplasmic droplets will be conducted to determine the significance of the droplet on the fertilizing ability of the spermatozoa.

PROGRESS: 80/10 TO 80/12. I. Feeding CuSO₄(0-800 ppm) to natural dark mink did not cause adverse effects in the adult animals and resulted in darker fur. No differences were observed in hematologic parameters of control and CuSO₄ treated mink, although the higher levels of CuSO₄ supplementation resulted in increased liver copper levels and decreased kit survival. II. Experiments to compare placental and mammary transfer of PCBs and PBBs in mink and European ferrets revealed that PCE Aroclor 1242 crosses the placenta more readily than PBBs. Differences in the type of placental exchange may account for the variation in transplacental exchange of these compounds between mink and ferrets. Considerably greater quantities of both compounds were obtained by the offspring via lactation than by placental transfer. III. Preliminary results of studies pertaining to the renewed use of Great Lakes fish for feeding mink indicate that present PCE levels in most species of fish are such that optimum performance cannot be expected when they are fed to mink for extended periods. IV. A study has been undertaken to investigate urinary incontinence ("wet belly" disease) in male mink. Observations on affected and normal animals are in progress and urine and blood samples have been collected for analysis. V. Experiments have been initiated to determine the effects of sodium hypochlorite added to the feed or

water on growth and survival of mink. VI.

PUBLICATIONS: 80/10 TO 80/12

AULERICH, E.J. and RINGER, R.K. 1980. Toxicity of the Polychlorinated Biphenyl Aroclor 1016 to Mink. Environm. Res. Lab., Office Res. Develop., US Environm. Protection Agency, Duluth, MN, 24 pp.

BLEAVINS, M.E., AULERICH, E.J. and RINGER, R.K. 1980. Polychlorinated Biphenyls (Aroclors 1016 and 1242): Effects on Survival and Reproduction in Mink and Ferrets. Arch. Environm. Contam. Toxicol. 8:627-635.

THEUERKAUF, D.A. and AULERICH, E.J. 1980. A Bibliography of Mustelids. Part VII: Badgers. Animal Science Dept., Michigan State University, E. Lansing, MI, 35 pp.

BROOKHYSER, K.M. and AULERICH, E.J. 1980. Consumption of Food, Body Weight, Perineal Colour and Level of Progesterone in the Serum of Cyclic Female Chinchillas. J. Endocr. 87:213-219.

BLEAVINS, M.E. 1980. The Effects of Two Polychlorinated Biphenyl Mixtures (Aroclors 1242 and 1016) on Mink and Fer

008.029*

CEIS0065119

RECYCLING WASTES INTO ANIMAL FEEDS

JOHNSON B E; FISHERIES & WILDLIFE; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.

Proj. No.: MICL03146

Project Type: STATE

Agency ID: SAES

Period: 01 JAN 74 To 19 FEB 81

OBJECTIVES: Combine dried animal wastes (e.g., poultry wastes) and items from local wastewater ponds into a pellet acceptable for various high yield, low cost fish species grown under intensive culture conditions.

APPROACH: Microplankton and macrophytes will be mechanically harvested from MSU wastewater ponds. Analyses will be made on these and farm animal wastes for components important in fish diets. These products will be processed and combined to form fishfood pellets. Northern climate fishes with potential for high production at low cost will be fed standard commercial diets and experimental pellets. Growth rates, food conversion rates and fish production will be compared, resulting in maximum dietary use of farm animal wastes and biological production from wastewater ponds.

PROGRESS: 74/03 TO 81/02. Rainbow trout grew well on diets formulated from aquatic plants, crustaceans and poultry wastes. Carp growth on this diet was inversely related to quantities of poultry waste. Water quality in a terminal wastewater lake maintained exceptional growth rates for forage and recreational fish without accumulation of harmful levels of toxic materials in fish. The growth of cage-reared channel catfish was significantly impaired by high pH and ammonia concentrations in a terminal wastewater pond.

PUBLICATIONS: 74/03 TO 81/02

JOHNSON, B.E. and DUGGIELD, D.L. 1980. Utilization of Wastewater for Intensive Fish Culture. Project A-082 Completion Report for Office of Water Research and Technology, U.S. Department of Interior. 34 pp.

DUFFIELD, D.J. 1979. Cage Culture of Channel Catfish, *Ictalurus punctatus* (Rafinesque), in a Tertiary Wastewater Treatment Pond and a Private Pond in Southern Michigan. M.S. Thesis, Mich. State Univ.

KERNS, C.L. and ROELOFS, E.W. 1977. Poultry Wastes in the Diet of Israeli Carp. *Bamidgeh* 29(4):125-135.

BAHR, T.G., KING, D.L., JOHNSON, B.E. and KERNS, C.L. 1977. Municipal Wastewater Recycling: Production of Algae and Macrophytes for Animal Food and Other Uses. Developments in Industrial Microbiology 18:121-134.

KERNS, C.L. 1976. The Use of Selected Biological Materials Produced by Tertiary Wastewater Treatment Ponds in the Diet of Two Species of Fish. M.S. Thesis, Mich. State Univ., 47 pp.

008.030*

CFIS0045643

EVALUATION OF BY-PRODUCTS FROM CATFISH PROCESSING WASTE FOR CATFISH FEED SUPPLEMENTS

WILSON R P; FREEMAN D W; BIOCHEMISTRY; MISSISSIPPI STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI. 39762.

Proj. No.: 7003-20530-004-A

Project Type:

COOPERATIVE AGREEMENT

Agency ID: ARS

Period: 07 SEP 79 To 30 SEP 81

OBJECTIVES: Evaluate nutritional value for channel catfish fingerlings of concentrated protein, bone meal and oil by-products made from catfish processing waste; recommend practical catfish feed formulations based on optimum use of these by products.

APPROACH: Determine protein efficiency ratio, protein digestibility and amino acid availability in aquaria studies with channel catfish fingerlings fed several concentrated protein by-products made from catfish processing wastes (heads, viscera and skins) in isonitrogenous, isocaloric semi-purified diets. Evaluate possible adverse effects of added catfish oil and/or bone meal prepared from catfish processing waste. Incorporate acceptable by-products into practical commercial-type catfish feeds and evaluate in aquaria feeding tests.

PROGRESS: 80/01 TO 80/12. This is a specific cooperative agreement between SEA and Mississippi State University to assist the catfish industry in locating suitable uses for by-products made from processing wastes. Initial fingerling feeding tests were made with four by-products as follows: silage with bones, silage without bones, catfish bone meal, and standard menhaden meal (control). Results were disappointing for the silage by-products. Digestible protein for these products was less than 30% apparently due to uncontrolled protein cleavage. Catfish fingerlings cannot utilize short-chain amino acids. Further work to define this problem has been initiated.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

008.031*

CRIS0083555

PRACTICAL FEED FORMULATIONS AND FEEDING PRACTICES FOR CATFISH FARMING IN MS

BUSCB R L; TUCKER C S; ROBINETTE B R; DELTA BRANCH EXPERIMENT STA; MISSISSIPPI STATE UNIVERSITY, STONEVILLE, MISSISSIPPI. 38776.

Proj. No.: MIS-0852

Project Type: GRANT

Agency ID: CS&S

Period: 18 FEB 81 To 28 FEB 83

OBJECTIVES: Evaluate the practical application of computer derived least cost ration formulations in catfish production ponds; compare experimental rations developed from the most current catfish nutrition information available to a standard commercial ration used throughout the industry; evaluate any effects of peanut meal as a feed ingredient on the shelf life of processed fish; evaluate diet formulation for winter feeding regimes in catfish production ponds.

APPROACH: Experimental rations will be formulated and compared to currently used commercial rations in both summer and winter feeding studies for channel catfish. Research will be conducted with both fingerling and market-size channel catfish cultured in 0.4/ha earthen ponds.

008.032*

CRIS0073179

ANALYSIS OF THE MARKET POTENTIAL FOR FRESH WATER AQUACULTURAL PRODUCTS PRODUCED IN NEVADA

GARRETT J R; TAYLOR R L; AGRIC & RESOURCE ECONOMICS; UNIVERSITY OF NEVADA, RENO, NEVADA. 89557.

Proj. No.: NEV00270
Agency ID: CSFS

Project Type: HATCH
Period: 01 JUL 77 To 30 SEP 80

OBJECTIVES: Determine the cost and availability of byproduct food stuffs for feeding catfish and shrimp in Nevada. Estimate the demand for catfish, shrimp and plants produced in fresh warm water ponds. Estimate the marketing margins for fresh water products and estimate marketing constraints placed on fresh water products by the institutional trade.

APPROACH: Availability and costs will be estimated for byproduct feeds which prove feasible as shrimp and catfish food in a large scale pilot production study. Nevada brokerage firms, and if necessary California processing firms, will be surveyed to ascertain the possibility of marketing live shrimp. These firms will also be interviewed to determine existing marketing margins for different types of products handled by these firms. A similar procedure will be followed for catfish and freshwater plants that might be complementary to shrimp and catfish.

PROGRESS: 77/01 To 80/09. Budgetary analysis of production costs of freshwater shrimp produced in 10 one-acre plots reflect a cost of \$2.23 per lb. live weight at production levels experienced in the experiment. (About 2,000 lbs. per acre.) Increased feeding levels and other management practices could possibly raise production to 3,000 lbs. or even 4,000 lbs. per acre. Production costs for these levels were estimated to be \$1.60 and \$1.31 per lb., respectively. Four marketing alternatives were considered: Whole live, whole fresh, fresh; headless and frozen headless. Processing costs for the first two alternatives were negligible, but both headless process required substantial capital investment and operating costs. Costs for processing 20,000 lbs. of live shrimp were \$7.79 for fresh headless and \$7.91 for frozen headless. Thus, at current production levels, total cost of producing fresh headless shrimp would be \$12.15 per lbs. Even doubling the production level to 40,000 lb. would only reduce the total cost per lb. of product to \$6.53--well above the current wholesale price of \$4.50. Production of live or fresh whole fresh-water shrimp does appear to be a viable pursuit for persons with a source of hot water providing they can develop a ready market for the product.

PUBLICATIONS: 77/01 To 80/09

ONYEAGBAKO, C. 1979. Marketing Alternatives of the Grant Malaysian Prawn (*Macrobrachium rosenbergii*), M. S. Thesis, University of Nevada-Reno.

00E.033

CFIS0081937

NEW FOOD PRODUCTS FROM UNDERUTILIZED FISH SPECIES

MORSE R E; FCCD SCIENCE; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.

Proj. No.: NJ10410

Project Type: STATE

Agency ID: SAES

Period: 10 APR 80 To 09 APR 85

OBJECTIVES: Determine the best estimated of availability of East Coast fish species, e.g. Whiting, Squid, Butterfish, Eel; study factors which affect their low acceptability; to prepare new food products of much higher, consumer acceptability from underutilized fish species.

APPROACH: Underutilized fish species, Whiting, Squid, Butterfish and Eels will be examined to determine which factors contribute to low consumer acceptance. Especial emphasis will be given on texture, flavor, aroma and color by using existing chromatographic techniques.

PROGRESS: 80/01 To 80/12. Various conditions and methods to grow the American eel (*Anguilla rostrata*) were studied. The fish were caught in a glass eel stage (5 cm in length) and grown to a full size (60-70 cm. in length) in tanks. The effect of some environmental factors on growth were studied. Special emphasis was placed on feed composition in relation to fat content and fat composition of a fully grown eel. This is the critical factor in consumer acceptance in smoked eel.

PUBLICATIONS: 80/01 To 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

008.034

CFIS0066910

RECLAMATION OF PROTEIN AND FLAVOR MATERIALS FROM CLAM WASH WATER

HOOD L F; ZALL R R; FOOD SCIENCE; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.

Proj. No.: NYC-143380

Project Type: STATE

Agency ID: SAES

Period: 08 NOV 74 To 30 SEP 81

OBJECTIVES: Convert pollutants from a clam processing facility into profitable food products.

APPROACH: Wash water from the mincing and shredding of clams will be pumped through a pulverizer to mince the tissue pieces. The material will be filtered or clarified to remove the sand. Solids content will be standardized and the produce processed as clam juice. An alternate approach will be to recover the tissue particulates from the wash water and process them as a clam chowder base.

PROGRESS: 80/01 To 80/12. Fish broth was prepared by combining cleaned yellowtail flounder (*Limanda ferruginea*) racks with six times their weight of cold tap water, and boiling in a steam jacketed kettle. After cooking, the liquid portion was strained to remove bones. The resultant liquid, called fish broth, was put into cans and retorted. The results of these studies indicate that the racks must be fresh or have been frozen cleaned in order to make a high quality broth. Broth made from racks which had been stored overnight uncleaned in ice developed off odors and flavors during storage. Processing conditions contributed little to the deterioration of the broths. The broth would be used as a food ingredient. Therefore, it was utilized at varying levels in a fish chowder to determine if it could function as a partial or complete fish replacement. An equivalent chowder could be made when half of the fish was replaced by broth. When the broth was used as a total replacement the taste panel scores of the chowders decreased. It was anticipated that the rack residues remaining after broth manufacture would be converted to fish meal. Mineral and amino acid assays were conducted on fish meals made from the rack residues. These meals were of equivalent nutritive quality to a commercial meal.

PUBLICATIONS: 80/01 To 80/12

HOOD, L.F. and ZALL, R.R. 1980. Recovery and Utilization of Seafood Processing Wastes. In: Advances in Fish Science and Technology Fishing News Books, Ltd. Farnham, England. pp. 355-361.

008.035

CFIS0064528

POTENTIAL OF DIFFERENT UNDERUTILIZED SPECIES OF FISH FOR CONVENIENCE FOODS

BAKER R C; REGENSTEIN J M; POULTRY & AVIAN SCIENCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.

Proj. No.: NYC-157380

Project Type: STATE

Agency ID: SAES

Period: 01 DEC 78 To 30 SEP 83

OBJECTIVES: To develop nutritious, palatable convenience and economical products from species of fish not explored in the past. To study the factors which affect water holding capacity of fish flesh which is extremely important in functionality, cook-out, texture, juiciness and flavor of new fish products. To study composition of the effect of bones in fish flesh on functionality, flavor and texture of further processed foods.

APPROACH: Product development will proceed according to the following plan: Brainstorming for ideas, developing new products, testing the product for optimum consumer satisfaction and storage studies. Five mechanisms will be studied for increasing water holding capacity: pH, ionic strength, specific ionic effects cleavage of actomyosin linkages and calcium and magnesium binding. Hnd deboned filets, minced fish and fish bones will be studied by measuring variables such as pH, proximate analyses and

representative functional properties.

PROGRESS: 80/01 TO 80/12. Experiments on extending shelf life of red hake and salmon were conducted using potassium sorbate in a dip or in storage ice, and/or stored in Barrier Bags (cryovac) with modified atmospheres. Effective treatments were as follows: (1) All potassium sorbate treatments inhibited some TMA-producing bacteria; (2) CO(2) in modified atmospheres without ice at 20 or 60% was highly effective in extending shelf life of fresh fish. The greatest effect was obtained with a combination of 1% w/v potassium sorbate ice and an atmosphere of 60% CO(2), with refrigerated storage. Taste panel results indicated no off-flavors or off-odors attributable to treatment after storage of at least 4 weeks, after the fish was received at our lab. A study of the effects of different polyphosphates on the water binding properties of trout muscle showed differences in magnitude and in mechanisms by which the polyphosphates produced these changes. Hexameta- and glass-phosphates have a much greater potential for increasing water binding than pyro- or tripolyphosphate, mostly by a specific anion effect. In contrast, pyro- and tripolyphosphate increased water binding potential mostly through pH increases. Hexameta- and glass-phosphates were less effective for reducing expressible moisture than pyro- or tripolyphosphate, probably because of the inability of the longer chain polyphosphates to interact with the proteins.

PUBLICATIONS: 80/01 TO 80/12

- FEY, M.S. 1980. Extending the Shelf Life of Fresh Fish by Potassium Sorbate and Modified Atmospheres at 0-1 Degrees C. Ph.D. Thesis, Cornell University, Ithaca, NY, 451 pp.
- JAUREGUI, C.A. 1981. Effect of Polyphosphates on the Water Binding Properties of Muscle Proteins. Ph.D. Thesis, Cornell University, Ithaca, NY, 144 pp.
- BAKER, R.C. and DARFLER, J.M. 1980. Development of Products from Minced Fish: 7. Canned Fish Balls in Tomato Sauce. New York Sea Grant Bulletin.

008.036 CFIS0083222
EXTENDING THE SHELF-LIFE OF FISH

REGENSTEIN J M; BAKER R C; POULTRY SCIENCE; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-157381 Project Type: STATE
Agency ID: SAES Period: 01 JAN 81 To 30 SEP 83

OBJECTIVES: To improve the shelf-life of fresh fish particularly underutilized species by modified atmosphere (carbon dioxide), low temperature and/or additives such as potassium sorbate, so that they may be successfully shipped to inland and overseas destinations.

APPROACH: To improve the texture stability of frozen red hake and whiting (underutilized East Coast gadoids), particularly after mincing. Additives and heat treatments will be investigated. To determine if the trimethylamine oxide to dimethylamine and formaldehyde reaction is cold-activated or freeze-activated. To better understand the mechanism by which polyphosphates effect the water retention properties of fish flesh.

008.037 CFIS0063358
USE OF CLAM BY-PRODUCTS

SHALLENBERGER R S; FOOD SCIENCE & TECHNOLOGY; N Y AGRICULTURE EXPT STATION, GENEVA, NEW YORK. 14456.
Proj. No.: NYG23343 Project Type: STATE
Agency ID: SAES Period: 01 JAN 73 To 31 DEC 80

OBJECTIVES: Explore means by which the surf clam (*Spisula solidissima*) digestive tract, a waste product of the clam processing industry, may be utilized, either as food or as a source of enzymes for assisting in the waste disposal problems of plant food processing industries.

APPROACH: The digestive tract of the surf clam will be extracted and a screening program for enzyme activities will be executed. Particular attention will be given to the existence of unusual gluconases capable of hydrolyzing glucans which are the major component of the surf clam diet, and also the major component of plant food processing wastes.

PROGRESS: 73/01 TO 80/12. The carbohydrase activities extractable from the significant waste of the shellfish processing industries have been tabulated and characterized. Many have promising application elsewhere in the technological community. Potential applications include pretreatment of wastes in plant food processing industries and the brewing industry. One product, laminarinase, is now commercially available through a chemical supply house.

PUBLICATIONS: 73/01 TO 80/12
KERSCHNER, L.E. 1981. Studies on a Beta-D-gluconase in Mollusca. M.S. Thesis, Cornell Univ., Ithaca. 122 pp.

008.038* CRIS0073941
FACTORS AFFECTING THE TEXTURE OF SEAFOODS

HAMANN D D; LANIER T C; FOOD SCIENCE; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC02111 Project Type: HA1CH
Agency ID: CS&S Period: 01 NOV 77 To 30 SEP 82

OBJECTIVES: Investigate factors affecting the texture of products made from mechanically deboned fish tissue, collect texture data on several species and commercial handling procedures develop methods for improving texture, and develop products from N. C. coast species that have commercial potential.

APPROACH: Atlantic croaker and other species will be studied to determine the effect of harvesting, handling and processing conditions on protein denaturation and resulting poor texture. Major muscle proteins will be separated into sarcoplasmic protein and individual myofibrillar protein such as myosin and actin to study their roles in gel formation, water binding, etc. Enzyme activity during heating and resulting protein changes will be determined. Results will be applied to development or improvement of specific products.

PROGRESS: 80/01 TO 80/12. An alkaline protease found in mechanically deboned fish has been shown to be derived from both muscle tissue and visceral contamination and to cause texture breakdown during thermal processing of fish gels. Alkaline protease was partially purified from both muscle and liver tissue (both enzymes being cytoplasmic in nature and heat stable). The muscle protease is a sulfhydryl protease and does not require Ca⁺⁺ for its activity while the liver enzyme(s) is Ca⁺⁺-activated. Several Atlantic fish species have been examined with respect to the textural properties of gels prepared from the washed and unwashed minces. Processing factors which affect the textural characteristics of fish gels include processing temperature/time, pressure, method of comminution, additives (soy, egg and whey albumins, various starches and hydrocolloids), method of forming, and frozen storage. Several simulated shellfish meats have been successfully fabricated based on washed mince (surimi) such as shrimp, clam strips and scallops. Work is processing to develop appropriate electrophoretic, isoelectric focusing and/or immunoelectrophoretic techniques for the determination of species composition of minced fish and surimi blocks.

PUBLICATIONS: 80/01 TO 80/12
LIN, T.S., SU, H.K. and LANIER, T.C. 1980. Characterization of Fish Muscle Proteases Using Radio-labeled Protein Substrates. *J. Food Sci.* 45(4):1036-1039.
LIN, T.S. and LANIER, T.C. 1980. Properties of an Alkaline Protease from the Skeletal Muscle of Atlantic Croaker. *J. Food Biochem.* 4:17-28.

008.038* CRIS0075507
DEVELOPMENT OF IMPROVED HANDLING, SHIPPING/STORAGE
AND MARKETING PRACTICES FOR FISHERY PRODUCTS

LANIER T C; FOOD SCIENCE; N CAROLINA STATE
UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC02113 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 78 To 30 SEP 83

OBJECTIVES: Describe the factors which contribute to loss of quality in fresh and frozen raw seafoods, develop and test rapid methods of quality assessment and evaluate new handling, packaging, storage/shipment and marketing techniques for their potential in improving market life and quality of these products.

APPROACH: North Carolina seafood species will be studied to determine how handling, processing and storage methods may be imposed to minimize quality deterioration due to bacterial and autolytic processes. Gross and specific enzyme assays will be used to identify the source and mode of action of degradative enzyme systems. Various packaging and storage regimes, involving both refrigerator and freezer temperatures, will be tested in combination with various prestorage treatments (sanitizers, antioxidants, etc.) to improve market life of fishery products.

PROGRESS: 80/01 TO 80/12. Freeze thaw handling as a means of merchandising prepackaged fish appears to be feasible from both a technical and marketing standpoint. Previous supermarket sales tests demonstrated the acceptability of chilled fish labeled "previously-frozen." Vacuum-packaged fish previously frozen for 100 days at -20 degrees C, thawed and held chilled were found to have a saleable life equal to that of fresh fish from the same lot stored chilled in an identical manner. Shelf-life studies of fresh and previously-frozen grey trout are continuing in order to evaluate modified atmosphere packaging, various predrips and thorough washing prior to packaging as means of extending the life. Analyses will include: changes in the microbial flora on the surface, changes in gaseous composition within the package. A second consumer test will compare sales of prepackaged (modified atmosphere) fresh and previously-frozen fish (so-labeled) with that of vacuum packaged frozen fish.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

008.040* CRIS0073629
ESTUARINE INVERTEBRATE BEHAVIOR; AN INDEX OF SUBACUTE
TOXICITY OF AQUATIC HERBICIDES

HARTHALMUS G T; ZOOLOGY; N CAROLINA STATE UNIVERSITY,
RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC05397 Project Type: STATE
Agency ID: SAES Period: 15 JUN 77 To 31 DEC 78

OBJECTIVES: Determine the chronic, subacute behavioral effects of 2,4-D herbicide on grass shrimp, Palaemonetes pugio Holthuis; to explore the feasibility of assessing xenobiotic-induced behavioral dysfunctions of aquatic vertebrates and invertebrates by application of behavioral toxicology techniques.

APPROACH: Dosages of 2,4-D which produce no lethality or locomotor dysfunction for 7 days following a 3 day post-collection period will be determined for adults and larvae. Then, the phototactic behavioral reflexes of dark adapted and dosed shrimp will be tested daily in compartmentalized chambers illuminated by a horizontally directed, intensity controlled monochromatic light stimulus with a duration of 5s at 15s intervals for 5 replications. Shrimp in the compartment nearest the light will be designated photo-positive. Swimming speeds of larvae will be determined in Petri dishes by measuring distances traveled per unit time.

PROGRESS: 77/07 TO 78/12. The effect on adult females, three larval stages, and eggs of the grass shrimp, Palaemonetes pugio, exposed to subacute doses of the herbicide Weedar-64 (registered trademark) (Am. Chem., Inc.), containing 48.3% of the dimethylamine salt of 2,4-dichlorophenoxyacetic acid, was tested. Auxiliary ingredients, mainly water, were assumed to be non-toxic. Alteration of phototaxis was chosen as the indicator of an effect on adults and larvae; eggs were examined for percent hatch. Photoacoustic patterns of larvae and adults receiving 100 ppm Weedar-64 daily were recorded for 12 days. Positive phototaxis was reduced by 2,4-D in all three larval stages tested. Sensitivity varied with developmental stage (stage 1 was most sensitive). Stage 1 larval responses were altered more by 2,4-D exposure than by aging, but for stages 3 and 7, larval ages influenced phototaxis more than doses. Adults were unaffected. The doses tested did not affect the hatching of eggs.

PUBLICATIONS: 77/07 TO 78/12
MOYER, C.A.J. 1978. Effect of the herbicide 2,4-d on the phototactic response of the grass shrimp, Palaemonetes pugio. M. S. Thesis. N. C. State University, Raleigh. 33 p.

008.041 CRIS0031586
UTILIZATION OF LATENT MARINE RESOURCES AND
BY-PRODUCTS WASTE

LAW D K; FOOD SCIENCE & TECHNOLOGY; OREGON STATE
UNIVERSITY, CORVALLIS, OREGON. 97331.
Proj. No.: ORE00831 Project Type: STATE
Agency ID: SAES Period: 01 JUL 79 To 30 JUN 84

OBJECTIVES: Convert hake, hake waste and other underutilized fish and fish waste into a more useful form by autolytic hydrolysis, oil, bone, and odor removal, concentration, and/or drying.

APPROACH: Conventional heat exchange systems will be compared to scraped surface systems to determine the most effective method for autolytic hydrolysis. Methods for oil, bone, and odor removal necessary to upgrade protein quality will be examined using centrifugal and concentrated and/or dried using commercially applicable procedures that will provide demonstration samples that may be used for marketing and other evaluations.

PROGRESS: 80/01 TO 80/12. Conversion of hake to a food quality protein concentrate continues to be the main orientation of this project. Samples of whole hake were digested and deboned. Some of these samples were oil extracted and spray dried, producing an FPC with excellent functionality. An unextracted sample was also spray dried. Fifty pounds of this sample was prepared for salmon nutrition studies. A number of improvements were innovated. These included: (1) the development of a metering system to feed the hopper leading to the heat exchanger, (2) installation of a reaction vessel that permitted continuous flow, (3) development of an extraction and recovery system for the fish oil. It was noted that hake oil could be of two distinct qualities. Those feeding on shrimp appeared to produce a red pigmented oil and those feeding on anchovies an amber yellow oil. Samples of partially deboned and acidified hydrolysate were prepared for feeding trials for the Animal Science Department. A change in the pattern of the Oregon trawl fleet resulted in an increase in catch of the "soft brown" rockfish (Sebastes entomelas). During 1980 approximately 7000 metric tons were landed. This generated more than 4000 metric tons of carcass waste that created a disposal problem. The problem was aggravated by indications that mink did not do well when subjected to this type of feed. This scrap digested well in our system and produced an animal food grade product with good feed characteristics.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

008.042* CRIS0066637
THE TREATMENT AND USE OF WASTE PRODUCTS AND CHEMICALS
IN THE DIET OF AQUATIC ANIMALS

SIMPSON K L; LEE T C; CHICHESTER; FOOD & RESOURCE
CHEMISTRY; UNIVERSITY OF RHODE ISLAND, KINGSTON,
RHODE ISLAND. 02881.
Proj. No.: RI00015 Project Type: HATCH
Agency ID: CSRS Period: 03 OCT 74 To 30 SEP 80

OBJECTIVES: Feed crab waste & evaluate it as a feed supplement for trout & salmon. Experiment with microwave energy as an alternate method of cooking crab sections. Utilization of the waste product will determine the value of the process to the producer. We propose to synthesize epoxy canthaxanthin & determine the effect of these alkylating agents on trout. Evaluate citrus peels that have been processed as a feed supplement to some aquatic animals.

APPROACH: Diets for trout & salmon have been developed & in some cases commercial rations are available. The materials to be tested will either be adsorbed on prepared diets or incorporated into defined diets. Where the best diet is at present unknown the effect of various test diets will have to be determined by looking at growth rate & the condition of various organs. An attempt will be made to determine the point of deposition of various compounds that are added. Fish necropsy will be performed to determine abnormal effects particularly with the addition of epoxy canthaxanthin. Microwave energy cooking & thawing will be used as an alternative means of processing crab. The waste material from this will be compared with conventionally cooked material.

PROGRESS: 74/10 TO 80/09. The deposition of carotenoid pigments was studied in the freshwater prawn with and without eyestalk ablation. Ablated prawn fed a pigmented diet showed a significant increase in pigmentation over the nonablated controls fed pigmented diets. The major pigment in the flower *Adonis aestivalis* was proved to be astaxanthin diester. The diester was completely characterized to the SS' chiral form. The whole flower fed to rainbow trout proved to be toxic but an extract showed good pigmentation. Fatty acid analysis proved that the ester is hydrolyzed and resynthesized in the trout skin. *Adonis* flowers represent the only plant source of the salmon pigment. In an effort to assess the cause of some brine shrimp supporting growth and survival of larval fish, *Artemia* were contaminated with environmental levels of dieldrin. These *Artemia* were fed to winter flounder. No mortalities were observed but lower growth was noted. Some increased lipid metabolism was seen and some metabolism of the chlorinated hydrocarbons was suggested.

PUBLICATIONS: 74/10 TO 80/09

- SCHAUBER, P.S., JCHNS, D.M., CLNEY, B.E. and SIMPSON, K.L. 1980. Lipid Level, Energy Content and Fatty Acid Composition of Newly Hatched Nauplii. In: The Brine Shrimp *Artemia*. Eds., Persoone, G. et al., Universa Press, Wetteren
- SEIDE L, C.R., KRYZNCWEK, J. and SIMPSON, K.L. 1980. Amino Acid Composition and Electrophoretic Protein Patterns of *Artemia*. In: The Brine Shrimp *Artemia*. Eds. P. Persoone, G., et. al., Universa Press, Wetteren (Belgium). 2:375-382.
- SOEJIMA, T., KATAYAMA, T. and SIMPSON, K.L. 1980. Carotenoid Composition of Seven Geographical Strains of *Artemia*. In: The Brine Shrimp *Artemia*. Eds. Persoone, et al., Universa Press, Wetteren (Belgium). 2:613-622.
- MCLEAN, S. 1980. Effects of Cis-chlordane and Dieldrin on the Short Food Chain *Artemia* to Winter Flounder. M.S. Thesis, University of Rhode Island.

008.043 CRIS0082927
SENSORY & NUTRITIONAL EVALUATION OF SEAFOODS

PATEL K; PERCIVAL S; FOOD SCIENCE & TECHNOLOGY;
UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND.
02881.

Proj. No.: RI00067 Project Type: HATCH
Agency ID: CSRS Period: 01 NOV 80 To 30 SEP 83

OBJECTIVES: Assess seafood quality using both objective and sensory methods. Determine the nutrient content as influenced by processing, preparation and storage. Study properties in food systems as influenced by processing, preparation and storage conditions. Use the information to develop new products from underutilized regional resources.

APPROACH: There is much work to be done with assessing seafood quality in terms of acceptability and nutritional values. Additionally, the effects of storage, cooking and processing on the parameters must be determined. An essential component of this work is the formation of a data bank. This is necessary in order to be able to store, organize and retrieve the large volumes of data that will be generated. Procedures include statistical differences and correlation. From this data, a characteristic edible profile and nutritional value of a species can be outlined.

008.044 CRIS0081890
THE USE OF SELECTED MARINE MATERIALS AND BY-PRODUCTS
FOR CERTAIN HORTICULTURAL CROPS

KINGMAN A R; HORTICULTURE; CLEMSON UNIVERSITY,
CLEMSON, SOUTH CAROLINA. 29631.
Proj. No.: SC00456 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 80 To 30 JUN 83

OBJECTIVES: Evaluate the effects of seaweeds, seaweed extracts, fish by-products, such as oyster shells, shrimp shells, fish meals and fish emulsions on nutrient availability. Determine the growth regulating properties of selected seaweed materials.

APPROACH: All materials used in the research will be chemically analyzed. Rates of application will be determined through greenhouse tests. Crops, including chrysanthemum, geranium, holly, azalea and several vegetables will be grown in the mixtures under standard and reduced commercial fertilizer regimes. Correlations between soil and foliar analyses and accumulated plant dry weights will be made to determine fertilizer utilization under greenhouse and field conditions. Vegetable yield and quality parameters will also be determined. Seaweed extracts will be analyzed for plant hormones. Effective and quick purification techniques for use of Gas Liquid Chromatography will be explored. Using seaweeds of known hormone content(s) and reference hormone materials, Applications to plants will be made in the greenhouse. Growth and quality comparisons will be made.

PROGRESS: 80/07 TO 80/12. Chemical analysis of coastal SC fish by-products resulted in 9.0, 3.8, .36, and 7.2% N, P, K, and Ca, respectively, with several trace elements present. This material will be incorporated into the backfill for *Ilex crenata rotundifolia* under simulated landscape conditions. Simplification of purification and extraction procedures for gas liquid chromatographic (GLC) analysis of sea plant products has been accomplished. Identification of several plant growth regulating hormones have resulted. The significance of the research is energy conservation through agricultural use of sea plants and marine by-products, rapid GLC analysis of sea plant products by manufacturers, and possible application of the simplified GLC procedure for analysis of an array of natural materials.

PUBLICATIONS: 80/07 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

008.045 CRIS0063667
QUALITY FACTORS FOR FISH AND SHELLFISH STORAGE

FINNE G; ANIMAL SCIENCE; TEXAS A&M UNIVERSITY,
COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06031 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 74 To 12 NOV 82

OBJECTIVES: To determine the yield after each processing step for both fresh and pre-frozen fish. To assess microbiological characteristics of minced flesh as influenced by species, processing steps and raw product quality. To determine chemical properties and frozen storage stability of minced flesh from different species. Freezing finfish. To determine composition of finfish as influenced by season, species, and area of catch. To establish optimum freezing rates and storage temperatures. To evaluate effectiveness of glazes, packaging methods and materials, controlled atmospheres and antioxidants in extending frozen shelf life of Gulf of Mexico finfish.

APPROACH: Deboned fish flesh. Minced flesh from 6 to 8 different species will be produced. Analyze deboned flesh for total protein, fat, ash, moisture, fatty acid composition, total volatile nitrogen, malonaldehyde, soluble protein and pH. Number and types of microorganisms will be determined after each processing step. Using above chemical quality parameters, determine stability of frozen deboned flesh over one-year storage period. Freezing of finfish—Using chemical, microbiological and sensory evaluations, determine frozen storage stability of fish packaged five different ways. Evaluate effect of freezing rates and frozen storage temperatures by using different freezing techniques.

PROGRESS: 80/01 TO 80/12. Composition, quality and stability during frozen storage of Gulf of Mexico finfish species were investigated. The fish, which were frozen both fresh and after five days on ice, included; spotted trout, black drum, tilefish, flounder, swordfish and red fish. Each species was frozen vacuum packed, in a carbon dioxide atmosphere, water-glazed, over-wrapped with PVC and over-wrapped dressed. All samples were held at two different temperatures during frozen storage. In every case tested, vacuum packed fish was shown to have superior frozen storage stability followed by dressed and glazed fish. For the lean white species (flounder, tilefish, trout and red fish) little difference between holding at -30 degrees C and -15 degrees C could be observed after one year of frozen storage. For the dark muscle fish however, a holding temperature of -30 degrees C was shown to be superior. Black drum developed rancidity early except for fish packed in vacuum. Swordfish also developed some rancidity however, the main problem with this species during frozen storage was shown to be loss in water holding capacity and subsequent bad texture. All other fish tested were of good quality even after one year of frozen storage. This study will help the Gulf Seafood industry develop frozen finfish products. Melanosis in shrimp is a major problem to the Texas shrimp industry.

PUBLICATIONS: 80/01 TO 80/12

- TENHET, V., FINNE, G., NICKELSON, R. and TOLCLODAY, D. 1980. Penetration Mechanism and Distribution Gradient of Sodium Tripolyphosphate in Peeled and Deveined Shrimp. Proc. 5th Ann. Trop. and Subtrop. Fisheries Tech.
- TENHET, V., FINNE, G., NICKELSON, R. and TOLCLODAY, D. 1980. Determination of Phosphorous in Shrimp Treated with Sodium Tripolyphosphate. Proc. 5th Ann. Trop. and Subtrop. Fisheries Tech. of the Americas 5:195-204.
- FINNE, G., NICKELSON, R., QUIMBY, A. and CONNALLY, N. 1980. Minced Fish Flesh from Non-traditional Gulf of Mexico Finfish Species: Yield and Composition. J. Food Sci. 45:1327-1329.

008.046 CRIS0071432
PROCESSING QUALITY AND PACKAGING FACTORS WHICH AFFECT THE UTILIZATION OF FISH AND SHELLFISH

FINNE G; VANDERZANT C; ANIMAL SCIENCE; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.

Proj. No.: TEX06242 Project Type: HATCH
Agency ID: CSRS Period: 30 MAY 79 To 29 MAY 82

OBJECTIVES: Evaluate physical parameters that accelerate melanosis, determine precursors of melanosis and enzyme kinetics, evaluate potential inhibitors of melanosis, determine Na-bisulfite decomposition mechanism. Evaluate quality characteristics of fish in various gaseous atmospheres controlled initially and and "completely" during refrigerated storage, determine changes in gaseous composition in packages, evaluate spoilage parameters of fish in controlled atmospheres.

APPROACH: Factors related to handling on board will be evaluated, enzymes associated with melanosis will be extracted from shrimp, purified and their activities determined, potential inhibitors tested, head space gases from sulfite treated shrimp will be analyzed. Fish packaged in six gas atmospheres stored at 0-2 and 5-8C for 18 days will be examined for sensory, biochemical and microbiological qualities, composition of gases in packages will be analyzed by gas chromatography.

PROGRESS: 80/01 TO 80/12. Modified-atmosphere packaging (MAP) of fish using carbon dioxide was shown to be effective in inhibiting the growth of typical gram-negative spoilage organisms. Gram-positive organisms, especially lactobacilli, not normally associated with fish held on ice, were little affected by the modified atmospheres. This selective inhibition of the typical gram-negative spoilage organisms, together with the much slower growth rate of gram-positive organisms on fish, results in a significant extension of shelf-life when using CO(2) atmospheres. The seafood industry should benefit from the use of MAP systems with CO(2). The higher initial costs of packaging would certainly be compensated by savings on transportation and handling costs and, most of all, by a significant extension in the shelf-life of the product. Indole levels have recently been used by the Food and Drug Administration as an index of quality in fresh and frozen shrimp. The determination of indole, however, has been performed using sophisticated and expensive instrumentation prohibiting its use as a quality control tool in the seafood industry. A simple method where indole is extracted with light petroleum from trichloroacetic acid-precipitated shrimp muscle was developed. The extracted indole, soluble in light petroleum, is re-extracted with Ehrlich's reagent and indole in form of a rose indole complex can be determined spectrophotometrically. It is anticipated that this modified method may find its use as a much needed quality control tool in the seafood industry.

PUBLICATIONS: 80/01 TO 80/12

- HANKS, H., NICKELSON, R. and FINNE, G. 1980. Shelf-life Studies on Carbon Dioxide Packaged Finfish from the Gulf of Mexico. J. Food Sci. 45:157-162.
- NICKELSON, R. and FINNE, G. 1980. Brine Freezing Shrimp. Proc. 5th Ann. Trop. and Subtrop. Fisheries Tech. of the Americas 5:158-164.
- LANNELONGUE-FAVRE, M. 1980. Storage Characteristics of Fresh Fish Packed in Modified Gas Atmospheres Containing Carbon Dioxide. M.S. Thesis, Texas A and M University, 57 pp.

008.047* CRIS0064807
MICROBIOLOGICAL ASPECTS TO SHELLFISH SANITATION AND QUALITY

VANDERZANT C; RAY S M; ANIMAL SCIENCE; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06054 Project Type: HATCH
Agency ID: CSRS Period: 07 JAN 74 To 30 SEP 80

OBJECTIVES: Determine the level and seasonal distribution of *Vibrio parahaemolyticus* in freshly harvested oysters, clams and mussels. The effect of processing and handling procedures in wholesale and retail operations on *V. parahaemolyticus* also will be studied. Data on environmental and water characteristics will be used to examine possible relations between microbiological quality of seafoods and environmental characteristics.

APPROACH: Cystere, clams and mussels from Galveston Bay and waters and sediment from these areas will be examined for microbiological parameters (V. parahaemolyticus, coliforms, fecal coliforms, etc.).

Proj. No.: 7002-20530-001-A

Project Type:

COOPERATIVE AGREE.

Agency ID: AES

Period: 18 SEP 78 TO 30 SEP 80

PROGRESS: 74/01 TO 80/01. Vibrio parahaemolyticus is a potential pathogen transmitted to humans by consumption of contaminated seafoods. V. parahaemolyticus was present in low concentrations in about 60% of oysters, water and sediment of the Gulf of Mexico. No seasonal distribution of this organism was noted. There was no significant relationship between levels of V. parahaemolyticus and other bacteriological or environmental parameters. No increase in V. parahaemolyticus concentrations of seafood occurred when good processing practices were applied. Most seafood isolates of V. parahaemolyticus belonged to serotype O5: K17 and differed from typical clinical isolates. Few were hemolytic (Kanagawa-positive). Kanagawa-positive and Kanagawa-negative strains of V. parahaemolyticus were examined for enterotoxigenicity, enteropathogenicity, drug resistance and plasmid DNA content. No significant relationship existed between cultural characteristics and indices of pathogenicity. Only 3 of 31 strains, all patient isolates, contained plasmid DNA with molecular weights of 24 or 60 million daltons.

OBJECTIVES: Explore pesticide levels in catfish processing waste by sampling by-products obtained from catfish grown under commercial farm environments. (TO-1).

APPROACH: Following a literature search, obtain separate samples of heads, viscera, and skins from catfish processing plants located in two separate geographic areas (Mississippi River Delta and southwest Alabama) during the summer and winter growing seasons. Evaluate these samples for organochlorine insecticides such as aldrin, DDT and its analogues, dieldrin and heptachlor and correlate these data to the environmental management factors under which the fish were cultivated.

PUBLICATIONS: 74/01 TO 80/01

NO PUBLICATIONS REPORTED THIS PERIOD.

PROGRESS: 78/09 TO 80/09. Two channel catfish were collected at plant site from each of 59 farms in Ala., Ark., and Miss. The fish were brought back to the lab at Auburn Univ. and the head, skin, and viscera were removed as in the commercial processing operation. In 18 of the samples, the three parts were analyzed separately. The distribution of the pesticides among these three tissues was constant; therefore, it was assumed that in the remaining 41 samples, the 3 tissues could be composited for analysis. The pesticides assayed were a-BHC, heptachlor epoxide, pp'DDE, pp'DDD, dieldrin, endrin, and toxaphene. All samples assayed contained lower concentrations of pesticides than FDA action levels for human foods. Of all the pesticides assayed for, toxaphene was found in the highest amounts. However, only 4 samples exceeded 1 mg toxaphene/kg waste. The FDA action level for this substance is 5 mg/kg. The data provided by this study represent samples from the major catfish producing areas in the U.S. collected in two separate areas (i.e. Ala. vs. Miss.) through two growing seasons. Comparing pesticide values derived from this study with values in food and feed products made from other animal sources, catfish processing wastes contain very low levels of pesticides. Catfish processing wastes can be made into feedstuffs which can safely be blended into livestock or fish feeds.

PUBLICATIONS: 78/09 TO 80/09

NO PUBLICATIONS REPORTED THIS PERIOD.

008.048* CRIS0083616
METHODS OF MODIFIED-ATMOSPHERE PRESERVATION OF REFRIGERATED FRESH FISH

LINDSAY R C; DEIBEL R B; FOOD SCIENCE; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.

Proj. No.: WIS05171

Project Type: STATE

Agency ID: SAES

Period: 01 JUL 80 TO 31 JUL 82

OBJECTIVES: To investigate the modified-atmosphere packaging of fresh fish with special emphasis on the behavior of Clostridium botulinum Type E in conditions of short-term, high abuse temperatures. To investigate the behavior of C. botulinum Type E in long-term storage under refrigeration conditions with particular reference to the effects and influences of sorbic acid and varying atmosphere. To develop practical and effective methods for assessing the potential shelflife of modified-atmosphere packaged fresh fish.

009.002* CRIS0058961
FRESHWATER FOOD ANIMALS

LOVELL R T; MCCOY E W; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.

Proj. No.: ALA00630

Project Type: HATCH

Agency ID: CSRS

Period: 01 FEB 71 TO 30 SEP 81

OBJECTIVES: Evaluate economics of production, processing, and marketing of freshwater food animals. Develop and improve products and processing methods that will enhance marketability and insure quality of cultured freshwater food animals.

APPROACH: Mechanically deboned flesh from various fishes will be evaluated with regard to yield, quality, and storage stability. Waste from fish processing will be evaluated chemically and biologically, and technology will be developed for economic waste utilization. Methods will be tested for control of geosmin related off-flavor in pond raised fish. Costs and returns associated with production of food fish in various culture systems will be assessed. Identify and evaluate alternative marketing and distribution systems for fish with respect to market expansion, consumer reactions, and optimizing income to producers and processors.

APPROACH: Fresh and saltwater species of fish will be obtained from commercial sources, and packaged in a range of modified-atmospheres, including carbon dioxide mixtures. Samples will be inoculated with mixed-strain C. botulinum spores and held under a range of conditions, including temperature abuses (60 degree - 90 degree F) up to 72 hours. Toxicities will be determined by mouse bioassays. Methods will be evaluated for assuring safety from C. botulinum, and will include carbon dioxide atmospheres, chemical preservation with potassium sorbate, and other food-approved additives. Microbiological and chemical indices for quality will be evaluated for application to preserved fish.

PROGRESS: 80/01 TO 80/12. 59 collections of catfish processing waste (head, skin, viscera) from the major processing plants and representing production ponds from Ala., Miss. and Ark. were analyzed for a-BHC, heptachlor, DDE, DDT, Dieldrin, endrin and toxaphene. All samples contained toxaphene. All samples contained toxaphene; the range was 0.06 to 3.6 mg/kg.

009.001 CRIS0044774
EVALUATION OF PESTICIDE LEVELS IN CATFISH PROCESSING WASTES

LOVELL R T; FREEMAN D W; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.

9. Product Quality, Nutritive Value, Consumption

DDE and DDT was found in most; the range of DDE was 0.01 to 0.56 mg/kg and the range of DDT was 0.01 to 0.58 mg/kg. None of the pesticide concentration in any sample exceeded the levels allowed in human foods, indicating the waste should be safe to use in commercial fish feeds. 35 off-flavored catfish collected from processing plants in Mississippi during April-June 1980 were evaluated by a trained sensory panel for quality and intensity of off-flavor. Only six of the samples had the distinct geosmin flavor which was formerly thought to be the major off-flavor in pond raised catfish. The most prominent flavor was "fecal" (sewage or manure); other were "rancid", "paint", "diesel", and "algae". Extracts from each fish were sent to the Southern Regional Research Center (USDA - AR) for compound identification.

PUBLICATIONS: 80/01 TO 80/12

- LOVELL, R.L. 1980. Utilization of Catfish Processing waste. Auburn Univ. Agri. Exp. Sta. Bull. S 21. 19 p.
- LOVELL, R.L. 1980. S-83 Annual Report: Freshwater Food Animals. So. Coop. Ser. Sp. Rep., June, 1980. 20 pp.
- LOVELL, R.L. 1980. Effects of Feeding Full-Fat Soybean meal on Growth and Flesh Quality in Catfish. Aquaculture 6(3):35.
- LOVELL, R.L. 1980. Nutritional Value of Fish. Aquaculture 6(5) 45.
- LOVELL, R.L. 1980. Effects of Feed on Sensory Quality of Fish. Aquaculture 6(6) 41.

009.003* CRIS0066589

PIGMENTS OF MEAT AND FISH PRODUCTS (OFF-COLORS IN TUNA)

BROWN W D; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-FST-3011-WE Project Type: BATCH
Agency ID: CSRS Period: 30 SEP 74 To 30 SEP 79

OBJECTIVES: Determine factors involved in development of off-colors in tuna fish.

APPROACH: Determine the extent of influence of post-mortem levels of organic phosphate compounds on oxidation rate of myoglobin. Evaluate the extent of contribution of oxidation to the darker colors of some species of fish, especially when frozen. Determine if organic peroxides produced during storage of fish are involved in greening reactions with myoglobins. Develop new color stabilizers for canned fish pet food products to replace nitrite in the event the use of nitrite should be banned. Develop new assay for free ribose inasmuch as the latter compound has been shown to be involved in an important deteriorative browning reaction in precooked skipjack tuna; evaluate means of inhibiting this browning reaction, e.g. by dipping fish prior to freezing in inhibitor solution.

PROGRESS: 74/09 TO 79/09. A method was developed for determining relative and absolute concentrations of myoglobin pigment derivatives in meats and fish, both untreated and treated with atmospheres containing carbon monoxide. A study was made to determine the fate of (14C) carbon monoxide in cooked or stored ground beef samples. Following exposure of meat samples to labeled CO, samples were either stored or cooked for varying periods of time. Aqueous and fat extracts were made and the amounts of radioactivity in these fractions and in the residues were determined. Activity in the aqueous fraction was due entirely to carboxymyoglobin; that in the lipid fraction was insignificant. During storage, CO was lost with a half-life of about 3 days. Maximum loss from cooked patties was about 85%. The use of low levels of CO may prevent the discoloration noted when red meats are stored in elevated levels of CO(2). Microbiological and color shelf lives of ground beef patties exposed to a 1% carbon monoxide, 50% carbon dioxide (balance air) atmosphere were significantly increased compared to controls held in air at 2 degrees C. Accompanying studies were made of the uptake of carbon monoxide by myoglobin in beef patties exposed to a 1% CO atmosphere, and the subsequent loss of carbon monoxide when samples are

placed in an air atmosphere under fluorescent illumination. The half-life for the loss of carbon monoxide from such samples was found to be about 2 days.

PUBLICATIONS: 74/09 TO 79/09

- WATTS, D.A., WOLFE, S.K. and ERCWYN, W.D. 1978. Fate of (14C) carbon monoxide in cooked or stored ground beef samples. Journal of Agricultural and Food Chemistry 26(1):210-214.
- WOLFE, S.K., WATTS, D.A. and ERCWYN, W.D. 1978. Analysis of myoglobin derivatives in meat or fish samples using absorption spectrophotometry. Journal of Agricultural and Food Chemistry 26(1):217-219.
- GEE, D.L. and ERCWYN, W.D. 1978. Stability of carboxymyoglobin in refrigerated ground beef. Journal of Agricultural and Food Chemistry 26(1):273-274.
- GEE, D.L. and BROWN, W.D. 1978. Extension of shelf life in refrigerated ground beef stored under an atmosphere containing carbon dioxide and carbon monoxide. Journal of Agricultural and Food Chemistry 26(1):274-276.

009.004*

CRIS0080190

MARINE FOOD SCIENCE AND TECHNOLOGY

BROWN W D; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-FST-3865-H Project Type: BATCH
Agency ID: CSRS Period: 01 OCT 79 To 30 SEP 84

OBJECTIVES: Provide new or altered technology resulting in improved quality in seafood products, including the production of more appealing products for the consumer and those in which nutrient retention is maximized. Provide means of improved and extended distribution of fresh and frozen seafoods via new and alternate methods of handling and processing. Develop new marine food products. Collect basic biochemical data on protein, lipid and other constituents of aquatic animals.

APPROACH: Apply innovative technological procedures to a variety of seafood products and determine the resulting quality of such products by chemical, microbiological and sensory analyses. Pursue detailed studies of the effects of modified atmosphere storage on seafood products, including investigation of the effectiveness of high levels of carbon dioxide in such systems. Determine structure and properties of myoglobins and other pigments from a variety of aquatic animals; examine lipid composition and oxidation in seafoods; and investigate deleterious chemical and microbiological changes in fish.

PROGRESS: 80/01 TO 80/12. Rockfish fillets and salmon steaks were held in atmospheres containing 20% or 40% carbon dioxide. Controls were stored in air. At intervals of refrigerated storage up to 14 days, samples were removed for sensory, chemical, and microbiological analyses. Samples held in air were judged by panelists to have stronger aromas than others held under carbon dioxide at either level. The higher level of carbon dioxide was more effective. Storage under carbon dioxide was effective in reducing the formation of trimethylamine and ammonia, and markedly inhibited microbial growth. Histamine production by *Proteus morganii*, *Proteus vulgaris* and *Hafnia alvei* cultures isolated from spoiled skipjack tuna was measured under twelve environmental conditions. The highest histamine concentrations were found at 19 degrees C. and 30 degrees C; no histamine was formed at 1 degree C. *Proteus* organisms at first formed high levels of histamine, such of which was subsequently destroyed. The concentration of histamine in tuna products may depend on an equilibrium between histamine production and destruction. Amino acid sequences of the soluble tryptic peptides of yellowfin tuna myoglobin, comprising 60% of the total residues, were determined; the amino terminus is acetylated.

PUBLICATIONS: 80/01 TO 80/12

RICE, R.B., WATTS, D.A. and BROWN, W.D. 1979. Sequences of the Soluble Tryptic Peptides from Myoglobin of Yellowfin Tuna (Thunnus albacares). Comparative Biochemistry and Physiology 62B(4):481-487.

BROWN, W.D., ALBRIGI, M., WATTS, D.A., BEYER, B., SPRUCE, B. and PRICE, K.J. 1980. Modified Atmosphere Storage of Rockfish (Sebastes miniatus) and Silver Salmon (Oncorhynchus kisutch). Journal of Food Science 45(1):93-96.

ARNOLD, S.B., PRICE, R.J. and BROWN, W.D. 1980. Histamine Formation by Bacteria Isolated from Skipjack Tuna, Katsuwonus pelamis. Bulletin of the Japanese Society of Scientific Fisheries 46(8):991-995.

009.005* CRIS0064485
DIETARY FACTORS IN WHITE FISH MEAL RESPONSIBLE FOR CATARACT FORMATION IN TROUT

AZARI P; BIOCHEMISTRY; COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO. 80523.
Proj. No.: CCL00032 Project Type: STATE
Agency ID: SAES Period: 01 JUL 73 To 30 JUN 80

OBJECTIVES: Investigate some of the nutritional factors in white fish meal responsible for growth retardation and high incidence of cataract in trout. Modify the white fish meal by addition of necessary factors or deletion of injurious substances so that it could be effectively used as a supplement to trout feed.

APPROACH: Feeding experiments: Long-range feeding of trout on a complete white fish feed will be performed in order to determine the incidence and time factor involved in the formation of cataract. The effect of lipid-free and heavy-metal-free diets will also be studied. Organic solvents will be used to extract lipid components, and specific chelating agents will be employed to remove heavy elements. The compositional analysis of white fish meal will be aimed at determining the amino acid content of proteins, free and bound carbohydrates and heavy trace elements. Automated amino acid analysis, gas chromatography and atomic absorption procedures will be used, respectively to accomplish these.

Compositional analysis of lens proteins from normal and cataractous fish will be done after solubilization and separation of lens proteins by conventional procedures, followed by acid hydrolysis or proteins to liberate amino acids. The levels of cysteine, cystine and tryptophan will be particularly of interest.

PROGRESS: 79/01 to 79/12. Inclusion of white fish meal at a 20% level into the trout diet was found to cause cataract (67% at 140 days) and higher incidence of mortality (48%) as compared to herring-meal diet. No significant difference in the amino acid composition was found between herring and white fish meals. Fortification of the white-fish diet with tryptophan, histidine, tyrosine, phenylalanine, cystine, lysine or combination of all showed no significant decrease in the incidence of cataract. Fortification of diet with vitamins, A, D, E, B(12) or niacin did not alleviate the problem. Mineral analysis of the white fish and herring meals revealed significantly lower content of Fe, Zn, Se and Mn and a higher content of Ca and P for the white-fish, as compared to herring meal. Incorporation of commercially available mineral mix (protein-mineral chelates) into the white fish diet at 5-10% levels abolished the incidence of cataract and reduced the mortality by 90%. The ratio of calcium to available phosphate was found to be approximately 1.5 times higher for white-fish diet as compared to herring. Inclusion of additional phosphate into the white-fish diet to produce a Ca/P ratio close that of herring diet, reduced the incidence of cataract to 1%. The Na-K ATPase activity of cataractous lens was decreased by about 50%, as compared to normal lens. Fortification of white-fish diet with the mineral mix caused an increase of Na-KATPase activity to 84% of the normal diet.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

009.006* CRIS0071104
FOOD PRODUCT DEVELOPMENT FROM FLORIDA UNDERUTILIZED FISH SPECIES

DENG J C; FOOD SCIENCE; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-FS-01789 Project Type: BATCH
Agency ID: CSRS Period: 13 AUG 76 To 30 JUN 81

OBJECTIVES: Develop new products, minced fish products, intermediate moisture mullet roe, and canned fish; evaluate quality and investigate storage stability of the new products.

APPROACH: Several Florida underutilized fish species, either alone or mixed, will be investigated to determine the quality and subsequent storage stability of minced fish products. The improved method for processing mullet roe and the salt content, water activity and darkening problem related to the intermediate moisture mullet roe will be studied. The processing of various canned fish products, the quality and subsequent storage stability of the products will be studied.

PROGRESS: 80/01 TO 80/12. Fish patties were prepared from mixed minced light color fish (sheephead) flesh with various concentrations of sodium alginate (NaAlg), tripolyphosphate (TPP), and salt (NaCl). The overall trend indicated that as the NaAlg. level was increased, the breaking force (firmness) decreased. At 0.10% NaAlg. as the NaCl level was increased, it was necessary to decrease the TPP concentration in order to attain the same breaking force. As the NaAlg. level was increased at a constant TPP level, the breaking force increased. At NaAlg. levels 0.10% the trend begins to change so that in some instances it was necessary to increase the TPP to a maximum point and then decrease it in order to maintain the same breaking force. Consequently at a fixed NaAlg. and a constant TPP level, two levels of NaCl would produce the same breaking force. Also, if the NaAlg. and TPP levels remained constant, then an increase in NaCl would first cause a decrease in breaking force and then a slight increase. The trend toward an increase in breaking force became less apparent at the higher NaAlg. levels. Effect of washing temperature on fish muscle proteins in the washing treatment of minced fish mullet was studied.

PUBLICATIONS: 80/01 TO 80/12

HSU, W.H., DENG, J.C. and CORNELL, J.A. 1980. Effect of Salting Time, Dehydration Temperature and Dehydration Time on Quality of Intermediate Moisture Mullet Roe. J. Food Sci. 45:102.

HSU, W.H. and DENG, J.C. 1980. Processing of Cured Mullet Roe. J. Food Sci. 45:97.

DENG, J.C. 1981. Effect of Temperatures on Fish Muscle Alkaline, Protease Interaction and Texture Quality. J. Food Sci. 46:62.

DENG, J.C. and TCHASZEWSKI, F.T. 1980. Effect of Alginate, Tripolyphosphate and Sodium Chloride on Quality of Minced Fish Flesh Croaker. Proceedings of Int. Conf. on Fish Sci. and Tech. Aberdeen, Scotland.

009.007* CRIS0068717
SMOKING OF SEAFOOD AND POULTRY

KOBURGER J A; OBLINGER J L; FOOD SCIENCE; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-FS-01763 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 76 To 30 JUN 81

OBJECTIVES: Investigate the effects of brining, smoking and storage on the chemical, microbial and sensory attributes of selected seafood and poultry products.

APPROACH: The effects of brine concentration, brining time, smoking times and temperature will be studied as to their effects on quality attributes of selected seafood and poultry products.

PROGRESS: 80/01 TO 80/12. Effects of brine concentration (0-6%), intensity of smoking (1.5 or 3.0 hr), method of cooking (baked, broiled or fried) and frozen storage on the acceptance of cold smoked mullet fillets were determined. A twenty member sensory panel indicated that fillets soaked in 4% brine for 30 min, smoked for 1.5 hr at 48C and deep fat fried were an acceptable product. Frozen storage of the smoked fillets for two weeks or of the whole fish for six weeks prior to smoking had no significant effect on acceptance of the product. Panel members gave the product a "very good" rating and indicated they would purchase it if available.

PUBLICATIONS: 80/01 TO 80/12

KOBURGER, J.A. and OTWELL, W.S. 1980. Florida Smokies: A Fried Cold Smoked Fillet Produced From Roe Mullet. Proc. Trop. and Subtrop Fish Conf. 5:54-61.

OTWELL, W.S., KOBURGER, J.A. and DEGNER, R.L. 1980. Low-Temperature Smoking Technique Opens Foute for New Fish Products. Food Prod. Develop. 14:16-18.

009.008

CRIS0068075

ENVIRONMENTAL FACTORS AFFECTING SURVIVAL OF THERMALLY-INJURED BACTERIA FOUND ON FISHERY PRODUCTS

BEUCHAT L R; FOOD SCIENCE; GEORGIA AGRIC EXPT STATION, EXPERIMENT, GEORGIA. 30212.

Proj. No.: GEO01209

Project Type: HATCH

Agency ID: CSRS

Period: 01 JUL 75 To 30 DEC 80

OBJECTIVES: Construct an instrument for monitoring the effects of rates of chilling and freezing on lethality to bacteria; evaluate methodology for isolation and enumeration of *Vibrio parahaemolyticus* with regard to suitability of procedures for the resuscitation of thermally (heat and cold) stressed cells; formulate and evaluate new culture media for the support of thermally stressed *V. parahaemolyticus*; study the effects of natural (shellfish) environments versus laboratory formulations on the survival and injury of thermally shocked bacteria associated with fishery products.

APPROACH: An instrument will be built with the capacity to accurately and precisely chill or freeze samples of bacteria at selected rates and temperature extremes. Culturing media recommended for enrichment and isolation of *V. parahaemolyticus* will be examined for their usefulness to resuscitate thermally injured cells. Effects of chemicals on rates and extent of death of fish spoilage bacteria will be evaluated.

PROGRESS: 80/07 TO 80/12. No progress report this period.

PUBLICATIONS: 80/07 TO 80/12

BEUCHAT, L.R. 1980. Inhibitory Action of Potassium Sorbate, Sodium Benzoate, and Sucrose and Glycerol Esters of Fatty Acids Against *Vibrio parahaemolyticus*, (Abstr.). World Congr., Foodborne Infections and Intoxications, Berlin, F.R.G.

MCCN, N.J., BEUCHAT, L.R. and HAYS, E.R. 1980. Evaluation of Lactic Bacteria for Extending the Shelf Life of Shrimp, (Abstr.). Prog. 40th Annu. Mtg. IFT, New Orleans, 8-11 June, p. 150.

NAKAYAMA, T.O.M. and BEUCHAT, L.R. 1980. Application of Microwaves to Extend the Shelf Life of Fresh Stored on Ice, (Abstr.). Sou. Assoc. Agric. Sci. 3-6 Feb., Hot Springs, AR., 17:7-8.

009.009

CRIS0071211

THE OXIDATIVE DETERIORATION OF LIPIDS IN MECHANICALLY DEBONED POULTRY AND FISH

LILLARD D A; TOLEDO R T; FOOD SCIENCE; UNIVERSITY OF GEORGIA, ATHENS, GEORGIA. 30602.

Proj. No.: GEO00586

Project Type: BACHELOR

Agency ID: CSRS

Period: 27 AUG 76 To 26 AUG 83

OBJECTIVES: Determine the role of hemoproteins, unsaturated lipids, free fatty acids, and free amino acids on the rate and mechanism of lipid oxidation in mechanically deboned fish and poultry meat. Determine the significance of the bone marrow of fish and poultry as a source of catalysts of lipid oxidation. Characterize the antioxidant component in shrimp and determine its use in mechanically deboned products. Develop methods to prevent or delay lipid deterioration in mechanically deboned products.

APPROACH: Mechanically deboned fish and poultry will be fractionated and the role of each component in lipid oxidation will be determined using a rapid oxygen uptake procedure. The constituents of bone marrow of fish and poultry will be characterized and the importance of the bone marrow as a source of prooxidants will be determined. Various approaches to prevent or delay oxidation of these products will include the removal of prooxidants, the addition of compounds to inactivate the prooxidants or the use of antioxidants. The initial screening of these methods will be conducted on model systems and the most promising treatments will be used on mechanically deboned products to determine their industrial use. The reported antioxidant component in shrimp will be isolated, identified, and used as one of the antioxidant treatments.

PROGRESS: 80/01 TO 80/12. An investigation was initiated to determine the effects of antioxidants, storage temperature, packaging conditions and type of bird on the oxidative stability of freeze-dried poultry. Freshly slaughtered broilers and spent hens were hand deboned and the debone meat was mixed and ground after the addition of 2% salt and either BBT, BHA or no antioxidant. The ground meat was studied into cellulose casings and cooked in a water bath until an internal temperature of 77 degrees C was reached. After cooling, the cooked loaves were cut into cubes (1 x 1 x 2.5 cm) and frozen in a blast freezer at -30 degrees C. The cubed meat was freeze dried in two batches with nitrogen being used to release the vacuum on one batch while air was used on the second batch. The meat cubes were vacuum packaged with a nitrogen flush being used on the nitrogen treated samples. Samples were stored at 25 degrees and 50 degrees C and analyzed at 0, 4, 8, 12, and 24 weeks for TBA reagents, total values and browning index. The results indicated that TBA values are not very reliable when measuring oxidative rancidity in freeze-dried chicken. TBA numbers increased to a maximum value then decreased as the storage time continued. Antioxidants, BBT, and BHA, reduced the rate of increase in TBA values and maximum TBA values were reached after a longer storage period. Total carbonyl values also increased as the freeze dried samples were stored. Antioxidants had very little effect on the rate of carbonyl formation.

PUBLICATIONS: 80/01 TO 80/12

ROGERS, T.L. 1980. Isolation and Characterization of Natural Antioxidants in Shrimp Processing Waste. M.S. Thesis, University of Georgia Library, Athens, Georgia. p. 75.

009.010*

CRIS0071426

HISTAMINE/HONEYCOMBING IN SKIPJACK TUNA

FRANK B A; NIP W; NIP W; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY OF HAWAII, HONOLULU, HAWAII. 96822.

Proj. No.: HAW00573

Project Type: STATE

Agency ID: SAES

Period: 01 JUL 76 To 30 SEP 81

OBJECTIVES: Develop methodology for measuring decomposition in skipjack tuna (*Katsuwonus pelamis*). Learn the conditions of handling causing high histamine and/or honeycombing.

APPROACH: Suitable analytical methods for histamine, histidine and honeycomb in skipjack will be selected and developed. These are fluorescence, thinlayer and high pressure liquid chromatography. Appropriate samples indicative of methods of handling will be analyzed. These will include times and temperatures.

PROGRESS: 80/01 TO 80/12. A study was completed on the effect of low-temperature (30 to 50 degrees F) incubation on histamine formation, honeycombing and quality deterioration in skipjack tuna. A study was completed on the effect of low-temperature (30 to 50 degrees F) incubation on microbial growth and histidine decarboxylation in skipjack tuna. A study was completed on the quantitative relationship between collagen breakdown and honeycombing in skipjack tuna. A nomograph was prepared to show the relationship of time-temperature-histamine in skipjack tuna under controlled conditions in the 70-100 degrees F range. A paper, "Bacterial histamine formation in skipjack tuna," was presented at the annual meeting of the Pacific Fisheries Technologists, March 16-19, 1980, in Astoria, Oregon. Tuna Research Workshop V was sponsored on December 11-12, 1980, in Honolulu to present a final report on the progress made on this project. A paper "Histamine formation and honeycombing during decomposition of skipjack tuna (*Katsuwonus pelamis*) at elevated temperatures," has been submitted for publication in Marine Fisheries Review. Additional manuscripts are being prepared for publication.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

009.011* CRIS0073715
POST-HARVEST HANDLING AND PROCESSING OF MACROBRACHIUM
PRAWNS

NIP W; MOY J H; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY
OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW00576-S Project Type: STATE
Agency ID: SAES Period: 01 JUL 77 To 30 SEP 80

OBJECTIVES: Define the quality of fresh and cooked prawns in terms of physical, chemical, bacteriological and organoleptic attributes. Assess the effect of various processing techniques (freezing, holding, packaging, storage and thawing) on the quality of the frozen prawns. Determine and recommend a set of handling, holding and processing conditions in terms of acceptable quality of frozen prawns for long term storage.

APPROACH: Zero-time control samples will be analyzed in terms of texture, pH, trimethylamine, collagen, and salt content, bacterial count and taste score. Prawns will be processed, stored and analyzed for the various quality attributes. Optimum conditions for processing, packaging and storing of frozen prawns will be determined based on the above results.

PROGRESS: 77/07 TO 80/12. Various postharvest handling and freezing procedures for the freshwater prawn, *Macrobrachium rosenbergii* were tested. Results of the frozen storage stability studies (6 mos) suggested that prawns may be chilled up to 48 hrs, then frozen and still maintain acceptable quality; the quality of prawns held under chilled conditions 48 hrs after thawing was still acceptable; post-blanching chilled storage may not be a practical prefreezing technique for commercial preservation and marketing of frozen prawns; and prawns can be frozen either in air or in brine at -18 degrees C, packaged in polymylar bags with or without vacuum, or frozen in ice-blocks, and still maintain acceptable quality. Effect of purging on quality factors and cost-effectiveness were also tested. No significant difference (p less than or equal to 0.05) was found between the purged prawns and the control in their muscle's pH, ammonia content, soluble/insoluble collagen ratio, and peak height/plateau height ratio. However, the decrease in pH and peak height/plateau height ratio, and the increase in ammonia content and soluble/insoluble collagen with ice-chilled time were highly significant (p less than or equal to 0.01), indicating a gradual quality degradation when stored on ice. Postharvest purging helped to improve the appearance of the prawn but its cost-effectiveness based on economic feasibility analysis was doubtful.

PUBLICATIONS: 77/07 TO 80/12

NIP, W.K. and MOY, J.H. 1978. Effect of Freezing Methods on the Quality of the Prawn *Macrobrachium rosenbergii*. Proc. of World Maricult. Soc. 10:761-768.

009.012* CRIS0066181
PREFLAVORED CHANNEL CATFISH

CAUL J F; FOOD & NUTRITION; KANSAS STATE UNIVERSITY,
MANHATTAN, KANSAS. 66506.
Proj. No.: KAN00919 Project Type: STATE
Agency ID: SAES Period: 01 JUL 74 To 30 JUN 78

OBJECTIVES: Explore the effects of conventional home cookery on the flavor of whole channel catfish preflavored with three commercial flavorants (e.g., onion, liquid smoke, garlic) when the treated fish are fresh; have been held in a household refrigerator 2-3 days; have been frozen in a household freezer, stored 1-2 months, then thawed before cooking.

APPROACH: Farm-raised channel catfish, 1/2-1 pound, will be preflavored by adding known quantities of flavorant(s) to their aquarium water. After being dressed and cooked, preflavored catfish and controls will be examined by flavor profile panel. Preflavoring treatments, cookery and examinations will be repeated at least once; at least two concentrations or two exposure times of each flavorant will be used. Research will be reported as a master's thesis.

PROGRESS: 74/06 TO 78/07. Prior work having shown the feasibility of preflavoring channel catfish in laboratory aquariums, experiments were conducted to explore the effects of conventional home cookery on the flavor of whole channel catfish preflavored with a commercially available liquid smoke flavorant. An experienced taste panel found that the flavor was retained in fish stored in home-type refrigerator for 1-3 days or in a commercial freezer up to 10 weeks; the dressed fish, 167-349 grams, were cooked plain by microwave or breaded, by frying. Details are given in Master's Thesis of Jo Karen Clithero, "Preflavoring Channel Catfish," 1975.

PUBLICATIONS: 74/06 TO 78/07
NO PUBLICATIONS REPORTED THIS PERIOD.

009.013 CRIS0070825
EVALUATION OF AQUATIC PLANTS AS POTENTIAL FEEDSTUFF
FOR DAIRY CATTLE

RUSOFF L L; DAIRY SCIENCE; LOUISIANA STATE
UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LA801852 Project Type: STATE
Agency ID: SAES Period: 01 JUL 76 To 30 SEP 79

OBJECTIVES: Determine the chemical composition, and cell wall and fiber components of dry water hyacinth for indicating its possible nutritive value. Determine the digestibility of dry water hyacinth ("in-vitro" and "in-vivo" studies). Determine whether dry water hyacinth would have any palatability problems or harmful effects when fed to dairy animals. Determine the feeding value of dry water hyacinth as a source of protein or a roughage in the ration of growing dairy animals. Determine the feeding value of dry water hyacinth as a source of protein in a blended ration or as a roughage in the ration for lactating cows. Determine the feeding value of dry water hyacinth on milk yield and milk composition.

APPROACH: The nutritive value of dry water hyacinth will be evaluated by in-vitro and in-vivo studies. In-vitro cellulose and DM digestibility studies along with chemical analyses will be made. As a source of roughage, NH will be compared with C bermudagrass hay and alfalfa hay in rations for growing dairy heifers and lactating cows; as a source of protein at concentrate portion of the rations. Growth, milk production and composition will be studied.

PROGRESS: 79/01 TO 79/11. Paper prepared for presentation at the annual meeting of the Southern Division, American Dairy Science Association, New Orleans, La., 1979. Funds were not available for additional work during this period.

PUBLICATIONS: 79/01 TO 79/11

ZERINGUE, S.P., RUSOFF, L.I. and WCLVERTON, B.C.
1979. Water hyacinth a source of roughage for lactating cows. J. Dairy Sci. 62:Suppl. 1, 200.

009.014* CRIS0075300
FLAVOR DIFFERENCES OF MECHANICALLY- AND
HAND-PROCESSED CRAB MEATS

BIEDE S L; RUTLEDGE J E; FCCD SCIENCE; LOUISIANA
STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.
Proj. No.: LAB01981 Project Type: STATE
Agency ID: SAES Period: 01 MAY 78 To 30 APR 82

OBJECTIVES: Study the influence of handling procedure of flavor retention in mechanically-processed crab meat. Assess organoleptic and gross compositional differences between hand- and mechanically-processed crab meats. Relate gas chromatographic patterns to flavor scores of crab meats. Assess the composition and importance of the nonvolatile flavors in crab meats. Develop a method or methods for the flavor enhancement of mechanically-processed crab meat.

APPROACH: Hand- and mechanically-picked Blue crab meat will be assessed for organoleptic and chemical differences. Flavor components lost will be characterized using combined gas chromatography and mass spectrometry, amino acid analysis and electrophoresis. Mechanically-picked meats will be treated with flavor enhancers to improve the flavor.

PROGRESS: 80/01 TO 80/12. Isolation and characterization of protein losses resulting from the mechanical processing of Blue crab meat utilizing electrophoresis revealed significant differences in quantity and make-up of the protein fractions. Preliminary data have revealed the loss of the heavy lymph with mechanical processing. This appears to be a significant portion of the protein losses. Further work is being undertaken to determine the feasibility of using cooler stressed Blue crabs for mechanical processing. Comparisons are being made between the processing of fresh, brine frozen and stressed blue crabs, as well as the electrophoretic patterns of the salt and water extractable proteins, to determine the effects of cooler stress.

PUBLICATIONS: 80/01 TO 80/12

BIEDE, S.L., RUTLEDGE, J.E. and CALLABAN, C.A.
1980. Flavor Differences in Blue Crab Meats.
Scientific Information Bulletin No. 46. Takeda
Inc.
BIEDE, S.L., RUTLEDGE, J.E., BENDRY, P.L. and
CALLABAN, C.A. 1980. Effects of Mechanical
Processing on Crab Meat. La Agric. 23:14-17.

009.015 CRIS0075853
DEVELOPMENT OF RAPID SEAFOOD QUALITY TESTS FOR
COMMERCIAL AND REGULATORY USE

GRODNER R; HACKNEY C B; FOOD SCIENCE & TECHNOLOGY;
LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA.
70803.
Proj. No.: LAB01991 Project Type: STATE
Agency ID: SAES Period: 03 JUN 78 To 31 DEC 81

OBJECTIVES: Develop rapid analytical quality tests to detect chemical and biochemical mechanisms reflecting the chemical and physical deterioration of seafood products from the initial catch to a processed product for the consumer. Identify and establish key chemical compounds or components which can be related to the deterioration process of fresh seafood products. Correlate chemical and physical changes during the deterioration process in seafood with organoleptic data.

APPROACH: Simple and direct gas chromatographic (GC) techniques coupled with mass spectrographic analysis will be developed and utilized for identifying and separating chemical volatile components from commercially produced seafood products that are associated with flavor and the deterioration process. Organoleptic panels will be utilized for evaluations of flavor and deterioration and each chemical component and profile identified will be correlated with these evaluations. At the same time, morphological changes will be studied with a Scanning Electron Microscope (SEM) for correlations with identifiable chemical changes.

PROGRESS: 80/01 TO 80/12. The use of rapid and direct Gas Chromatographic (GC) techniques continued on shrimp, crab meat and crayfish (crawfish) as a means of establishing quality indices for decomposition measurements and correlations with chemical and/or biochemical tests. The acquisition of a new Varian BPLC Unit recently, will require new techniques and methodology to adapt our testing procedures. Work has continued to correlate structural changes with progressive decomposition as measured by GC and now HPLC. Structural changes were determined using photographic techniques of the scanning electron microscope and the transmission electron microscope. Scanning Electron Microscopy studies of *Vibrio cholerae* in relation to the factors affecting adsorption to Blue crabs and their shell were also studied with the scanning electron microscope. These studies revealed that *V. cholerae* cells were adsorbed in a more or less random pattern on the shell surface which may protect the cells from being washed off. Another area of continued investigation is based upon studies that reveal that microorganisms can suffer non-lethal injury from stresses, such as, low heat, low temperatures, low pH, low water activity, sanitizers and starvation as well as any various combinations of these stress.

PUBLICATIONS: 80/01 TO 80/12

DIETRICH, M.A. 1980. Factors Affecting the Adherence of *Vibrio cholerae* to the Blue Crab (*Callinectes sapidus*). M.S. Thesis. La. State Univ., Baton Rouge.

009.016* CRIS0009816
HANDLING AND PROCESSING OF FISH AND SHELLFISH

RUTLEDGE J E; GRODNER R; RAO R; FOOD SCIENCE &
TECHNOLOGY; LOUISIANA STATE UNIVERSITY, BATON ROUGE,
LOUISIANA. 70803.
Proj. No.: LAB00849 Project Type: STATE
Agency ID: SAES Period: 01 DEC 58 To 01 DEC 81

OBJECTIVES: Perform research on the best methods of harvesting, collecting, processing, packing, preserving, labeling, and distributing fish and shellfish. Work in packing plants to institute good manufacturing practices, quality assurance laboratories, and investigate the critical control points during the manufacture of fishery products. Monitor the microbiological, physical, chemical and organoleptic safety status of Gulf fish and shellfish on a routine basis to protect the consumer and industry.

APPROACH: Study the physical and biochemical mechanisms involved in deterioration of these products so that procedures may be developed to reduce the rate of decomposition and the formation of undesirable compounds in the foods. Rapid methods of testing will be developed to enable the producers and packers to evaluate the products prior to packing, and before the onset of initial spoilage. Tests will include the qualitative and quantitative measurement of pathogenic microorganisms, those that are an index of pollution, ammonia, trimethylamine, lactic acid, volatile acids, sulfhydryl groups, indole, amino N, etc., for the purpose of augmenting existing objective measurements. The reliability and predictability of the abbreviated tests will be compared to AOAC methods, and the data will be subjected to statistical analyses for sources of sample and technique, and products variation.

PROGRESS: 80/01 TO 80/12. Crawfish: The effect of cooking, vacuum packaging and the presence or absence of hepatopancreatic tissue on the development of oxidative rancidity in frozen crawfish were studied. Two-thioarbuturic acid (TBA) values were determined every two months during the course of the study. There was a steady increase in TBA values in all cases with the progress of storage time. Both cooking and the presence of fat (hepatopancreatic tissue) on the tailmeat accelerated the production of malonaldehydes as indicated by the TBA test. Vacuum packaging significantly (p less than 0.01) lowered the TBA values as did the absence of fat. Crabs: The effect of various cooking temperatures and time periods were evaluated in relation to color changes in Blue crabs. These changes were also compared to the internal body temperatures in the crabs during cooking. The rate of color development was found to be dependent on time and temperature of exposure. Crabs placed in water at 100 degrees C had a mean "a" value of 15.27 on the Hunter scale after only 30 seconds of exposure. Values on the "a" scale 15 and above were considered typical of the red-orange color of cooked crabs. However, at this time and temperature exposure the crabs had an internal body temperature on only 16 degrees C thus, still showing effects of refrigerated storage. Longer exposures did not greatly enhance the color. Hence, crabs cooked in boiling water for thirty second appear generally the same as one cooked for sixteen minutes.

PUBLICATIONS: 80/01 TO 80/12

AMR, A.S. and RUTLEDGE, J.E. 1980. Oxidative Rancidity in Whole-Glazed Frozen Crawfish. Proceedings of the 50th Annual Tropical and Sub-Tropical Fisheries Technological Conference of the Americas.

BIMELBLOCM, B.H. 1980. Heat Penetration, Shell Color Changes, and Meat Yields of Crabs, Crawfish, and Shrimp Under Various Cooking Conditions. M.S. Thesis, La. State Univ., Baton Rouge.

009.017

CRIS0009838

REGULATORY PROBLEMS OF LOUISIANA FOOD INDUSTRIES

RUTLEDGE J E; GRODNER R; LIUZZO J A; FOOD SCIENCE & TECHNOLOGY; LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA. 70803.

Proj. No.: LAB00958

Project Type: STATE

Agency ID: SAES

Period: 01 DEC 57 To 01 DEC 81

OBJECTIVES: Assist the Louisiana food producers to conform to international, federal, state and local food laws, standards and good manufacturing practices. Perform immediate research on problems which arise and cause a controversy between an agency and packer or producer, or between these groups and consumer agencies. Monitor the safety and regulatory acceptance of Louisiana food products through routine quality assurance tests, and assist in recall of defective, contaminated or adulterated products. Inform Louisiana processors of new laws and their scientific interpretations and significance, and recommend new manufacturing procedures and equipment when laws require such modifications.

APPROACH: Handle each situation according to its state of urgency. When a health hazard is involved, the problem will be given immediate attention as to the causative agent, the action taken by the regulatory agencies involved, and a review with the participants, after which recommendations and action for its solution will be made. Reviews will be made of all proposed regulations and then recommendations will be made to the appropriate industries as to what the future significance of each might be. Scientific information collected in our laboratories will be offered to the legal staffs of the companies concerned and the regulatory agencies upon request. Several major areas of competence will be good manufacturing practices, nutritional labeling, microbiological standards and guidelines, food additives, quality assurance, and manufacturing regulations.

PROGRESS: 80/01 TO 80/i2. The presence of *V. cholerae* in crabs taken in Louisiana has come under close scrutiny because of the implication of *V. cholerae* as a causative agent of foodborne illness in isolated outbreaks during the past few years. This study was initiated to provide regulatory agencies information on the thermal resistance of *V. cholerae* in crabs in order to establish safe cooking times. Results of the study have shown that the cooking procedures used by commercial crab processors appear to be generally adequate as far as bacterial quality of crab meat is concerned. One of the largest problems associated with establishing adequate cooking procedures is that the crabs vary in size, weight, condition, etc. which influences the heat penetration rate. Therefore, the safest recommendation would be to cook crabs until the slowest heating point reaches 71 degrees C and is maintained at that temperature for a minimum of 1-minute.

PUBLICATIONS: 80/01 TO 80/12

SCHUTTLZ, L.M. 1980. Thermal Resistance of *Vibrio cholerae* in Blue Crabs (*Callinectes sapidus*) Meat Homogenates. M.S. Thesis, La. State Univ., Baton Rouge.

009.018

CRIS0071161

QUALITY CONTROL OF CANNED SQUID

SLABY B M; TRUE R H; FOOD SCIENCE; UNIVERSITY OF MAINE, CRCNO, MAINE. 04469.

Proj. No.: ME08594

Project Type: STATE

Agency ID: SAES

Period: 01 JUL 76 To 30 SEP 80

OBJECTIVES: Determine quality of squid mantle and tentacles canned in oil and brine using 3 3/4 oz. sardine cans.

APPROACH: Two species of squid (*Illex illecebrosus*) and (*Loligo pealei*) will either be salted (1, 2 and 4 lbs per bushel) or brined (12, 22 and 32" salometer) and stored at 33, 50 and 70°F. Squid stored in ice will serve as reference sample. Evaluation of raw material will involve sensory and microbiological tests on samples removed at daily intervals. Canned product (skinless) will be evaluated for appearance, odor and texture. Drained weight and total solid analysis will be performed to determine weight loss due to handling and processing. Effect of blanching (149°F for 2 min) and the use of CaCl₂ on texture of selected samples (best quality product) will be evaluated. Shelf life of canned product will be initiated.

PROGRESS: 75/10 TO 80/09. Shelf life of brine refrigerated whole squid (*Illex illecebrosus*) was about 3 days at 7.2 degrees C and 5 days at 0.6 degrees C. No difference in keeping quality was detected when using 3 or 12% brine. Salt-requiring, heat-sensitive bacteria predominated in the spoilage flora. Sensory evaluation of whole squid and canned mantles showed significant correlations with trimethylamine-nitrogen and tyrosine content of the raw material. Precanning blanching caused 3% shrinkage and 15% loss of dry matter in fresh squid, which increased with preprocess storage conditions to a maximum of 56% shrinkage and 42% loss of dry material. Squid mantles with skin removed were canned in oil, using quarter-pound aluminum sardine cans. The product had a good appearance, a mild flavor, and a firm texture; however, the mantles required blanching prior to canning. Ten minutes blanching in 3 percent boiling brine resulted in about 45 percent shrinkage. Addition of polyphosphate to the blanch water did not reduce shrinkage. Presence of citric acid in blanch water or the use of different oils in the can did not improve the quality of the canned mantle strips. Frozen storage temperature (-23 and -40 degrees C) of the raw material had no significant effect on the quality of the canned product. Squid mantle strips canned in oil had an acceptable shelf life.

PUBLICATIONS: 75/10 TO 80/09

NO PUBLICATIONS REPORTED THIS PERIOD.

009.019* CRIS0069947
SHEAR PROPERTIES OF FROZEN FISH FILLET BLOCKS

WBEATON F W; AGRIC ENGINEERING; UNIVERSITY OF
MARYLAND, COLLEGE PARK, MARYLAND. 20742.
Proj. No.: MD-R-053 Project Type: BATCH
Agency ID: CSRS Period: 02 MAR 76 To 30 SEP 80

OBJECTIVES: Determine the shear properties of frozen fish fillet pieces. Determine effect of shearing on conformation of the resulting cut surface.

APPROACH: Frozen fish blocks will be sawed to sample size with hand saws. By use of an instron machine and/or a guillotine cutter the fish sample pieces will be sheared and the force necessary to cut the samples recorded. Sample thickness, cutting speed, sample temperature when cut, knife geometry, fish muscle fibre direction and possibly fish species will be variables investigated and related to peak force necessary to cut the sample. The conformation of the sheared sample will be investigated to determine the effect shearing action has on squareness of corners and other critical parameters.

PROGRESS: 76/01 TO 80/09. Samples of frozen cod fillet blocks having different thicknesses and fillet orientations were sheared using a guillotine shearing device at -12.2 degrees, -17.8 degrees and -23 degrees C. Knife bevel angles of 10 degrees, 20 degrees, and 30 degrees and cutting speeds of 2.5, 7.5 and 12.5 cm/sec were used. Peak shearing force, shearing energy and surface damage of front and rear slices were measured. Regression equations were developed to relate individually peak shearing force, shearing energy, and surface damage for front and rear surfaces with the variables of temperature, block thickness, knife bevel angle and knife velocity. One set of equations was developed for shearing perpendicular to the muscle fiber and one set for shearing parallel to the muscle fiber. Blocks can be sheared but damage to the sheared piece is unacceptable except for 1.27 cm thick block sheared at -12.2 degrees C using a 10 degrees knife bevel angle. Thus, shearing does not appear to be a feasible method for cutting frozen fish blocks into fish portions, and fish sticks. An alternative approach should be tried for reducing the fish "sawdust" loss. Product development research could produce a salable product from the "sawdust."

PUBLICATIONS: 76/01 TO 80/09
VENKATRAMANI, T.A. 1978. Shear Properties of Frozen Cod Fillet Blocks. M.S. Thesis. University of Maryland, College Park, 137 pp.

009.020 CRIS0045743
THE EFFECTS OF DIET ON THE RISK OF CANCER

BERSHOFF S; GORHACH S; IACONO J; NUTRITION INSTITUTE;
TUFTS UNIVERSITY, MEDFORD, MASSACHUSETTS. 02155.
Proj. No.: 5090-20913-003-G(1) Project Type: GRANT
Agency ID: AES Period: 07 SEP 79 To 31 DEC 81

OBJECTIVES: The study addresses the effects of diet on the risk of cancer.

APPROACH: Population group consuming diets low in protein but high in fat will be identified. A second group consuming diets low in protein but high in fat will be identified. A second group with diet high in protein from fish or poultry but not meat and low in fat will be identified. Seventy-two hour female dietary records and food, fecal and urine samples will be obtained. Analyses will be done on fecal and urinary estrogen and androgen levels, the concentration of cholesterol, the existence of mutagens in the feces. Procarcinogens will be incubated and the rate of formation of mutagens will be measured.

009.021 CRIS0067589
FACTORS AFFECTING THE FUNCTIONAL PROPERTIES AND QUALITY OF PROCESSED MUSCLE FOODS

REYNOLDS A E; FOOD SCIENCE & NUTRITION; MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: MICL01205 Project Type: BATCH
Agency ID: CSRS Period: 02 APR 75 To 01 APR 80

OBJECTIVES: Better understand the functional properties of muscle foods in processing systems, thereby improving product quality and allowing greater flexibility in the use of lower cost raw materials.

APPROACH: Muscle foods will be studied in model systems to compare their functional properties by studying water binding capacity, temperature stability and native physical and chemical properties; and functional systems to evaluate the properties which effect product quality, i.e., type of muscle protein, binding capacity, effect of additives, microbial changes, heat stability and fat levels.

PROGRESS: 79/01 TO 79/12. Freshwater suckers (Catostomidae family), an underutilized species, were obtained from Lake Huron (Saginaw Bay, Michigan) to study the possibility of developing new products utilizing its flesh. Suckers were mechanically deboned, then blast frozen and stored at -29 degrees C. Minced sucker was analyzed for fat, protein and moisture content. The effects of storage at 3 degrees C for 7 days and -29 degrees C for 90 days on the solubility of myofibrillar and sarcoplasmic proteins as well as nonprotein nitrogen of sucker flesh were also studied. Results showed that suckers have a lower caloric content than do red meats or poultry and therefore are an ideal source of animal protein for use in low calorie diets. Solubility of myofibrillar proteins decreased by either refrigeration (3 degrees C) or freezer (-29 degrees C) storage, while sarcoplasmic proteins and nonprotein nitrogen were essentially unchanged by both storage methods. In comparisons between sodium chloride and sodium tripolyphosphate, sodium chloride increased protein solubility, while sodium tripolyphosphate appeared to be more beneficial. For example, it increases myosin solubility, pH, swelling and gel forming ability.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

009.022* CRIS0077745
MIREX FEEDING STUDY IN CHANNEL CATFISH (ICTALURUS PUNCTATUS)

MERCER B D; HIDALGO R J; KITZMAN J V; ANIMAL HEALTH RESEARCH; MISSISSIPPI STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI. 39762.
Proj. No.: MIS-0837 Project Type: BATCH
Agency ID: CSRS Period: 18 APR 79 To 30 SEP 81

OBJECTIVES: Determine the mathematical relationships between dietary intake of mirex and ferramicide and the resulting whole body residues. Determine time/dose response relationships between dietary intake of mirex and ferramicide and whole body residues, selected tissue residues, mortality, pathophysiology of certain organs, growth and callagen formation. Determine correlation between mirex and ferramicide whole-body residues with organ residues, pathophysiology of organs and mortality.

APPROACH: Fifty channel catfish will be maintained in each of 45 separate 200-L tanks. Body weights of fish in each tank will be made every two weeks throughout the experiments. In separate experiments, 8 levels of mirex and ferramicide will be administered in a defined synthetic diet. Each dose level will be fed to fish in 4 or 5 tanks for 52 weeks. Fish fed each dose level and appropriate controls will be sacrificed at prescribed intervals and appropriate samples collected for assay and histopathology. Pesticide levels in feed, water and fish scales will be analyzed at the National Monitoring and Residue Analysis Laboratory, USDA, Gulfport, Mississippi.

PROGRESS: 80/01 TO 80/12. Forty-eight groups of fish in separate aquariums were fed purified mirex at levels of 0.01 - 32.0 ppm in a purified fish diet. Tissues collected at intervals up to 240 days were subjected to quantitative mirex analysis and histopathologic examinations. Growth rates and collagen assays were also determined. There were no histopathologic nor growth parameter changes that could be correlated with exposure rates of mirex. Results of mirex analysis indicated a direct correlation between total dietary intake and tissue residue levels. The kinetic and mathematical models have yet to be completed. The feeding segment of the project was terminated at 240 days (January 6, 1981) due to excessive mortality resulting from several outbreaks of *Aeromonas hydrophila* attributable to stress factors. Statistical analysis to determine if there is any time/dose relationship between dietary intake of mirex and morbidity or mortality is underway. The project will terminate in April 1981, at which time the objectives of this project will have been completed.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

009.023 CFIS0055497
DETECTION AND IDENTIFICATION OF MYCOTOXINS AND ALGAL TOXINS IN FOODS AND FEEDS

IKAWA M.; BIOCHEMISTRY; UNIVERSITY OF NEW HAMPSHIRE, DURHAM, NEW HAMPSHIRE. 03824.
Proj. No.: NB00205 Project Type: HATCH
Agency ID: CSRS Period: 20 OCT 77 TO 30 SEP 82

OBJECTIVES: Develop and apply rapid methods for detecting and identifying fungal and algal toxins in foods and feeds, isolate, characterize, and identify toxic and carcinogenic substances produced by fungi and algae.

APPROACH: Microbial methods involving the use of *Bacillus subtilis*, *Chlorella pyrenoidosa*, *Saccharomyces cerevisiae*, the brine shrimp *Artemia salina*, and mutants of *Salmonella typhimurium* will be applied for the detection of toxic and carcinogenic metabolites. Thin-layer or mini-column chromatography combined with fluorescence will be applied to the detection and identification of toxins. Toxicogenic fungi grown on food or feed sources, algal-contaminated foods, or algal blooms will be extracted and the toxins isolated by column or high pressure liquid chromatography. Gas-liquid chromatography and spectrometric methods will be used to characterize and identify the toxins.

PROGRESS: 80/01 TO 80/12. A method for identifying the paralytic shellfish poisons (PSP's) present in crude shellfish extracts has been under investigation. The method consisted of absorbing the toxins on a strong cation exchange resin column and eluting the toxins with a series of buffers followed by strong acid. The column was monitored by oxidizing an aliquot of each fraction with hydrogen peroxide and measuring the resulting fluorescence. Most of the PSP's will fluoresce under these conditions. A separation of the *Gonyaulax tamarensis* toxin could be achieved, with the less basic gonyautoxins (GTX 2 and GTX 3) eluting first and the more basic saxitoxin (STX) eluting last. When crude extracts of the toxic blue-green alga *Aphanizomenon flos-aquae* were tested in this procedure, an early eluting fluorescence peak and a late peak corresponding in position to STX were observed. This is additional evidence that STX is also produced by a blue-green alga. The early eluting peak of *A. flos-aquae* was very labile to acid and therefore appeared to differ from the GTX 2 and GTX 3 type toxins. Experiments also indicated that considerable *A. flos-aquae* toxicity was present in non-fluorescent bands. Fluorescence profiles were also run on toxin samples obtained from scallops in Japan and extracts of toxic crabs from the southern island of Japan. The STX peak was observed in the crab extract, thus confirming the presence of STX. The procedure developed may be useful for identifying PSP's and for determining their origin.

PUBLICATIONS: 80/01 TO 80/12
NEWBURGER, J.D., UEBEL, J.J., IKAWA, M., ANDESEN, K.E. and GAGOSIAN, R.B. 1979. Sterols of *Agarum cribosum*. *Desmosterol* in a Brown Alga. *Phytochemistry* 18:2042-2043.
IKAWA, M., NOGUCBI, T. and BASHIMOTO, K. 1980. Extraction of Paralytic Shellfish Poisons from Whole Oyster, Whole Short-necked Clam and Scallop Digestive Gland. *Bull. Japan. Soc. Scientific Fisheries* 46:201-205.
TAYLOR, R.P. and IKAWA, M. 1980. Gas Chromatography, Gas Chromatography-mass Spectrometry and High-pressure Liquid Chromatography of Carotenoids and Retinoids. *Methods in Enzymology* 67:233-261.
IANNITELLI, R.C. and IKAWA, M. 1980. Effect of Fatty Acids on Action of Polyene Antibiotics. *Antimicrob. Agents Chemother.* 17:861-864.

009.024 CFIS0072087
ROLE OF LIPIDS AND THEIR OXIDATION IN FISH QUALITY

KINSELLA J E; FOOD SCIENCE; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-143381 Project Type: STATE
Agency ID: SAES Period: 05 DEC 76 TO 30 SEP 81

OBJECTIVES: Analyze lipid components of fish. Elucidation of the mechanism of lipid deterioration in fish and the interaction of the products of lipid oxidation with proteins.

APPROACH: Lipids are extracted and analyzed by established procedures. Oxidation is quantified by TBA and carbonyl generation. The interaction of carbonyls with protein will be measured by adsorption processes using vapor analyses.

PROGRESS: 80/01 TO 80/12. The lipid and proximal composition of 15 species of freshwater fish was determined. The fish contained an average 78, 19, 1.1% moisture protein and ash, respectively. The lipids ranged from 0.7 to 7.2% with species. Cholesterol averaged 70 mg/100 g fillet. The detailed fatty acid composition of 18 species was determined. The content of polyunsaturated acids varied between species. The effects of cooking (deep frying, pan frying) on the lipid content and composition of trout, bluegill and eucker were determined. Uptake of frying oil was proportional to the surface area and lipid content of the fillets. Breaded fillets absorbed frying oil. Deep frying eluted cholesterol from the fillets. The role of phospholipids in releasing fatty acids was studied. It was shown that the lipid composition of dark and light muscles were different. Antioxidants limited the oxidation of fish lipids during storage. Fish tissue readily converts ω -3 polyunsaturated fatty acids to corresponding prostaglandins. A new tetraenoic prostaglandin was discovered in fish gill tissue. This was synthesized from docosahexaenoic acid.

PUBLICATIONS: 80/01 TO 80/12
MAI, J. and KINSELLA, J.E. 1979. Lipid Composition of Dark and White Muscle from White Sucker (*Catostomus commersoni*). *J. Food Sci.* 44:1101-1109.
MAI, J. and KINSELLA, J.E. 1979. Changes in Lipid Composition of Cooked Minced Carp (*Cyprinus carpio*) During Frozen Storage. *J. Food Sci.* 44:1619-1624.
MAI, J., SHETTY, J.K. and KINSELLA, J.E. 1980. Protein and Amino Acid Composition of Select Freshwater Fish. *J. Ag. Food Chem.* 28:884-885.

009.025 CRIS0059120
ENZYMES IN FOOD FERMENTATIONS

LEDFORD R A; REGENSTEIN J M; FOOD SCIENCE; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-143305 Project Type: STATE
Agency ID: SAES Period: 01 OCT 77 TO 30 JUN 83

OBJECTIVES: The over all objective of this project is to improve the quality of fresh fish by controlling the growth of psychrotrophic microorganisms and insure that changes in processing and handling of fresh fish do not lead to other microbiologically undesirable effects. As part of this overall objective, the following specific objectives will be pursued in this project.

APPROACH: The microflora of commercial, iced fish and other commercial forms of fish will be examined. The organisms present will be enumerated with particular emphasis on *P. putrefaciens*. In addition, the presence of trimethylamine (TMA) will be monitored. Lipolytic and proteolytic activity will also be monitored. The results of the microbiological work will be correlated with the sensory evaluation of both the raw and cooked fish in order to determine the importance of various microbiological patterns on consumer acceptability of the food. Samples prepared specifically for shelf-life studies involving both gas and chemical treatments will also be evaluated by the various tests proposed.

PROGRESS: 80/01 TO 80/12. Bacteriological analyses were performed on commercial milk samples subjected to consumer and trained taste panels as part of a comprehensive departmental project on milk quality. Methods used included the Standard Plate Count (SPC), Psychrotrophic Bacterial Count (PBC), Lab Pasteurization Count (IPC), and the Coliform Count. The potential application of a new rapid method to monitor microbiological quality, the pyruvate test, was evaluated. Recently, the research has begun to study key factors in determining the growth of psychrotrophic organisms in milk. The first series of experiments consisted of 24 samples tested fresh and 24 analyzed after holding at 7.5C to the sell-by date. The fresh samples averaged Standard Plate and psychrotrophic counts of 1,900 and 41, respectively, and the consumer panel scores indicated excellent milk quality. The samples held to sell-by dates ("aged" samples) had high Standard Plate and Psychrotrophic Counts: 13,000,000 and 11,000,000. The taste panels data indicate that the growth of psychrotrophic microorganisms in processed milk is a major factor limiting quality. The results also indicate that the pyruvate test values are influenced significantly by the growth of these organisms. In the second series of experiments, the rates of microbiological changes in milk samples from 30 N.Y. State plants were examined by testing after 1, 7, and 10 days. The average psychrotrophic counts were 15, 71,000, and 5,400,000, for the 1, 7, and 10 days samples, respectively.

PUBLICATIONS: 80/01 TO 80/12
IEDFORD, R.A., SENYK, G.P., SHIPE, W.F., FANDLER, D.K. and WOLFF, E.T. 1980. Bacteriological Evaluation of Fresh and Aged Market Milk. *J. Dairy Sci.* 63(Supplement 1):106.

009.026* CRIS0064528
POTENTIAL OF DIFFERENT UNDERUTILIZED SPECIES OF FISH FOR CONVENIENCE FOODS

BAKER R C; REGENSTEIN J M; POULTRY & AVIAN SCIENCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-157380 Project Type: STATE
Agency ID: SAES Period: 01 DEC 78 To 30 SEP 83

OBJECTIVES: To develop nutritious, palatable convenience and economical products from species of fish not explored in the past. To study the factors which affect water holding capacity of fish flesh which is extremely important in functionality, cook-out, texture, juiciness and flavor of new fish products. To study composition of the effect of bones in fish flesh on functionality, flavor and texture of further processed foods.

APPROACH: Product development will proceed according to the following plan: Brainstorming for ideas, developing new products, testing the product for optimum consumer satisfaction and storage studies. Five mechanisms will be studied for increasing water holding capacity: pH, ionic strength, specific ionic effects cleavage of actomyosin linkages and calcium

and magnesium binding. Hand deboned fillets, minced fish and fish bones will be studied by measuring variables such as pH, proximate analyses and representative functional properties.

PROGRESS: 80/01 TO 80/12. Experiments on extending shelf life of red hake and salmon were conducted using potassium sorbate in a dip or in storage ice, and/or stored in Barrier Bags (cryovac) with modified atmospheres. Effective treatments were as follows: (1) All potassium sorbate treatments inhibited some TMA-producing bacteria; (2) CO(2) in modified atmospheres without ice at 20 or 60% was highly effective in extending shelf life of fresh fish. The greatest effect was obtained with a combination of 1% w/v potassium sorbate ice and an atmosphere of 60% CO(2), with refrigerated storage. Taste panel results indicated no off-flavors or off-odors attributable to treatment after storage of at least 4 weeks, after the fish was received at our lab. A study of the effects of different polyphosphates on the water binding properties of trout muscle showed differences in magnitude and in mechanisms by which the polyphosphates produced these changes. Hexameta- and glass-phosphates have a much greater potential for increasing water binding than pyro- or tripolyphosphate, mostly by a specific anion effect. In contrast, pyro- and tripolyphosphate increased water binding potential mostly through pH increases. Hexameta- and glass-phosphates were less effective for reducing expressible moisture than pyro- or tripolyphosphate, probably because of the inability of the longer chain polyphosphates to interact with the proteins.

PUBLICATIONS: 80/01 TO 80/12

FEY, M.S. 1980. Extending the Shelf Life of Fresh Fish by Potassium Sorbate and Modified Atmospheres at 0-1 Degrees C. Ph.D. Thesis, Cornell University, Ithaca, NY, 451 pp.
JAUREGUI, C.A. 1981. Effect of Polyphosphates on the Water Binding Properties of Muscle Proteins. Ph.D. Thesis, Cornell University, Ithaca, NY, 144 pp.
BAKER, R.C. and DARFLER, J.M. 1980. Development of Products from Minced Fish: 7. Canned Fish Balls in Tomato Sauce. *New York Sea Grant Bulletin.*

009.027 CRIS0068791
COMPARATIVE STUDIES OF LOBSTER AND CHICKEN MUSCLE

REGENSTEIN J M; POULTRY & AVIAN SCIENCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-157310 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 SEP 78

OBJECTIVES: Further compare the filament regulatory proteins, (troponin and tropomyosin) of lobster; one of the few solely thin filament-regulated invertebrates, with chicken. Also compare lobster and chicken myosins.

APPROACH: Ca binding of regulatory proteins will be carefully characterized and quantitated by equilibrium dialysis binding and quantitative SDS gel electrophoresis. The effects of DIME on myosin ATPase activities and on SDS gels will also be investigated.

PROGRESS: 79/01 TO 79/09. The water holding capacity (WHC) of both rainbow trout (*Salmo gairdneri*) white muscle and lobster (*Homarus americanus*) tail muscle controls did not change as the muscle went from pre- to post-rigor. The trout muscle WHC values were similar to those of post-rigor chicken breast muscle and they did not change markedly with additions of sodium pyrophosphate (PP(i)), Mg, Ca or combinations of these. In contrast, the WHC of lobster muscle was more like the WHC of pre-rigor chicken breast muscle. The pre-rigor lobster muscle showed a large increase in WHC values with the addition of pyrophosphate (205% of control) but with the addition of Mg to the sample the increase was depressed (166% of control) and Ca addition even more markedly depressed the WHC (90% of control). In both cases, Mg and Ca seemed to have approximately the same effect on WHC whether PP(i) was present or not. Kena, on the other hand, increased the WHC of both pre- and post-rigor trout and lobster muscle. Ca seemed to negate the

increasing effect Kena had on WBC. Mg addition with Kena caused a large increase in the WBC of the pre-rigor lobster muscle; the WBC capacity with Kena alone was 123% of control while the WBC with Kena and Mg was 231% of control.

PUBLICATIONS: 79/01 TO 79/09
NO PUBLICATIONS REPORTED THIS PERIOD.

009.028* CRIS0083222
EXTENDING THE SHELF-LIFE OF FISH

REGENSTEIN J M; HAKER F C; POULTRY SCIENCE; CORNELL UNIVERSITY, ITRACA, NEW YORK. 14853.
Proj. No.: NYC-157381 Project Type: STATE
Agency ID: SAES Period: 01 JAN 81 To 30 SEP 83

OBJECTIVES: To improve the shelf-life of fresh fish particularly underutilized species by modified atmosphere (carbon dioxide), low temperature and/or additives such as potassium sorbate, so that they may be successfully shipped to inland and overseas destinations.

APPROACH: To improve the texture stability of frozen red hake and whiting (underutilized East Coast gadoids), particularly after mincing. Additives and heat treatments will be investigated. To determine if the trimethylamine oxide to dimethylamine and formaldehyde reaction is cold-activated or freeze-activated. To better understand the mechanism by which polyphosphates effect the water retention properties of fish flesh.

009.029* CRIS0073941
FACTORS AFFECTING THE TEXTURE OF SEAFOODS

HANANN D D; LANIER T C; FOOD SCIENCE; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC02111 Project Type: HATCH
Agency ID: CSRS Period: 01 NOV 77 To 30 SEP 82

OBJECTIVES: Investigate factors affecting the texture of products made from mechanically deboned fish tissue, collect texture data on several species and commercial handling procedures develop methods for improving texture, and develop products from N. C. coast species that have commercial potential.

APPROACH: Atlantic croaker and other species will be studied to determine the effect of harvesting, handling and processing conditions on protein denaturation and resulting poor texture. Major muscle proteins will be separated into sarcoplasmic protein and individual myofibrillar protein such as myosin and actin to study their roles in gel formation, water binding, etc. Enzyme activity during heating and resulting protein changes will be determined. Results will be applied to development or improvement of specific products.

PROGRESS: 80/01 TO 80/12. An alkaline protease found in mechanically deboned fish has been shown to be derived from both muscle tissue and visceral contaminator and to cause texture breakdown during thermal processing of fish gels. Alkaline protease was partially purified from both muscle and liver tissue (both enzymes being cytoplasmic in nature and heat stable). The muscle protease is a sulfhydryl protease and does not require Ca^{++} for its activity while the liver enzyme(s) is Ca^{++} activated. Several Atlantic fish species have been examined with respect to the textural properties of gels prepared from the washed and unwashed minces. Processing factors which affect the textural characteristics of fish gels include processing temperature/time, pressure, method of comminution, additives (sco, egg and whey albumins, various starches and hydrocolloids), method of forming, and frozen storage. Several simulated shellfish meats have been successfully fabricated based on washed mince (surimi) such as shrimp, clam strips and scallops. Work is processing to develop appropriate electrophoretic, isoelectric focusing and/or

immunoelectrophoretic techniques for the determination of species composition of minced fish and surimi blocks.

PUBLICATIONS: 80/01 TO 80/12
LIN, T.S., SU, H.K. and LANIER, T.C. 1980.
Characterization of Fish Muscle Proteases Using Radio-labeled Protein Substrates. J. Food Sci. 45(4):1036-1039.
LIN, T.S. and LANIER, T.C. 1980. Properties of an Alkaline Protease from the Skeletal Muscle of Atlantic Croaker. J. Food Biochem. 4:17-28.

009.030* CRIS0075507
DEVELOPMENT OF IMPROVED HANDLING, SHIPPING/STORAGE AND MARKETING PRACTICES FOR FISHERY PRODUCTS

LANIER T C; FOOD SCIENCE; N CAROLINA STATE UNIVERSITY, RALEIGH, NORTH CAROLINA. 27650.
Proj. No.: NC02113 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 78 To 30 SEP 83

OBJECTIVES: Describe the factors which contribute to loss of quality in fresh and frozen raw seafoods, develop and test rapid methods of quality assessment and evaluate new handling, packaging, storage/shipment and marketing techniques for their potential in improving market life and quality of these products.

APPROACH: North Carolina seafood species will be studied to determine how handling, processing and storage methods may be imposed to minimize quality deterioration due to bacterial and autolytic processes. Gross and specific enzyme assays will be used to identify the source and mode of action of degradative enzyme systems. Various packaging and storage regimes, involving both refrigerator and freezer temperatures, will be tested in combination with various prestorage treatments (sanitizers, antioxidants, etc.) to improve market life of fishery products.

PROGRESS: 80/01 TO 80/12. Freeze thaw handling as a means of merchandising prepackaged fish appears to be feasible from both a technical and marketing standpoint. Previous supermarket sales tests demonstrated the acceptability of chilled fish labeled "previously-frozen." Vacuum-packaged fish previously frozen for 100 days at -20 degrees C, thawed and held chilled were found to have a saleable life equal to that of fresh fish from the same lot stored chilled in an identical manner. Shelf-life studies of fresh and previously-frozen grey trout are continuing in order to evaluate modified atmosphere packaging, various pre-dips and thorough washing prior to packaging as means of extending the life. Analyses will include: changes in the microbial flora on the surface, changes in gas composition within the package. A second consumer test will compare sales of prepackaged (modified atmosphere) fresh and previously-frozen fish (so-labeled) with that of vacuum packaged frozen fish.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

009.031 CRIS0061084
IMPROVING THE ASSURANCE OF QUALITY AND SAFETY OF CONSUMER'S FOOD

DOCRESS S; GLASS E D; KEENEY P G; DAIRY SCIENCE; PENNSYLVANIA STATE UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA. 16802.
Proj. No.: PEN02010 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 77 To 30 SEP 82

OBJECTIVES: Develop procedures and programs to detect food-borne pathogens and to control them in the food supply. Develop procedures to identify food additives and to evaluate them for efficacy and safety before and after interaction with food. Develop procedures and programs to identify unintentional additives in the food supply and to determine their sources and potential health significance.

APPROACH: Seafood products and frozen convenience foods will be evaluated and the effect of heating on pathogens in these foods studied. Lysozyme holds potential as a new food preservative. Its effectiveness, especially its action on clostridial spores will be studied. Various foods, especially milk, will be monitored for pesticide and industrial chemical residues.

PROGRESS: 80/01 TO 80/12. Decontamination studies were conducted in order to remove residues (up to 90 times the current FDA action level) of the organochlorine hydrocarbon insecticide mirex from brown trout. Various conventional heat treatments were not effective. Ultraviolet (24.48, and 72 hours) and gamma irradiation (1,3, and 5 Mrad) of macerated muscle tissue decreased the initial concentrations by 30, 43, and 46% and 10, 23 and 38 %, respectively.

PUBLICATIONS: 80/01 TO 80/12

CIN, D. A. 1980. Mirex in brown trout ('Salmo Trutta') the effect of food processing and preservation methods in attempts to remove this chlorinated hydrocarbon insecticide. M.S. Thesis. Penn State Univ.

CIN, D. A., KROGER, M. 1981. Effects of heat treatment, ultraviolet light and gamma irradiation on mirex insecticide residues in brown trout. J. Food Sci.

009.032* CRIS0082927
SENSORY & NUTRITIONAL EVALUATION OF SEAFOODS

PATEL K; PERCIVAL S; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.

Proj. No.: RI00067 Project Type: BATCH
Agency ID: CSRS Period: 01 NOV 80 To 30 SEP 83

OBJECTIVES: Assess seafood quality using both objective and sensory methods. Determine the nutrient content as influenced by processing, preparation and storage. Study properties in food systems as influenced by processing, preparation and storage conditions. Use the information to develop new products from underutilized regional resources.

APPROACH: There is much work to be done with assessing seafood quality in terms of acceptability and nutritional values. Additionally, the effects of storage, cooking and processing on the parameters must be determined. An essential component of this work is the formation of a data bank. This is necessary in order to be able to store, organize and retrieve the large volumes of data that will be generated. Procedures include statistical differences and correlation. From this data, a characteristic edible profile and nutritional value of a species can be outlined.

009.033 CRIS0083412
ENZYME DEVELOPMENT FOR SEAFOOD QUALITY

RAND A G JR; FOOD SCIENCE & TECHNOLOGY; UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.

Proj. No.: RI00022 Project Type: BATCH
Agency ID: CSRS Period: 23 JAN 81 To 30 SEP 82

OBJECTIVES: To develop a simple, rapid, visual test unit employing enzymatic tests for the assessment of fish quality.

APPROACH: An integrated series of tests will be created to assess component stability and determine the quality status of seafood for possible grading. The multitest unit will be evaluated in a series of stability trials on fish common to the waters of Southern New England.

009.034* CRIS0073560
THE QUALITY OF SEAFOOD CONSUMED BY THE PEOPLE OF SOUTH CAROLINA

KOLI A; SCUTH CAROLINA STATE COLL, ORANGEBURG, SOUTH CAROLINA. 29115.

Proj. No.: SC.X-PR-0001-BN-21 Project Type: GRANT
Agency ID: CSRS Period: 02 MAR 77 To 01 SEP 82

OBJECTIVES: Determine mercury levels of Sea and Freshwater fish consumed by the people of South Carolina, determine the effect of fish species on the accumulation and distribution of mercury in their tissues, and compare levels of mercury found by geographic location and relate to environmental factors.

APPROACH: Determine the availability of knowledge on the quality of seafood consumed by the people of South Carolina. The fish samples will be collected from the Atlantic Coast of South Carolina for determination of mercury content. To accomplish this the state's coastline will be divided into 30 sections of ten miles apart. The fish samples will be frozen on dry ice and stored in a freezer. The fish tissue will be analyzed for mercury contents by flameless atomic absorption spectroscopy--Mercury Analyzer.

PROGRESS: 80/01 TO 80/12. A survey of mercury and other toxic trace element residues in saltwater fish from the Atlantic Coast of South Carolina was conducted to see if the problem of the magnitude of toxic trace elements contamination was evident in the South Carolina Fishery. Samples of fish and shellfish from the Atlantic Coast of South Carolina were collected during 1978 and 1979. The fish collected were Spot, Whiting, Silver Snapper, Red Snapper, Flounder, Shrimp, Sea Bass, Squid, Grouper, Bluefish, Clam, Crab, Scallop, Speckled Trout, Croaker, Mullet, etc. The whole fresh fish were placed in plastic bags and frozen in a freezer. Triplicate samples of fish tissues were analyzed by wet digestion method. Sample flasks were incubated in reagent grade sulfuric acid and nitric acid mixture using a constant temperature shaking-water bath at 58 degrees C. Digests were analyzed using atomic absorption spectrophotometry procedures outlined by Hatch and Ott, and Uthe et al, as modified for use with a Perkin-Elmer, Coleman Mass-50 Mercury Analyzer and Flame atomic absorption spectrophotometer, Perkin-Elmer Model 306 and 5000. Thirteen trace metal elements were determined by atomic absorption spectrophotometry analysis of fish tissues. Trace elements determined were Mercury, Cadmium, Copper, Zinc, Arsenic, Lead, Iron, Magnesium, Chromium, Nickel, Aluminum, Manganese and Cobalt. A significant finding of this report are that larger fish had higher trace element contents than smaller fish of the same species.

PUBLICATIONS: 80/01 TO 80/12

KOLI, A.K. and CANTY, W.I. 1979. Determination of Methylmercury in Fish of South Carolina. Oceanic Abstract 16:472.

KOLI, A.K., SANDEU, S.S., CANTY, W.I., FELIX, K.L., REED, R.J. and WHITMORE, R. 1979. Trace Metals in Some Fish Species of South Carolina. Oceanic Abstract 16:884.

009.035* CRIS0063667
QUALITY FACTORS FOR FISH AND SHELLFISH STORAGE

FINNE G; ANIMAL SCIENCE; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.

Proj. No.: TEX06031 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 74 To 12 NOV 82

OBJECTIVES: To determine the yield after each processing step for both fresh and pre-frozen fish. To assess microbiological characteristics of minced flesh as influenced by species, processing steps and raw product quality. To determine chemical properties and frozen storage stability of minced flesh from different species. Freezing finfish. To determine composition of finfish as influenced by season, species, and area of catch. To establish optimum freezing rates and storage temperatures. To evaluate effectiveness of glazes, packaging methods and

materials, controlled atmospheres and antioxidants in extending frozen shelf life of Gulf of Mexico finfish.

APPROACH: Deboned fish flesh. Minced flesh from 6 to 8 different species will be produced. Analyze deboned flesh for total protein, fat, ash, moisture, fatty acid composition, total volatile nitrogen, malonaldehyde, soluble protein and pH. Number and types of microorganisms will be determined after each processing step. Using above chemical quality parameters, determine stability of frozen deboned flesh over one-year storage period. Freezing of finfish—Using chemical, microbiological and sensory evaluations, determine frozen storage stability of fish packaged five different ways. Evaluate effect of freezing rates and frozen storage temperatures by using different freezing techniques.

PROGRESS: 80/01 TO 80/12. Composition, quality and stability during frozen storage of Gulf of Mexico finfish species were investigated. The fish, which were frozen both fresh and after five days on ice, included; spotted trout, black drum, tilefish, flounder, swordfish and red fish. Each species was frozen vacuum packed, in a carbon dioxide atmosphere, water-glazed, over-wrapped with PVC and over-wrapped dressed. All samples were held at two different temperatures during frozen storage. In every case tested, vacuum packed fish was shown to have superior frozen storage stability followed by dressed and glazed fish. For the lean white species (flounder, tilefish, trout and red fish) little differences between holding at -30 degrees C and -15 degrees C could be observed after one year of frozen storage. For the dark muscle fish however, a holding temperature of -30 degrees C was shown to be superior. Black drum developed rancidity early except for fish packed in vacuum. Swordfish also developed some rancidity however, the main problem with this species during frozen storage was shown to be loss in water holding capacity and subsequent bad texture. All other fish tested were of good quality even after one year of frozen storage. This study will help the Gulf Seafood industry develop frozen finfish products. Melanosis in shrimp is a major problem to the Texas shrimp industry.

PUBLICATIONS: 80/01 TO 80/12

- TENNETT, V., FINNE, G., NICKELSON, R. and TOLODAY, D. 1980. Penetration Mechanism and Distribution Gradient of Sodium Tripolyphosphate in Peeled and Deveined Shrimp. Proc. 5th Ann. Trop. and Subtrop. Fisheries Tech.
- TENNETT, V., FINNE, G., NICKELSON, R. and TOLODAY, D. 1980. Determination of Phosphorous in Shrimp Treated with Sodium Tripolyphosphate. Proc. 5th Ann. Trop. and Subtrop. Fisheries Tech. of the Americas 5:195-204.
- FINNE, G., NICKELSON, R., QUIMEY, A. and CONNALLY, N. 1980. Minced Fish Flesh from Non-traditional Gulf of Mexico Finfish Species: Yield and Composition. J. Food Sci. 45:1327-1329.

009.036* CRIS0071432
PROCESSING QUALITY AND PACKAGING FACTORS WHICH AFFECT THE UTILIZATION OF FISH AND SHELLFISH

FINNE G; VANERZANT C; ANIMAL SCIENCE; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06242 Project Type: BATCH
Agency ID: CSRS Period: 30 MAY 79 To 29 MAY 82

OBJECTIVES: Evaluate physical parameters that accelerate melanosis, determine precursors of melanosis and enzyme kinetics, evaluate potential inhibitors of melanosis, determine Na-bisulfite decomposition mechanism. Evaluate quality characteristics of fish in various gaseous atmospheres controlled initially and and "completely" during refrigerated storage, determine changes in gaseous composition in packages, evaluate spoilage parameters of fish in controlled atmospheres.

APPROACH: Factors related to handling on board will be evaluated, enzymes associated with melanosis will be extracted from shrimp, purified and their activities determined, potential inhibitors tested,

head space gases from sulfite treated shrimp will be analyzed. Fish packaged in six gas atmospheres stored at 0-2 and 5-8C for 18 days will be examined for sensory, biochemical and microbiological qualities, composition of gases in packages will be analyzed by gas chromatography.

PROGRESS: 80/01 TO 80/12. Modified-atmosphere packaging (MAP) of fish using carbon dioxide was shown to be effective in inhibiting the growth of typical gram-negative spoilage organisms. Gram-positive organisms, especially lactobacilli, not normally associated with fish held on ice, were little affected by the modified atmospheres. This selective inhibition of the typical gram-negative spoilage organisms, together with the much slower growth rate of gram-positive organisms on fish, results in a significant extension of shelf-life when using CO(2) atmospheres. The seafood industry should benefit from the use of MAP systems with CO(2). The higher initial costs of packaging would certainly be compensated by savings on transportation and handling costs and, most of all, by a significant extension in the shelf-life of the product. Indole levels have recently been used by the Food and Drug Administration as an index of quality in fresh and frozen shrimp. The determination of indole, however, has been performed using sophisticated and expensive instrumentation prohibiting its use as a quality control tool in the seafood industry. A simple method where indole is extracted with light petroleum from trichloroacetic acid-precipitated shrimp muscle was developed. The extracted indole, soluble in light petroleum, is re-extracted with Ehrlich's reagent and indole in form of a rose indole complex can be determined spectrophotometrically. It is anticipated that this modified method may find its use as a much needed quality control tool in the seafood industry.

PUBLICATIONS: 80/01 TO 80/12

- BANKS, H., NICKELSON, R. and FINNE, G. 1980. Shelf-life Studies on Carbon Dioxide Packaged Finfish from the Gulf of Mexico. J. Food Sci. 45:157-162.
- NICKELSON, R. and FINNE, G. 1980. Brine Freezing Shrimp. Proc. 5th Ann. Trop. and Subtrop. Fisheries Tech. of the Americas 5:158-164.
- LANNELONGUE-FAVRE, M. 1980. Storage Characteristics of Fresh Fish Packed in Modified Gas Atmospheres Containing Carbon Dioxide. M.S. Thesis, Texas A and M University, 57 pp.

009.037* CRIS0064807
MICROBIOLOGICAL ASPECTS TO SHELLFISH SANITATION AND QUALITY

VANDERZANT C; RAY S M; ANIMAL SCIENCE; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06054 Project Type: BATCH
Agency ID: CSRS Period: 07 JAN 74 To 30 SEP 80

OBJECTIVES: Determine the level and seasonal distribution of *Vibrio parahaemolyticus* in freshly harvested oysters, clams and mussels. The effect of processing and handling procedures in wholesale and retail operations on *V. parahaemolyticus* also will be studied. Data on environmental and water characteristics will be used to examine possible relations between microbiological quality of seafoods and environmental characteristics.

APPROACH: Oysters, clams and mussels from Galveston Bay and waters and sediment from these areas will be examined for microbiological parameters (*V. parahaemolyticus*, coliforms, fecal coliforms, etc.).

PROGRESS: 74/01 TO 80/01. *Vibrio parahaemolyticus* is a potential pathogen transmitted to humans by consumption of contaminated seafoods. *V. parahaemolyticus* was present in low concentrations in about 60% of oysters, water and sediment of the Gulf of Mexico. No seasonal distribution of this organism was noted. There was no significant relationship between levels of *V. parahaemolyticus* and other bacteriological or environmental parameters. No increases in *V. parahaemolyticus* concentrations of seafood occurred when good processing practices were applied. Most seafood isolates of *V. parahaemolyticus*

belonged to serotype 05: K17 and differed from typical clinical isolates. Few were hemolytic (Kanagawa-positive). Kanagawa-positive and Kanagawa-negative strains of *V. parahaemolyticus* were examined for enterotoxigenicity, enteropathogenicity, drug resistance and plasmid DNA content. No significant relationship existed between cultural characteristics and indices of pathogenicity. Only 3 of 31 strains, all patient isolates, contained plasmid DNA with molecular weights of 24 or 60 million daltons.

PUBLICATIONS: 74/01 TO 80/01
NO PUBLICATIONS REPORTED THIS PERIOD.

009.038* CRIS0060713
LIPID METABOLISM IN AQUATIC ORGANISMS

BOTTINO N E; BIOCHEMISTRY & BIOPHYSICS; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX01926 Project Type: STATE
Agency ID: SAES Period: 01 SEP 71 To 31 MAY 81

OBJECTIVES: Characterize the fatty acyl lipids of various trophic levels in open waters in the proximity and under the Ross Ice Shelf. Evaluate the transfer of lipids through these trophic levels. Characterize the influence of a reduced degree of illumination on the polyunsaturated fatty acid content of the lipids of various trophic levels.

APPROACH: Various experiments are proposed to study the metabolism of lipids in aquatic organisms and its application to improve the quality of these aquatic products as human food. Various fatty acid mixtures will be fed to shrimp and the growth rate determined. Seasonal variations in the sterol composition of shrimp from the Gulf of Mexico will be characterized. Groups of *Tilapia aurea* will be fed different diets and the degree of fat production will be determined, and Marine invertebrates will be grown in the presence of inorganic selenium and the incorporation of the element will be followed. Furthermore, the selenium-compounds formed will be characterized.

PROGRESS: 80/01 TO 81/05. Studies were continued on basic and applied aspects of the metabolism of lipids (fats) and selenium in aquatic organisms. The sterols of Gulf of Mexico shrimp (white and brown shrimps were analyzed) were 90 to 95% cholesterol plus small amounts (1 to 2% each) of other components. The level of cholesterol in shrimp muscle was about 1 g per 100 g. About 90% of the cholesterol was free, the rest being cholesterol esters. No major differences were detected between the two species of shrimp that were studied. *Tilapia aurea* is a freshwater fish that is becoming very popular among aquaculturists. Our studies on this advanced significantly when we were able to adapt recently developed methods to the isolation of *Tilapia* liver mitochondria. These studies will be subject of a future publication. Work on the physiological and toxicological effects of selenium in an algae continued vigorously. We are in the process of analyzing the selenium-containing gases (probably selenides) exhaled by various algae. Furthermore, we have analyzed the biochemical components of various algae after their exposure to selenium and found selenium in amino acids, proteins, carbohydrates and lipids in decreasing order. These and experiments with radiolabeled selenium indicate that selenium is incorporated into the algal cells and also that selenium as selenite is much better incorporated than selenium as selenate.

PUBLICATIONS: 80/01 TO 81/05
BOTTINO, N.R., GENNITY, J., LILLY, L.M., SIMMONS, E. and FINNE, G. 1980. Seasonal and Nutritional effects of the fatty acids of three species of shrimp, *Penaeus setiferus*, *P. aztecus*, and *P. duorarum*. *Aquaculture* 19:139.

009.039* CRIS0080100
CAGE CULTURE OF TILAPIA IN THE VIRGIN ISLANDS

RAKOCY J E; NAIR A; ADMINISTRATION; COLL OF VIRGIN ISLANDS, ST CROIX, VIRGIN ISLANDS. 00850.
Proj. No.: VI00024 Project Type: BATCH
Agency ID: CSRS Period: 01 OCT 79 To 30 SEP 84

OBJECTIVES: Develop practical cage culture methods of tilapia fish production suitable to the freshwater resources of the Virgin Islands. Evaluate the acceptability of tilapia as a food fish by the local populace.

APPROACH: Various tilapia species and their hybrids will be evaluated under similar growing conditions for use in freshwater cage culture production systems. Imported commercial pelleted fish feed will be compared to themselves and other animal feeds for cage culture use. Feeds comprised of locally produced ingredients will be formulated and evaluated for tilapia culture in cages. Stocking densities, the use of sliding feeding-rate schedules, and the evaluation of monosex cultures obtained by mechanical grading or hand sexing of tilapia (separation of sexes by observing sexually dimorphic external characteristics.) will be investigated for fish production in cages under Virgin Islands pond conditions. Fish produced in cage culture research will be evaluated by taste panels and sold to the public. Acceptability of tilapia as a food fish will be evaluated by questionnaires and the actual marketability of the fish when compared to locally caught salt water species.

PROGRESS: 80/01 TO 80/12. An experiment, presently in its twelfth month, was conducted to evaluate three commercial feeds, each of which was fed to caged tilapia according to three feeding rate schedules. The feeds were floating catfish pellets from Purina (#5140) and Sunshine Mills (Tupelo, MS) and sinking crumbles (Tilapia Finisher) from Central Soya (San Juan, PR). The protein content was 32% for Purina and Sunshine and 30% for Central Soya. The treatments were replicated three times with a stocking rate of 200 fish/m³. The feeding rate schedules were 3% of body weight throughout the experiment, 5% for 2 months followed by reductions to 4,3,2 and 1% at monthly intervals (time slide) and thereafter maintained at 1%, and 5% to a mean weight of 60 g followed by reductions to 3% up to 100 g, 2% up to 150 g and 1% up to harvest (weight slide). The fish were fed once per day, 6 days per week, for 270 feeding days. After 6 months, the Central Soya treatments were discontinued because feed was lost through the cage sides during feeding, resulting in low growth rates. Analysis of the data after 11 months indicates that more growth was obtained with Purina. Mean weights for Purina were 269 g (3%), 246 g (time slide) and 301 g (weight slide) compared to respective mean weights of 229, 220 and 225 g for Sunshine. The cage mesh, (6-mm Vexar) partially clogged with algae and prevented adequate water circulation, contributing to low dissolved oxygen levels and growth rates, which generally averaged less than 1 g/day.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

009.040* CRIS0075551
CIGUATERA FISH POISONING IN THE U.S. V.I.:
BIOCHEMICAL, PHYSIOLOGICAL, AND MICROBIOLOGICAL STUDIES

MCMILLIAN J P; RAKOCY J E; BUSCH R L; ADMINISTRATION;
VIRGIN ISLANDS AGRIC EXPT STAT, KINGSBILL ST CROIX,
VIRGIN ISLANDS. 00850.
Proj. No.: VI00020 Project Type: BATCH
Agency ID: CSFS Period: 26 MAY 78 To 25 MAY 83

OBJECTIVES: Achieve a better understanding of the biology and chemistry of ciguatera. Develop a simple, reliable test for the ciguatera toxicity of fish. Determine the biological source(s) of toxin.

APPROACH: The nature of the Virgin Islands ciguatera will be determined and compared to that investigated in other areas. Ciguatera extracts will be tested whether it inhibits the growth of a variety of rapidly growing bacteria. The gut contents of toxic

and non-toxic fish will be examined for the presence of microorganisms that may be associated with ciguatera. The usefulness of immunological methods to detect ciguatera toxin will be determined. Suspect coral reef microorganisms will be grown on artificial media to determine if a ciguatera-like substance is produced. Efforts will be made to determine whether the toxin can be detected by immunological methods and also whether there is an alteration of blood or liver enzymes in ciguatera fish.

PROGRESS: 80/01 TO 80/12. Two methods of purification for ciguatera extracts obtained from fish flesh previously implicated in human poisonings have been developed. The first method involves two-step thin-layer chromatography, TLC-I and TLC-II, which give, respectively, lethal doses (LD₅₀) of 500 mg/kg and 10 to 100 mg/kg when tested in the mouse bioassay. The second technique employs silicic acid column chromatography (CC) and give a LD₅₀ of 50 to 200 mg/kg. The second method (CC) is much less time and labor intensive than the first and provides comparable purification. Gambierdiscus toxicus is a dinoflagellate found in the tropical oceans of the world usually on or near coral reefs, often in association with various macroalgae. Extraction and bioassay of G. toxicus from field collections in the Virgin Islands and from unicellular cultures (provided by Southern Illinois University) suggests the presence of at least three toxic fractions; a chloroform soluble fraction (CTX), an acetone insoluble fraction (MTX), and an acetone soluble fraction (Other).

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

009.041 CRIS0072469
ANALYSIS OF DOMESTIC FOOD DEMAND AND CONSUMPTION BEHAVIOR

HAVLICEK J JR.; AGRIC ECONOMICS; VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.
Proj. No.: VA-0622280 Project Type: HATCH
Agency ID: CSFS Period: 01 JAN 77 To 30 SEP 81

OBJECTIVES: Develop systems of behavioral relationships explaining consumer demand. Define and estimate parameters describing demand and consumption decisions with particular emphasis on food demand behavior and nutritional intake. Assess the implications of the findings from analytical and policy perspectives.

APPROACH: Demand and consumption models will be formulated which will permit incorporating more than price and income variables. Focus will be on identifying and measuring the impacts of major factors on demand behavior at various levels of the marketing channel and household demand and consumption behavior for selected meat, poultry, seafoods, cereals, and fruit and vegetable products. In particular, the effects non-food expenditures and food policies such as food stamps will be taken into consideration. Cross-sectional data such as HLS Consumer Expenditure Survey data and USDA Household Food Consumption Survey data will be analyzed in addition to various types of time series data for the selected food products. Analyses will utilize statistical and econometric methods such as analysis of variance, chi-square analyses, regression analysis, and systems of simultaneous equations.

PROGRESS: 80/01 TO 80/12. Analyses of consumer purchases of ground beef, steaks, roasts, pork, poultry, other meats, seafood, and food away from home indicated a dramatic decrease in the at-home consumption of beef, a slight decrease in the at-home consumption of other meats and in food consumed away from home, and a slight increase in the at-home consumption of pork, poultry, and seafood in the Northeast, Midwest, South, and West. A comparison of the S(1)-branch system and the constant elasticity of demand system (CHDS) indicated (1) the S(1)-branch system generated more reliable structural estimates, (2) the goodness-of-fit of the S(1)-branch system to the sample data was better than the goodness-of-fit of the CHDS, and (3) the predictive ability of the

S(1)-branch system to independent data samples was better than the predictive ability of the CHDS. The statistical theoretical framework of complete demand systems was summarized from an historical perspective, and several development, usefulness, and estimation issues of complete demand systems were analyzed. Quantity data from the 1972-1974 BLS Consumer Expenditure Diary Survey were edited and prepared for use by researchers across the U.S. Errors and discrepancies with respect to socioeconomic and demographic factors and expenditures, quantity, packaging, price, and other variables were identified.

PUBLICATIONS: 80/01 TO 80/12
CAPPS JR., C. 1980. The Impacts of Selected Nonfoods, Foods, Socioeconomic and Demographic Characteristics on the Decision to Purchase Various Meats and Seafoods for Home Consumption. AJAE. December. Abstract.
CAPPS JR., O. and HAVLICEK JR., J. 1980. Impacts of Selected Nonfoods, Foods, Socioeconomic and Demographic Characteristics on the Decision to Purchase Various Meats and Seafoods in the U.S. and the South. Staff Paper SP-80-3.
CAPPS JR., O. and HAVLICEK JR., J. National and Regional Household Demands for Meats and Seafood in the U.S.: A Complete Systems Approach. AJAE. December. Abstract.
CAPPS JR., O. and HAVLICEK JR., J. 1980. Static Theoretical Framework of Complete Demand Systems. Dept. of Agric. Econ. Staff Paper SP-80-12. Virginia Tech, Blacksburg, VA. September. 68 pp.
CAPPS JR., O. and HAVLICEK JR., J. The Demand for Selected Meats and Seafood Using the S(1)-Branch System. Chap

009.042 CRIS0064710
POISONOUS DINOFLAGELLATES AND SHELLFISH POISONING

SCHNOES H K; SCHANTZ E J; BIOCHEMISTRY; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.
Proj. No.: WIS02045 Project Type: STATE
Agency ID: SAES Period: 01 SEP 73 To 30 DEC 80

OBJECTIVES: Research objectives include: Culturing of poisonous dinoflagellates; isolation and characterization of new toxins; study of their chemistry and biochemistry of action; and study of their biosynthesis.

APPROACH: Organisms are cultured in large carboys, in natural and artificial seawater under constant illumination. Isolation involves a series of chromatographic steps including ion exchange, adsorption, and gel chromatography. New compounds are to be characterized by physical techniques (nuclear magnetic resonance and mass spectroscopy, especially) as well as chemical degradations. The toxins will be structurally modified to explore structure activity relationships.

PROGRESS: 80/01 TO 80/12. We have investigated the potent neurotoxins produced by species of marine dinoflagellate of the genus Gonyaulax. From laboratory culture of a producing organism (G. excavata) as well as from toxin-contaminated shellfish (scallops, collected in the Bay of Fundy) we have isolated six toxins and characterized their structures. All compounds are structurally related to saxitoxin which we previously characterized. The six toxins are: saxitoxin, neo-saxitoxin (1-hydroxysaxitoxin), 11Alpha-hydroxysaxitoxin sulfate, 11Beta-hydroxysaxitoxin sulfate, 11Alpha-hydroxyneosaxitoxin 11-sulfate, and 11Beta-hydroxyneosaxitoxin 11-sulfate. The toxins accumulating in shellfish are the same as those produced by the dinoflagellate but occur in different relative abundance. A variety of chemical analogs of saxitoxin have been prepared and the affinity and binding specificity of the natural toxins and their chemical analogs for the sodium channel in nerve membranes has been investigated to obtain information on the structural features of the molecule which are important for toxin/channel interaction. The five-membered guanidine ring and the C-12-ketone function of these compounds were shown to be the most important features determining

binding affinity. From the dinoflagellate *Gymnodinium breve* (indigenous to the Gulf of Mexico, and responsible for massive fish kills there) we have isolated two ichthyotoxic compounds in pure form.

PUBLICATIONS: 80/01 TO 80/12

BOYER, G.L., WICHMANN, C.F., MOSSER, J., SCBANTZ, E.J. and SCBNOES, B.K. 1979. Toxins Isolated From Bay of Puody Scallops. In: Toxic Dinoflagellate Blooms, Taylor, D.L. and Seliger, B.B., Eds., pp. 373-376. Proceedings of the Second
 NICCCLAI, A., SCBNOES, B.K. and GIBHCNS, W.A. 1980. Study of the Stereochemistry, Relaxation Mechanisms and Internal Motions of Natural Products Utilizing Proton Relaxation Parameters: Solution and Crystal Structure of

009.043 CRIS0081435
 IDENTIFICATION OF OFF-FLAVOR COMPOUND SOURCES FOR FISH AND WATER FROM THE UPPER WISCONSIN RIVER

LINDSAY R C; FOOD SCIENCE; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.
 Proj. No.: WIS02520 Project Type: STATE
 Agency ID: SAES Period: 15 AUG 79 To 30 SEP 83

OBJECTIVES: Identify the malodorous volatile constituents contributing to off-flavored fish and water from the Upper Wisconsin River at selected sites between Brokaw and DuBay Dam; attempt to identify sources of off-flavored compounds through matching of odor types and compound profiles.

APPROACH: A variety of fish will be obtained from Department of Natural Resources sampling crews. The fish will be processed into usual edible portions, and appropriate samples will be subjected to sensory analysis to locate species with notable levels of off-flavors. Subjective evaluation will be followed by suitable analyses for recovery of volatile malodorous compounds. Identity of offending compounds will be established through GC-MS and supporting techniques and contribution to off-odor and flavors will be established and subjectively. Matching of volatile profiles of water and fish will be attempted to locate sources of Compounds.

PROGRESS: 80/01 TO 80/12. Research has continued on the assessment of off-flavors in fish taken from several sites between Brokaw and DuBay Dam on the Wisconsin River. Data have been developed which show that seasonal effects may influence apparent flavors of walleye pike, and that these effects may be either natural environmental influences or a result of industrial activities along the river. Vacuum distillation methods for recovery of volatile flavor compounds have been applied, and samples are currently under analysis by combined gas chromatography-mass spectrometry. Sources of compounds identified in walleye pike appear to be the food chain, naturally occurring constituent reactions, environmentally-related natural compounds, and those from industrially-related activities on the river.

PUBLICATIONS: 80/01 TO 80/12
 NO PUBLICATIONS REPORTED THIS PERIOD.

10. Marketing and Economics

010.001 CRIS0072375
 THE STATUS AND RELATION OF THE COASTAL ZONE TO ALABAMA'S ECONOMY

HARDY JR W E; CLONTS JR B A; MCCOY E W; AGRI ECONOMICS & RURAL SOCIO; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
 Proj. No.: ALA-01-0059 Project Type: STATE

Agency ID: SAES Period: 01 JAN 77 To 31 DEC 77

OBJECTIVES: Describe the scope of industrial activity in the coastal region of Alabama, with emphasis on the seafood industry. Major sectors of industries will be delineated and their interrelationships analyzed to estimate the contribution of each industry to economy of the coastal area and State. Determine economic and environmental impact of the Alabama seafood industry of total resources, other industries of coastal zone, and the State.

APPROACH: Appropriate primary and secondary data will be assimilated and analyzed. This will include descriptive and quantitative data. Based on the data, an input-output model will be constructed to determine the effects of various industries. Industrial and environment considerations will be analyzed. Information will be useful to state and local area planners.

PROGRESS: 79/01 TO 79/12. A secondary data base of environmental input-output coefficients was constructed and combined with the economic input-output model developed during earlier stages of the project. Model analysis permits an evaluation of the environmental effects of each of the thirty sectors which were found to exist in the Alabama coastal economy. Manuscripts are being developed which will completely describe both the economic and environmental input-output models.

PUBLICATIONS: 79/01 TO 79/12
 NISSAN, E., WILLIAMS, D.C., GREEN, T., BAEDY, W.E. and NELSON, E.G. 1979. An Economic Input-Output Analysis for Mississippi-Alabama Coastal Counties. Mississippi-Alabama Sea Grant Program, MASGP-78-029, Ocean Springs, MS.
 NELSON, E.G. and HARDY, JR., W.E. 1979. "The Economy of Alabama's Coastal Counties," Highlights of Agricultural Research. Ala. Agric. Exp. Sta., Vol. 26, No. 2.

010.002* CRIS0058961
 FRESHWATER FOOD ANIMALS

LOVELL E T; MCCOY E W; FISHERIES & ALLIED AQUACULTURE; AUBURN UNIVERSITY, AUBURN, ALABAMA. 36830.
 Proj. No.: ALA00630 Project Type: HATCH
 Agency ID: CSRS Period: 01 FEB 71 To 30 SEP 81

OBJECTIVES: Evaluate economics of production, processing, and marketing of freshwater food animals. Develop and improve products and processing methods that will enhance marketability and insure quality of cultured freshwater food animals.

APPROACH: Mechanically deboned flesh from various fishes will be evaluated with regard to yield, quality, and storage stability. Waste from fish processing will be evaluated chemically and biologically, and technology will be developed for economic waste utilization. Methods will be tested for control of geosmin related off-flavor in pond raised fish. Costs and returns associated with production of food fish in various culture systems will be assessed. Identify and evaluate alternative marketing and distribution systems for fish with respect to market expansion, consumer reactions, and optimizing income to producers and processors.

PROGRESS: 80/01 TO 80/12. 59 collections of catfish processing waste (head, skin, viscera) from the major processing plants and representing production ponds from Ala., Miss. and Ark. were analyzed for a-BHC, heptachlor, DDE, DDT, Dieldrin, endrin and toxaphene. All samples contained toxaphene. All samples contained toxaphene; the range was 0.06 to 3.6 mg/kg. DDE and DDT was found in most; the range of DDE was 0.01 to 0.56 mg/kg and the range of DDT was 0.01 to 0.58 mg/kg. None of the pesticide concentration in any sample exceeded the levels allowed in human foods, indicating the waste should be safe to use in commercial fish feeds. 35 off-flavored catfish collected from processing plants in Mississippi during April-June 1980 were evaluated by a trained sensory panel for quality and intensity of

off-flavor. Only six of the samples had the distinct geosmin flavor which was formerly thought to be the major off-flavor in pond raised catfish. The most prominent flavor was "fecal" (sewage or manure); other were "rancid", "paint", "diecel", and "algae". Extracts from each fish were sent to the Southern Regional Research Center (USDA - AR) for compound identification.

PUBLICATIONS: 80/01 TO 80/12

- LOVELL, R.T. 1980. Utilization of Catfish Processing waste. Auburn Univ. Agri. Exp. Sta. Bull. S 21. 19 p.
- LOVELL, R.T. 1980. S-83 Annual Report: Freshwater Food Animals. So. Coop. Ser. Sp. Rep., June, 1980. 20 pp.
- LOVELL, R.T. 1980. Effects of Feeding Full-Fat Soybean Meal on Growth and Flesh Quality in Catfish. Aquaculture 6(3):39.
- LOVELL, R.T. 1980. Nutritional Value of Fish. Aquaculture 6(5) 45.
- LOVELL, R.T. 1980. Effects of Feed on Sensory Quality of Fish. Aquaculture 6(6) 41.

010.003 CRIS0060945
CATFISH BREEDING, PRODUCTION, AND MARKETING

ELAM E W; AGRI ECONOMICS & RURAL SOCIOLOG; UNIVERSITY OF ARKANSAS, FAYETTEVILLE, ARKANSAS. 72701.
Proj. No.: ARK00763 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 71 To 30 SEP 81

OBJECTIVES: Develop processing and marketing technology for the catfish industry.

APPROACH: Interviews with buyers and controlled in-store interviews with customers will be used to collect data on preference, usage, buying practices and other influential variables to provide the basis for evaluating the market potential for catfish products and marketing strategies.

PROGRESS: 80/01 TO 80/12. The regional project did not have an economic component that was active this year. Minimum contact was maintained with State and Federal agencies regarding volume of production and marketing data. Some materials were furnished to the Cooperative Extension Service for their educational program.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

010.004 CRIS0066364
ECONOMICS OF AQUACULTURE

JOHNSTON W E; BOWITT R E; CARMAN E F; AGRI ECONOMICS; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-AEC-3107-ME Project Type: HATCH
Agency ID: CSRS Period: 11 SEP 74 To 30 SEP 82

OBJECTIVES: Investigate the economic potential for commercial aquaculture. The long-range goal of this project focuses on the economic potential of species not presently identified as commercially productive in culture systems. The immediate focus will be on the northern (or New England) lobster *Homarus americanus*.

APPROACH: The investigation has two major components roughly parallel to economics of production potential and economics of market potential. The first relates to determining the "supply function" for lobsters from mariculture and will involve close liaison with other investigators studying the genetic, biological, and engineering potentials for culture. By necessity, the phase of the investigation will be a continuing one involving economic evaluation of experiments including perhaps recommendations for specific experimental designs, and ultimately economic evaluation and recommendations of proposed aquaculture systems. The second component, economics of market potential, has as its objectives the determination of economic feasibility and the assessment of the economic impact of the "new" industry.

PROGRESS: 80/01 TO 80/12. Major work on this project included the updating of the lobster model to early 1980 conditions for an invited presentation to an FAO symposium in Norway. Major cost components increased were construction, energy, and indirect costs. It was shown that while that system costs increased by 75% from 1975 to early 1980, non-heat costs rose by a lesser amount (37%), and that commercial feasibility for systems using heated effluents seems near at hand collaborating recent power company interests and investments in Maine and in Southern California. Project will terminate in 1981. /80/Symp.:E/56).

PUBLICATIONS: 80/01 TO 80/12

- JOHNSTON, W.E. and BOISFORD, L.W. 1980. Systems Analysis for Lobster Aquaculture. Presented at Symposium on New Developments in the Utilization of Heated Effluents and of Recirculation Systems for Intensive Aquaculture.
- FLETCHER, J.J. and JOHNSTON, W.E. 1980. Vessel Characteristics and Summary Report of Landings and Revenues of the Northern California Crab Fleet: Coastwide Summary Data Base, 1974-76. Davis, Processed. Prepared for National
- JOHNSTON, W.E. 1981. The Economy: Quality, Productivity and the Aquaculture Industry. Comments Made on the Major Topics Panel. California Aquaculture Association/California Fish Farmers Workshop, San Diego.

010.005 CRIS0080062
TOWARDS A THEORY OF THE REGULATED FISHERY

WILEN J E; INST OF ECOLOGY; UNIVERSITY OF CALIFORNIA, DAVIS, CALIFORNIA. 95616.
Proj. No.: CA-D*-ECL-3883 Project Type: STATE
Agency ID: SAES Period: 01 JUL 79 To 31 AUG 81

OBJECTIVES: Develop some new conceptual models of commercial fishing firms operating in a regulated fishery. The intended benefit will be a better understanding ex ante of the impact of various regulatory schemes on individual fishermen, of their reactions to such schemes, and of the reactions regulatory agencies in turn.

APPROACH: Combination of deductive conceptual modeling and empirical testing of the models. The first stage will involve capturing in as simple form as possible the nature of regulator-regulatee interactions and then deducing predictions. Then some regulatory case studies will be examined to verify or refute the hypothesis.

PROGRESS: 80/01 TO 80/12. This project is proceeding in two directions at present: extension of theoretical work done last year on behavioral models of fishermen decision-making, and testing of theories by investigating actual fisheries. The project remains an important issue for fisheries management--it is becoming increasingly necessary to forecast how fishermen will react to changing circumstances such as price and cost changes and regulation changes. Little work (theoretical or empirical) has been done on these issues. This year an agricultural economics graduate student at UCD is beginning dissertation work under my supervision extending some of the ideas developed thus far. We plan to spend time researching data availability in existing fisheries this summer.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

010.006 CRIS0068219
ECONOMICS OF PRODUCING AND MARKETING LONG ISLAND SOUND OYSTERS

LEONARD R L; AGRI ECONOMICS & RURAL SOCIOLOG; UNIVERSITY OF CONNECTICUT, STORRS, CONNECTICUT. 06268.
Proj. No.: CONS00466 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 75 To 31 JAN 79

OBJECTIVES: Project for the Long Island Sound oyster industry the impact of alternative regulatory and public investment policies on production, marketing, prices, employment, and industry profits.

APPROACH: Comparative budgeting will be used to estimate supply functions with alternative regulatory policies and levels of investment to improve public seed beds. A simultaneous equation model will be used to project the impact of alternative supply functions on price and quantity sold.

PROGRESS: 79/01 TO 79/12. Terminated January 31, 1978.

PUBLICATIONS: 79/01 TO 79/12

FELSON, W.I. 1979. An Economic Analysis of the Long Island Sound Oyster Industry. Ph.D. Thesis. Univ. of Connecticut, Storrs. 99p.

010.007 CRIS0063026
ECONOMIC BEHAVIOR OF FOOD AND FIBER FIRMS

PROCHASKA F J; COLETTE W A; ALVAREZ J; FOOD & RESOURCE ECONOMICS; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.

Proj. No.: FLA-AS-01621 Project Type: STATE
Agency ID: SAES Period: 01 NOV 72 TO 31 DEC 80

OBJECTIVES: Level and maintain current technical and economic data relative to enterprises and firms producing and marketing selected agricultural and marine commodities. Evaluate alternative firm decisions for maximizing net income. Appraise economic effects of institutional arrangements and regulations on firm operations.

APPROACH: Sample surveys and cost studies to establish input-output relationships, enterprise profitability and firm efficiency. Develop and analyze economic models of firm structure and operation with varying technical, economic, institutional and legal arrangements and restrictions using simulation, linear programming and other EDP methods and procedures.

PROGRESS: 80/01 TO 80/12. A formal decision model was constructed to determine the optimal time to replace an existing field of sugarcane. An analysis to evaluate the effects of producing sugarcane following rice production was completed. The economic feasibility of cancelling EOCB compounds in the Everglades Agricultural Area was evaluated. The energy input for celery production was computed for the Everglades and Central Florida. Developed a 1980 budget for field-corn production in the Everglades. Production, costs and returns data for Florida lobster fishermen were analyzed. The most profitable allocation of fishing effort between lobstering and stone crabbing by time of year or fishing season was determined. A biostatistical model was developed to analyze production of Gulf of Mexico reef fish. A profit maximizing dynamic linear programming model was developed to determine the optimal levels of field crop, forage and beef cattle enterprises in North and West Florida. The economic feasibility of on-farm grain storage and drying was evaluated. Collected and summarized data on grove care costs from grove caretakers in the Ridge and Indian River areas.

PUBLICATIONS: 80/01 TO 80/12

CRANE, D.R. and SPREEN, T.H. 1980. A Model of the Stubble Replacement Decision for Florida Sugarcane Growers. Southern Journal of Agricultural Economics 12:2. December.

ALVAREZ, J., KIDDER, G., SPREEN, T.H. and CRANE, D.E. 1980. Rates of Decline in Productivity of Florida Sugarcane. Soil and Crop Science Society of Florida Proceedings. 39:95-98.

MISHOE, J.W. and ALVAREZ, J. 1980. Energy Use in Florida Celery Production. In: Handbook of Energy Utilization in Agriculture, pp. 185-189, Pimental, D., Editor. Boca Raton, FL, CRC Press Inc.

LANDRUM, P.D. and PROCHASKA, F.J. 1980. The Florida Blue Crab Industry: Landings, Prices and Resources Productivity. State University System of Florida Sea Grant Report 34:51. Gainesville, University of Florida. August.

PREVATT, J.W., REYNOLDS, J.E. and MELTON, B.E. 1980. Determination of Optimal Levels of Field Crops, Forage and Beef Cattle Enterprises. Soil and Crop Science Society of Florida Proceedings 39:108-112.

010.008 CRIS0073519
ANALYSIS OF DOMESTIC FOOD DEMAND AND CONSUMPTION BEHAVIOR

PROCHASKA F J; TILLER D; FOOD & RESOURCE ECONOMICS; UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA. 32601.
Proj. No.: FLA-AS-01843 Project Type: HATCH
Agency ID: CSKS Period: 01 JAN 77 TO 30 SEP 81

OBJECTIVES: Develop systems of behavioral relationships explaining consumer demand. Evaluate present systems for food demand analysis and evolve criteria for improving information systems.

APPROACH: Development and estimation of the necessary parameters for an analytical system of demand relationships with special emphasis on a detailed analysis of the food sector. It is proposed that a microeconomic empirical approach which makes use of both economic and psychological factors be taken. Assessment of present data systems as to their adequacy for analysis of food demand. Work associated with the second part of this objective will concentrate on the formulation and testing of new or improved data systems. Continuity of information is necessary in order that movements and trends in food demand may be measured in response to changing socioeconomic conditions and/or governmental policies.

PROGRESS: 80/01 TO 80/12. An econometric model relating household expenditures on fishery products to the household's socio economic and demographic characteristics was estimated with ELS data. Specific independent variables included in the Tobit model were food stamps, income expenditures away from home, race, urbanization, occupation, education and adult equivalent scales. A total of 85 equations were estimated by region and seafood group. Cross tabulations of mean consumption levels by independent variables were made. An econometric model of the wholesale and retail demand for frozen concentrated orange juice (FCOJ) and chilled orange juice (COJ) was estimated. The endogenous variables of the model are FOB, FCOJ inventory, FOB prices, domestic retail size FOB movement, bulk FOB movement, retail prices of FCCJ and COJ and retail sales of FCCJ and CCJ. Derived reduced form equations were estimated and used to perform several stimulation exercises. Differences between elasticities derived from structural and reduced form equations are distinguished. Long-run price elasticities of demand for frozen concentrated orange juice and chilled orange juice were estimated to be -0.777 and -1.136, respectively. Time varying parameter estimation procedures were used to estimate the demand for frozen concentrated orange juice (FCOJ), chilled orange juice (COJ) and canned single strength (CSS) orange juice.

PUBLICATIONS: 80/01 TO 80/12

WARD, E.W. and TILLEY, D.S. 1980. Time Varying Parameters with Random Components: The Orange Juice Industry. Southern Journal of Agricultural Economics. Vol 12, Number 2, December.

MALICK, W.M. 1980. A Simultaneous Equation Model of the Florida Retail Orange Juice Marketing System. M.S. Thesis, University of Florida.

010.009 CRIS0084329
PRODUCTION ECONOMICS OF AQUACULTURE SPECIES IN HAWAII

SHANG Y C; SAMPLES K C; AGRI & RESOURCE ECONCMICS;
UNIVERSITY OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW00479-H Project Type: HATCH
Agency ID: CSRS Period: 01 MAY 81 To 30 SEP 83

OBJECTIVES: To determine current and experiment costs and returns for commercial production of catfish, oyster, mullet, marine shrimp and brine shrimp in Hawaii. To design a computerized budget generator for pond aquaculture in Hawaii.

APPROACH: This study will attempt to evaluate the profitability of the production of various aquaculture species in Hawaii for both intended fish farmers and policymakers. The cost and return method is used in this study. Data needed for analysis will be collected through personnel interview of producers and input suppliers. Sensitivity analysis will be conducted. Culture practices in other regions will be collected for reference.

010.010 CRIS0077778
ECONOMICS OF FISHERIES DEVELOPMENT AND MANAGEMENT FOR
THE HAWAIIAN ARCHIPELAGO

COMITINI S; DAVIDSON J R; AGRI ECONCMICS; UNIVERSITY
OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW00474-S Project Type: STATE
Agency ID: SAES Period: 01 JAN 79 To 30 SEP 82

OBJECTIVES: Determine the economic feasibility of alternative possibilities for fisheries development in the Hawaiian Archipelago. Determine the economic and social benefits and costs of fisheries development in the Hawaiian Archipelago.

APPROACH: This study will attempt to establish potentials for both economic benefits and costs of fisheries development and the nature of the tradeoffs between economic benefits and social values. The working hypotheses is that fishery development can produce positive net benefits even with "adequate" allowance for protection of social values.

PROGRESS: 80/01 TO 80/12. Work was completed on phase 1 of this project. A feasibility analysis of alternative paths of fisheries development was finalized using three classes of tuna (ahi) longliners as prototype vessels for planned development of the tuna resource. The high fuel requirements of the larger vessels appear to impose a major constraint on their profitability for long-distance operations. These findings will assist State planners to modify existing strategies for fisheries development in the Hawaiian archipelago.

PUBLICATIONS: 80/01 TO 80/12
COMITINI, S. and DAVIDSON, J.R. 1980. Economics of Fisheries Development for the Hawaiian Archipelago. Proc. of the Symposium on Status of Resource Investigations in the Northwestern Hawaiian Islands, Eds. Grigg, R.W. and

010.011* CRIS0074563
SYSTEMS ANALYSIS OF INTENSIVE AQUACULTURE: A CASE
STUDY OF OYSTER PRODUCTION

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OF HAWAII, HONOLULU, HAWAII. 96822.
Proj. No.: HAW00470S Project Type: STATE
Agency ID: SAES Period: 01 NOV 77 To 30 SEP 80

OBJECTIVES: The overall goal is to generate information which can be useful for improving on the economic efficiency of commercial oyster production in the State. Specific objectives are: Conduct a feasibility study which will examine biological, technical, and economic parameters in an intensive oyster production system, and develop and analyze alternative management strategies for the current specie and system configuration.

APPROACH: A systems analytic approach will be followed in this study. A simulation model will be developed of the land-based oyster culture operations of the Kahuku Seafood Plantation. This simulation model will incorporate the relevant biological, technical, and economic parameters of the operating system. The model will be used in the feasibility study and analysis of alternative management strategies.

PROGRESS: 77/11 TO 80/09. This study assessed the feasibility of land-based oyster aquaculture for Hawaii and examined the constraints which are likely to affect the development of an industry. Conclusions were: small scale land-based oyster culture is technically feasible. Commercial production on a limited scale is being attempted in Hawaii, but as yet, without sustained outputs. Opportunities to realize further efficiency gains through economies of scale are limited. Emphasis is on developing new management techniques within existing scales. Various uncertainties make it difficult for conventional commercial lending sources to assess the viability of oyster aquaculture ventures. Therefore, scale expansion will probably not be forthcoming.

PUBLICATIONS: 77/11 TO 80/09
NO PUBLICATIONS REPORTED THIS PERIOD.

010.012* CRIS0079155
IMPROVEMENT OF OGO PRODUCTION AND MARKETING IN HAWAII

DOTY M S; BOTANY; UNIVERSITY OF HAWAII, HONOLULU,
HAWAII. 96822.
Proj. No.: HAW00688 Project Type: HATCH
Agency ID: CSRS Period: 24 APR 79 To 30 SEP 82

OBJECTIVES: Inventory the current OGO (Gracilaria) industry its problems and potentials. Identify and appraise the environments of potential production areas in Hawaii. Experimentally grow Gracilaria in those areas and seasonally determine its market values and growth rates. Adapt methods of algal farming used elsewhere to selected areas and develop recommendations for peat and fertilizer control, and marketing. Demonstrate adapted farming technologies and provide technical advice with the aim of inducing Gracilaria farming in USA.

APPROACH: Analyze the results of interviews with the people now active in the Gracilaria industry to appraise the industry in Hawaii and elsewhere. Survey the environments of potential farm sites in Hawaii to select the more favorable and enlist owner interest. Monitoring test plantings to yield growth rates and market quality during the seasons will permit selection among the sites. Adapt farming methods in use elsewhere for optimal production and market place at the selected sites. Demonstration plots at suitable sites, discussions with the nearby people, and technical help will be used to get farming initiated and stabilized.

PROGRESS: 80/01 TO 80/12. The local Gracilaria fresh vegetable market shortage has continued. Curiously, quality and form variations have been found in the course of the seasonal study that seem to follow quickly upon changes in the environment. Thus, the correlated studies of the environments and growth rates are being continued and an experimental program added with additional appropriate measurements to elucidate the nature of these phenomena. Experiments to shorten the lag time observed in the harvesting methods used to date have been begun. These, in short, are primarily experimental harvesting by cutting off only certain of the longest more central branches of the thalli with the controls being the complete abbreviation of the thalli found to be the most favorable among the earlier harvest methods recommended as management practice. The work has been extended from Oahu to the island of Molokai under such staffing conditions that an equitable amount of effort may be spent on both as success in farming progresses. Interestingly, the Gracilaria species from Molokai are different both in form and gel nature from those on Oahu. This is hard to understand in view of the wide geographic distribution of the two principle species and so by transplanting

experiments explanations are being sought.

PUBLICATIONS: 80/01 TO 80/12

NC PUBLICATIONS REPORTED THIS PERIOD.

010.013*

CRIS0045121

PRELIMINARY COSTS OF CATFISH PROCESSING WASTE UTILIZATION

FREEMAN D W; DECOSSAS K M; SPADARO J J; USDA-ARS SOUTHERN REG RES CENTER, NEW ORLEANS, LOUISIANA. 70179.

Proj. No.: 7102-20530-002 Project Type: INHOUSE
Agency ID: ARS Period: 06 OCT 78 To 30 SEP 79

OBJECTIVES: Determine rates of waste production and compare the costs of disposal with alternate means of waste utilization for several large catfish processing plants. (TO-1).

APPROACH: Establish field contacts and visit several large processing plants in Arkansas, Mississippi, and Alabama to confirm how these processors dispose of their wastes. Obtain or estimate the costs of such disposal and obtain or estimate the rates of waste production. Prepare preliminary capital investment and processing costs for alternate methods of converting these wastes into usable products.

PROGRESS: 78/10 TO 79/09. Visits were made to three catfish processing plants in the Mississippi Delta and methods of waste disposal were evaluated in two of them. Offal collection, essentially the same in both plants, consists of automatically conveying the heads, viscera, and skin from the eviscerating table, skinner, and washer to a common discharge, where the mixture is screened from the wastewater and collected in a holding bin. The offal from one plant, 6 million lbs annually, is discharged in bulk into trucks that haul it in 20,000-lb. loads to a poultry rendering plant where it is blended in limited amounts with chicken waste to produce chicken feed. The renderer pay 1-2 cents/lb for the offal, which is about the cost to the processor for transporting it. The offal from the second plant, 4.5 million lbs. annually, is discharged into reusable 1500-2000-lb. capacity plastic containers, iced, and shipped, 20 containers per refrigerated trailer truck, to a cat food processor. The cat food processor pays 4 1/2 cents/lb. for the offal at destination, which covers all expenses to the catfish processor (labor, ice, stationary refrigeration of trailer truck during 2-day loading period, and transport costs) and 1/2 cent/lb. profit. A rendering plant of the poultry type is under construction at the third catfish processing plant visited, to which admission was not gained.

PUBLICATIONS: 78/10 TO 79/09

NC PUBLICATIONS REPORTED THIS PERIOD.

010.014

CRIS0081088

AN ECONOMIC EVALUATION OF ICE FISHING IN MAINE

REILING S D; AGRI & RESOURCE ECONOMICS; UNIVERSITY OF MAINE, CRONO, MAINE. 04469.

Proj. No.: ME08292 Project Type: STATE
Agency ID: SAES Period: 01 OCT 79 To 30 SEP 82

OBJECTIVES: Determine economic value of recreational ice fishing. Determine angler attitudes and preferences towards various fresh water species, recreational settings, ice fishing regulations. Determine the socioeconomic characteristics of ice fishermen and effect of these characteristics and attitudes on demand for and value of ice fishing activities. To estimate the demand for and value of ice fishing using published methodologies.

APPROACH: Primary data collected via mail questionnaire from a sample of 5000 people who purchased fishing licenses in 1978. Socioeconomic data collected and analyzed. Attitudes and preferences of fishermen concerning ice fishing regulations and species studied. Demand for and/or value of ice fishing estimated using several

approaches that have been suggested by other researchers. Methods and estimates of value will be compared for consistency and restrictions of assumptions required to use the different methods. Traditional distance zone travel cost, individual travel cost and contingent valuation are three of methods to be used to estimate value of ice fishing.

PROGRESS: 80/01 TO 80/12. A mail questionnaire was designed and utilized to collect primary data. A response rate of about 35% was obtained from the sample of almost 5,000 residents who purchased angling licenses in 1978. Analysis of the data indicates that about 42% of the respondents ice fished at least once during the last two seasons and about 31% ice fished during the 1979-80 season. Statistically significant differences exist between open-water and ice fishermen and their preferences. For example, motivations for fishing, the type of site preferred and the composition of the fishing party varied among the two categories of fishermen. Significant differences also exist with respect to age, occupation, sex, attitudes toward selected fishing regulations and the current residence of ice and open-water fishermen. Income and education levels are not statistically different. The economic value of ice fishing in Maine was also estimated using three different methods: a travel cost model, a contingent valuation approach and unit day values. Preliminary results indicate that the values obtained from the three methods are highly variable and are not comparable. This suggests that the value obtained for a recreational activity or facility may depend on the procedure used to estimate value. Additional work is required on the valuation models before they are reported.

PUBLICATIONS: 80/01 TO 80/12

TAYLOR, J.L. 1980. An Economic Evaluation of Ice Fishing in Maine. M.S. Thesis, 110 pp. University of Maine, Orono.

010.015

CRIS0080120

ECONOMIC IMPACTS OF THE 200-MILE LIMIT ON RURAL NORTHEASTERN COASTAL COMMUNITIES

STRAND I E; NORTON V T; MCCONNELL K E; AGRI & RESOURCE ECONOMICS; UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND. 20742.

Proj. No.: MD-A-026-CV Project Type: BATCH
Agency ID: CSER Period: 01 OCT 79 To 30 SEP 83

OBJECTIVES: Evaluate the economic impacts of extended fisheries jurisdiction on coastal communities with particular reference to opportunities for industrial and employment expansion. Evaluate the degree to which expansion and growth of the offshore fishing industry will be able to absorb labor and capital from declining inshore fisheries.

APPROACH: The objectives will be met by determining amount of changes in labor and capital employed in recreational and commercial fishing in the future and the likelihood that any excess labor and capital can be absorbed in the offshore industry. Three steps will be undertaken: Determining the extent, persistence and causes for declining production in inshore commercial and sport fisheries; Predicting employment and income from inshore fisheries; Assessing the likelihood of expansion in the offshore commercial and recreational fisheries and the ability of the expansion to absorb displaced inshore labor and capital.

PROGRESS: 80/01 TO 80/12. The project has progressed in the following areas: 1) conceptual issues in determining variation in inshore commercial seafood production, 2) examining the likelihood that increases will occur in offshore fisheries, 3) examining input-output and regional models to determine their usefulness in impact analysis, and 4) collecting and assembling data for use in regional models. With regard to, a model has been developed to estimate bioeconomic parameters for fisheries. It requires only data on catch and effort. Initial testing of the model has been done for Maryland Blue Crabs. One fishery, offshore surf clams, have been studied to determine how much, if any, additional

effort will be forthcoming. 3) and 4) Sportfishing data from North Carolina to Maine for 1979 has been assembled and processed. It will likely be linked to a regional model to determine impacts of various fisheries policy changes.

PUBLICATIONS: 80/01 TO 80/12

- STRAND, I.E. and CHAMBERS, R.G. 1980. Resource Stocks and Supply Estimation: An Alternative Approach. Abstract Am. J. Ag. Econ., Vol 62(Dec):1116.
- NORTON, V.J. 1980. Economic Considerations of State and Interstate Fisheries Management. Proceedings of a Conference on State and Interstate Fishery Jurisdiction: Problems and Progress. UNC-SG-80-02. pp. 27-34.
- STRAND, I.E. and NORTON, V.J. 1980(forthcoming). Some Advantages of Landings Taxes in Fisheries Management. Proceedings of the Technical Consultation of Fisheries Resource Allocation, International Game Fishing Association.
- STRAND, I.E., KIRKLEY, J.E. and MCCONNELL, K.E. 1981(forthcoming). Economic Analysis and Management of Atlantic Surf Clam. Economic Analysis for Fisheries Management Plans, Anderson, L.G., (Ed) Ann Arbor Science.
- YAGER, J.O. 1980. Cost Analysis of Striped Bass Culture. Master's Thesis, Univ. of Md., College Park, Md. 166 pp.

010.016* CFIS0073525
ECONOMICS OF BIVALVE MOLLUSK AQUACULTURE IN NEW ENGLAND

ALLEN P G; STOREY D A; CONRAD J M; FOOD & RESOURCE ECONOMICS; UNIVERSITY OF MASSACHUSETTS, AMHERST, MASSACHUSETTS. 01002.
Proj. No.: MAS00415 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 77 To 30 OCT 80

OBJECTIVES: Construct biological response models; specify alternative plausible technical alternatives; combine biological and engineering components into production models; conduct marketing and demand analyses to determine marketing costs, price and income elasticities and gross revenues for different output levels; combine production and marketing analyses to determine economic feasibility of different systems at different individual plant scales and aggregate levels of output.

APPROACH: Generate a data base, develop cost of production estimates and provide subsystem modeling support in cooperation with Texas A&M University. Modify Texas A&M computer program to fit local conditions.

PROGRESS: 77/10 TO 80/10. Two activities have been carried out on cooperative projects supported by NOAA-Office of Sea Grant. In cooperation with Texas A and M University. Data for the aquaculture budget generator were provided by a survey of shellfish aquaculturalists in New England and by the economic-engineering analysis of three synthetic model plants. As the budget generator becomes operational locally, it will enable the marine advisory service to provide detailed cost information to existing and prospective aquaculturalists. The economic-engineering analyses indicated that it was possible to produce 60g (85 mm) oysters at 1979 costs which ranged from \$18.50 in the lowest cost system to \$34.50 per bushel in the highest cost system. By comparison prices received for high-quality half-shell oysters were \$33.75 per bushel in 1979. Most operating oyster-producers had costs of at least \$37.50 per bushel, due to the experimental nature of their operations. In cooperation with Woods Hole Oceanographic Institution: A computer program has been written based on the lobster aquaculture program of the University of California, Davis. The new program contains features not found in any other bioeconomic simulator and in a variable planning horizon framework it includes both start up and operation sequences for either identical or nonidentical seasonal conditions for single, repeated batch or continuous batch operation.

PUBLICATIONS: 77/10 TO 80/10

- DONOHUE, M. 1980. An Analysis of the Economics of Shellfish Aquaculture Systems in New England, M.S. Thesis, Univ. of Mass.
- SAWICKI, V. 1980. The Economic Feasibility of Intensive Culture Oyster Production, M.S. Thesis, Univ. of Mass.

010.017 CFIS0071802
THE IMPACT OF THE 200 MILE ECONOMIC ZONE ON RURAL NEW ENGLAND COASTAL COMMUNITIES

STOREY D A; HUTCHINSON C; WILLIS; FOOD & RESOURCE ECONOMICS; UNIVERSITY OF MASSACHUSETTS, AMHERST, MASSACHUSETTS. 01002.
Proj. No.: MAS00387 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 76 To 30 SEP 79

OBJECTIVES: Construct bioeconomic models, determine ports which will support expanded fleets and landings; project sustained yields into processing and marketing; determine impact on rural development of rural coastal communities, including the number of industry related jobs, increases in coastal populations, and the necessity for additional local community investments.

APPROACH: Determine appropriate species and through econometric models identify yield functions and cost functions to determine a cost equation which would permit formulation of a management strategy. Then identification of processing and marketing networks will determine impact on the onshore investments and by using input-output methodology we will estimate population, employment, income, tax and town expenditures.

PROGRESS: 78/10 TO 79/10. Mathematical models of (1) demand for fish and (2) control theory for fishery biological systems were completed and published. The models provide a basis for more informed decisions about management of the New England fisheries under the Fishery Management and Conservation Act. The demand analyses indicated that price flexibilities are less than one for cod, haddock, flounder, and sea scallops. This suggests that these fish are unlike most farm food products because management policies to decrease landings in order to rebuild stocks would have the effect of decreasing fishermen's gross revenues. Boston auction prices were found instrumental in determining Gloucester and New Bedford prices. The daily auction at Boston occurs earlier than in New Bedford, while in Gloucester direct negotiation between fisherman and processor determines price. The stochastic control theory models were applied to the sea scallop fishery. Expected values of profits from these models were higher than for deterministic models. The main value of the research was in the methodology developed as an aid to future decision processes.

PUBLICATIONS: 78/10 TO 79/10

- HUTCHINSON, C.E. and FISCHER, T.F. 1979. Stochastic control theory applied to fishery management. IEEE Transactions on Systems, Man, and Cybernetics Vol. SMC-9, No. 5, pp. 253-259.
- ABMAD, M. 1979. Econometric analysis of ex-vessel prices for cod, haddock, flounder and scallops in Massachusetts. Ph.D. Thesis. Univ. Mass., Amherst.

010.018 CFIS0078986
ECONOMIC IMPACTS OF THE 200-MILE LIMIT ON RURAL NORTHEASTERN COASTAL COMMUNITIES

STOREY D A; FOOD AND RESOURCES ECONOMICS; UNIVERSITY OF MASSACHUSETTS, AMHERST, MASSACHUSETTS. 01002.
Proj. No.: MAS00464 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 79 To 30 SEP 83

OBJECTIVES: Evaluate the economic impacts of extended fisheries jurisdiction on coastal communities with particular reference to opportunities for industrial and employment expansion.

APPROACH: The general conceptual framework to be used for attaining objective (1) will be that of benefit cost analysis. All economic benefits are classified as either direct or indirect. The direct benefits can be measured conceptually by producer or consumer surpluses. The quantitative methods which will be used for measurement of direct benefits include statistical methods, especially regression analysis, and synthetic methods including budgeting, mathematical programming and optimal control. The participating faculty each have experience in application of one and, in some cases, several of these methods (e.g. Albello, Storey and Conrad, 1977; Gates and Norton, 1974; Dunham and Mueller, 1976).

PROGRESS: 79/10 TO 80/09. Work has continued on identification and development of bio-economic models which will permit projections of offshore harvesting volumes in New England and which will enable comparisons of the economic impacts of alternative policy scenarios.

PUBLICATIONS: 79/10 TO 80/09
NO PUBLICATIONS REPORTED THIS PERIOD.

010.019 CRIS0074610
FISHERIES AND WILDLIFE ECONOMICS RESEARCH IN THE
GREAT LAKES

TALBELM D E; FISHERIES & WILDLIFE; MICHIGAN STATE
UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: MICL01304H Project Type: HATCH
Agency ID: CSRS Period: 02 MAR 78 To 01 MAR 83

OBJECTIVES: Assess the primary benefits received by fish and wildlife resource users; estimate how benefits change when resources change; estimate the economic impacts of this resource use; estimate other related benefits, costs and impacts.

APPROACH: Recreational values estimated by constructing a simulation model of demand and supply of each variety of recreation (characterized by certain site-related attributes). Varieties identified by examining travel patterns. Demand for each is a function of the availability (price) of several varieties. Model can estimate value of adding, subtracting or changing sites statewide. Commercial values estimated by either estimating total demand and supply or by various bioeconomic modeling techniques. Bioeconomics can also be used to improve recreation models. Initial investigations will study Great Lakes and anadromous sport and commercial fishing. Studies will estimate sport vs commercial fishing tradeoffs and value changes caused by fish mortality from power plants.

PROGRESS: 80/01 TO 80/12. A study of fish impingement and entrainment at Consumers Power Company's Whiting generating plant on Lake Erie showed that the plant reduced the adult yellow perch population by about 1.7%. Related studies showed that the recreational value lost because of the reduction in perch population was about \$25,000 per year. Results of the study are currently central to a contested hearing between the Michigan Department of Natural Resources and Consumers regarding appropriate evaluation of losses and mitigation amounts. A study of angling demand and supply resulted in a simulation model which has been used to estimate fisheries values for several practical purposes. Management programs of the Michigan Department of Natural Resources and the Great Lakes Fishery Commission have been evaluated. A study of commercial fisheries population dynamics showed that the "surplus production model" does poorly in describing most of Michigan's commercial fish populations. An Anglers Guide to Michigan's Great Lakes was written and published as a commercial publication by the Michigan Department of Natural Resources. A model state law for commercial fisheries was written and is in the process of being published. It is expected to form the basis for a new Michigan statute, and it may influence laws in other states or provinces. Work was begun on a study of Great Lakes boating demand and supply, and economic impact. Data has been collected and is in the process of being analyzed for preliminary results.

PUBLICATIONS: 80/01 TO 80/12
FISHER, A.T., CURTIS, G.R. and TALBELM, D.E. 1980. Angler's Guide to Michigan's Great Lakes. Mich. Dept. Nat. Res., Lansing.
BRONSTEIN, D., THOMAS, M., TALBELM, D.E., GEETHEK, H. and RICHARDSON, A. 1980. Great Lakes Model Commercial Fishery Statute. Mich. Sea Grant Program, Univ. of Mich., Ann Arbor.
JORDAN, S.W. and TALBELM, D.E. 1981. The Economic Feasibility of Fisheries Management Options for Michigan's Great Lakes. J. Great Lakes Res.
TALBELM, D.E. and BISHOP, E.C. 1980. Benefits and Costs of Sea Lamprey (Petromyzon Marinus): Control in the Great Lakes. Some Preliminary Results. Can. J. Fish. Aquat. Sci. 37(11):2169-2174.
TALBELM, D.E. 1980. Limited Entry in Michigan Fisheries, in Wash. Sea Grant Program, Limited Entry as a Fishery Management Tool. Univ. of Wash. Press, Seattle. pp. 300-316.

010.020 CRIS0007202
NEW METHOD OF APPRAISING NUTRITIONAL STANDARDS

ECFGSTRM G A; FOOD SCIENCE & NUTRITION; MICHIGAN
STATE UNIVERSITY, EAST LANSING, MICHIGAN. 48824.
Proj. No.: MICL006689 Project Type: STATE
Agency ID: SAES Period: 25 OCT 61 To 07 JAN 81

OBJECTIVES: Review and analyze world food resources in relation to population demands and assess the role of food waste as well as increased utilization of marine resources in meeting world and regional needs.

APPROACH: Studies will be continued in this area and also in editing a 10-volume Encyclopedia of Food Science (partially supported by a grant from John C. Wiley).

PROGRESS: 80/01 TO 80/12. During 1980 studies were concentrated on defining and establishing more accurately on one hand the role of key animal food items (meat, milk and eggs) in the overall pattern of continents, regions and countries, as well as their utilization patterns, both in absolute and relative terms. This resulted in major revisions of the traditional notions as to the nutritive role of respective commodities such as beef, pork, milk, cheese, eggs, etc. When moving to aquatic protein this analysis renders an entirely new insight into the relative role of protein from agricultural as contrasted to aquatical sources. Fish averages have been computed in tilled land counterparts and, thus, new insights were gained into the true role of aquatic food as contrasted to agricultural contributions, in several instances revising prevailing notions in this regard. Through this quite new insights were furthermore obtained into the historical role of freshwater and ocean catches as to human feeding, frequently thereby revising traditional beliefs. In a similar manner detailed analyses have been expanded to many other key food categories such as cereals, pulses, tubers and 'empty calories' (fats and oils), evaluated as to C/N ratio and protein standing. Finally the global protein balance has been reviewed taking into account the specific effects of trade, in several instances comparable to that of long distance fishing. This material is now being reworked to be placed in books under preparation.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

010.021 CRIS0081043
MARKET POTENTIAL AND CURRENT MARKETING PROCEDURES AND
PRACTICES OF THE CATFISH FOR FOOD INDUSTRY

CONNER J R; WALDROP J E; AGRICULTURE; MISSISSIPPI
STATE UNIVERSITY, MISSISSIPPI STATE, MISSISSIPPI.
38762.
Proj. No.: MIS-0841 Project Type: STATE
Agency ID: SAES Period: 01 JUL 79 To 31 DEC 81

OBJECTIVES: Determine and describe the structural and operational characteristics and the procurement and marketing practices of the U.S. Catfish for Food processing industry; determine and describe the geographic distribution, operational characteristics and procurement and marketing practices of the food broker, wholesaler, distributor and chain grocery firm handling catfish for food products; and estimate the market potential for catfish for food within the current market area and within the current market structure.

APPROACH: In depth interviews with marketing and management personnel from processing food broker, wholesaler, distributor and chain grocery firms handling catfish for food will be conducted. In addition, interviews will be conducted with managers of a representative sample of catfish for food producer firms. Also, interviews will be conducted with a representative sample of retail firms handling domestically produced catfish for food. Volume of domestically produced catfish sold per store customer from the sample stores will be used to estimate potential volume that could be sold in the current market area.

PROGRESS: 80/01 TO 80/12. A catfish marketing study designed to ascertain structural and organizational characteristics of the catfish processor and wholesaler industries and develop preliminary estimate of market potential was initiated. The data from catfish processors and wholesalers has been collected via an extensive survey and the summarization and the analysis of that data is nearing completion. Work is underway to develop preliminary indications of market potential.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

010.022* CFIS0073179
**ANALYSIS OF THE MARKET POTENTIAL FOR FRESH WATER
AQUACULTURAL PRODUCTS PRODUCED IN NEVADA**

GARRETT J R; TAYLOR R L; AGRI & RESOURCE ECONOMICS;
UNIVERSITY OF NEVADA, RENO, NEVADA. 89557.
Proj. No.: NEV00270 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 77 To 30 SEP 80

OBJECTIVES: Determine the cost and availability of byproduct food stuffs for feeding catfish and shrimp in Nevada. Estimate the demand for catfish, shrimp and plants produced in fresh water ponds. Estimate the marketing margins for fresh water products and estimate marketing constraints placed on fresh water products by the institutional trade.

APPROACH: Availability and costs will be estimated for byproduct feeds which prove feasible as shrimp and catfish food in a large scale pilot production study. Nevada brokerage firms, and if necessary California processing firms, will be surveyed to ascertain the possibility of marketing live shrimp. These firms will also be interviewed to determine existing marketing margins for different types of products handled by these firms. A similar procedure will be followed for catfish and freshwater plants that might be complementary to shrimp and catfish.

PROGRESS: 77/01 TO 80/09. Budgetary analysis of production costs of freshwater shrimp produced in 10 one-acre plots reflect a cost of \$2.23 per lb. live weight at production levels experienced in the experiment. (About 2,000 lbs. per acre.) Increased feeding levels and other management practices could possibly raise production to 3,000 lbs. or even 4,000 lbs. per acre. Production costs for these levels were estimated to be \$1.60 and \$1.31 per lb., respectively. Four marketing alternatives were considered: Whole live, whole fresh, fresh; headless and frozen headless. Processing costs for the first two alternatives were negligible, but both headless process required substantial capital investment and operating costs. Costs for processing 20,000 lbs. of live shrimp were \$7.79 for fresh headless and \$7.91 for frozen headless. Thus, at current production levels, total cost of producing fresh headless shrimp would be \$12.15 per lb. Even doubling the production

level to 40,000 lb. would only reduce the total cost per lb. of product to \$6.53--well above the current wholesale price of \$4.50. Production of live or fresh whole fresh-water shrimp does appear to be a viable pursuit for persons with a source of hot water providing they can develop a ready market for the product.

PUBLICATIONS: 77/01 TO 80/09
CNYEAGRAKC, C. 1979. Marketing Alternatives of the Grant Malaysian Prawn (*Macrobrachium rosenbergii*), M.S. Thesis, University of Nevada-Reno.

010.023* CFIS0083202
REARING BAIT FISH IN WESTERN NEVADA

TAYLOR R L; VETERINARY MEDICINE; UNIVERSITY OF NEVADA, RENO, NEVADA. 89557.
Proj. No.: NEV00388 Project Type: STATE
Agency ID: SAES Period: 01 OCT 78 To 01 OCT 83

OBJECTIVES: Determine the supply and demand for bait fish used in western Nevada waters. Develop techniques for culture of native minnows acceptable for use in these waters. Encourage development of private commercial operations for raising and selling the suitable species of bait fish.

APPROACH: Collection of adult fish will be made from local waters and a captive population established in the laboratory. Artificial and natural spawnings will be attempted. Egg and fry development stages will be identified and food preferences determined. Growth rates will be determined.

PROGRESS: 80/01 TO 80/12. Adult Lahontan Tui Chubs, *Siphateles bicolor oboeus*, obtained from Walker Lake, Nevada were successfully spawned both artificially and naturally. Spawning mate made of Spanish Moss were a satisfactory egg substrate although the development of fungus on some eggs was a common problem. About 50% of chubs fed trout meal and screened brine shrimp flakes for the first 21 days survived. After 21 days mortality was minimal for chubs fed live brine shrimp naupliae. Survival of newly hatched fish raised in a semi-natural pond environment and not fed appeared to be as good as those raised in troughs and fed artificial diets.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

010.024 CFIS0081145
**ECONOMIC IMPACTS OF THE 200-MILE LIMIT ON RURAL
NORTHEASTERN COASTAL COMMUNITIES**

GREENWOOD P H; INST OF NAT & ENV. RESOURCES;
UNIVERSITY OF NEW HAMPSHIRE, DURHAM, NEW HAMPSHIRE.
03824.
Proj. No.: NB00265 Project Type: BATCH
Agency ID: CSRS Period: 03 JAN 80 To 30 SEP 83

OBJECTIVES: Evaluate the economic impacts of extended fisheries jurisdiction on coastal communities with particular reference to opportunities for industrial and employment expansion.

APPROACH: The general conceptual framework will be benefit/cost analysis. Quantitative measures to be used include regression analysis, mathematical modeling and control methods. Data on current volume and industry capacity will be secured from completed and current studies of the fisheries industry. Survey methods will be used to determine managers' intentions with respect to expansion, location, marketing, etc., with the intent to develop a dynamic disequilibrium model of the American lobster fisheries which has the capacity to evaluate the economic impact of the managers' decisions.

PROGRESS: 80/01 TO 80/12. This project has produced deterministic projections of American lobster (*Homarus (Americanus)*) harvest, value and effort through 1999. Landings, which were 33.5 million pounds in 1979, are predicted to decline to 24.7

millinn pounds in 1999, a 26% decline. Real prices are predicted to rise 79% over this period. Effort, which is measured by the number of pots fished, are projected to increase 37%. Real revenue per pot is expected to fall 13%. Stochastic projections of harvest have also been produced; these indicate that little absolute confidence may be placed on the point predictions. Harvest and value projections under varying levels of fishing effort have been produced. The economic welfare consequences of varying the level of imports of lobster from Canada has been simulated. The qualitative conclusions which emerge from these exercises are not startling and include: a) restricting effort rewards both the industry and the consuming public, b) an increase in imports rewards the consuming public and penalizes the industry.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

010.025 CRIS0080876
ECONOMIC DESCRIPTION OF THE NEW JERSEY COMMERCIAL FISHING INDUSTRY

ROSSI D; BECK R; AGRICULTURE & MARKETING; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ02430 Project Type: STATE
Agency ID: SAES Period: 01 JAN 80 To 30 JUN 81

OBJECTIVES: Inventory and analyze economic conditions in the commercial fishing industry in New Jersey with a specific focus on landings, vessels, docking and processing facilities, and employment and income generated within the industry. Identify current problems and needs of the commercial fishing industry and evaluate critical areas for future research.

APPROACH: Develop an overview of the commercial fishing industry, four areas of concentration were defined: Commercial landings of fish at NJ ports; commercial fishing vessels registered to and owned by NJ residents; docking and processing facilities located in the state; and employment and income generated within the industry. Data from various secondary sources, personal interviews with fishermen, facility operators, and personnel from banks and local, state and federal governments will be used to describe and classify the various sectors of the industry. This information will also be used to identify the various sectors of the industry. This information will also be used to identify current problems and needs of the industry, evaluate critical areas for future research and identify gaps in existing data and potential sources of new data.

PROGRESS: 80/01 TO 80/12. Efforts on the first objective of developing an overview of the commercial fishing industry in New Jersey have focused collection and analysis of secondary data. The data time series data on the following types of information has been collated and preliminary analysis has been performed: quantity and value of annual landings in New Jersey ports by major species, county and type of gear; quantity and value of monthly landings by county; number and type of fishing gear, fishing craft and fishermen employed; number of and employment in wholesale establishments; number of, employment in and value of production of processing establishments; number and value of production of canned and industrial fishery product plants; and levels of various fishery price indices. Detailed primary data on port, processing and wholesaling facilities has been collected by the Center of Coastal and Environmental Studies at Rutgers and will be available to the researchers shortly. Various problems and needs of the N.J. commercial fishing industry have been reviewed and one, the economic interrelationships between this industry and related sectors, has been singled out for further study. A research proposal has been developed and submitted to the National Sea Grant Office for funding.

PUBLICATIONS: 80/01 TO 80/12

NO PUBLICATIONS REPORTED THIS PERIOD.

010.026 CRIS0078981
HUMAN ECOLOGY OF NEW JERSEY FISHERIES

MCCAY B J; ECOLOGY; RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY. 08903.
Proj. No.: NJ26501 Project Type: STATE
Agency ID: SAES Period: 01 MAR 79 To 30 APR 82

OBJECTIVES: Document the nature of the fisheries of Ocean and Monmouth Counties, N.J., providing data needed for fisheries management plans and for state government involvement in fisheries development. Generate and test hypotheses about the role of fisheries cooperatives in the state in helping fishermen manage both market and natural environmental relations. Provide a format through which fishermen and other members of the industry of university and governmental help desired.

APPROACH: The methods to be used are those of anthropology: informal and formal interviews with fishermen on the docks, in their homes, and on their boats. Data will be arranged on forms their results will be analyzed.

PROGRESS: 80/01 TO 80/12. Anthropological field interviewing and observations were completed in two commercial fishing communities, continued in a third, and begun in a fourth and fifth; archival and oral-historical research was undertaken. The findings have clarified the role of the producers' cooperatives in helping members mitigate certain economic problems inherent in the fresh-fish marketing system of the region. The cooperatives mimic government systems of limited entry and quota controls. The potentials and limits to regional cooperation among the cooperatives have also become clear. The findings also reveal great cultural as well as economic and technological changes in the fisheries over the past century, as illustrated by the industrialization of the menhaden fishing industry and the concomitant loss of the acceptability of menhaden as direct human food. Finally, an attempt to account for the persistent violation of fisheries laws led to recognition of the importance of social and political history, as well as economics and ecology, in generating behavioral and cultural patterns. This finding has redirected our efforts toward depiction of fisheries legislation as "social legislation," with markedly different costs and benefits for different social/technological groups. It also appears that the technology and economics of different fishery types plus a "culture of the commons" are more useful, for policy purposes, than ethnicity and other descriptors of the culture of commercial fishermen.

PUBLICATIONS: 80/01 TO 80/12
MCCAY, E.J. 1980. A Fisherman's Cooperative, Limited: Indigenous Resource Management in a Complex Society. Anthropol. Quart. 53:29-38.
MCCAY, E.J. In Press. Optimal Foragers or Political Actors: Ecological Analyses of a New Jersey Fishery. Amer. Ethnol.
MCCAY, E.J. In Press. Menhaden as Food and Fertilizer: A Footnote to the Social History of New Jersey's Fisheries. New Jersey History.

010.027 CRIS0081479
ECONOMIC IMPACTS OF THE 200-MILE LIMIT ON RURAL NORTHEASTERN COASTAL COMMUNITIES

CONRAD J W; AGRICULTURE & MARKETING; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-121508 Project Type: HATCH
Agency ID: CSRS Period: 03 MAR 80 To 30 SEP 83

OBJECTIVES: Evaluate the economic impacts of extended fisheries jurisdiction on coastal communities with particular reference to opportunities for industrial and employment expansion. Evaluate the degree to which expansion and growth of the offshore fishing industry will be able to absorb labor and capital from declining inshore fisheries.

APPROACH: Seafood processors will be surveyed to determine source of raw product inputs and market destination for processed output. Investment plans on Long Island will be examined within a regional context to determine economic viability. The Long Island finfishery will be studied to determine those vessel/gear/species combinations which will support future fleet expansion and absorb excess capacity from inshore fisheries.

PROGRESS: 80/01 TO 80/12. The theory of multiproduct production has been reviewed as well as the associated econometric techniques for the direct estimation of product transformation functions or the dual cost function. Seafood processing firms, which typically employ several inputs to transform finfish or shellfish into two or more final products, will be surveyed for data which will allow estimation of elasticities of substitution and transformation as well as economies of scale. These elasticity parameters will, in turn, allow estimation of the impacts of input and output price changes on the level of processing activity and employment within rural fishing communities.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

010.028 CEIS0082905
MANAGEMENT OF A MULTIPLE COHORT FISHERY: THE HARD CLAM RESOURCES IN GREAT SOUTH BAY

CONRAD J M; AGRI ECONOMICS; CORNELL UNIVERSITY,
ITHACA, NEW YORK. 14853.
Proj. No.: NYC-121384 Project Type: STATE
Agency ID: SAES Period: 01 APR 80 To 30 SEP 83

OBJECTIVES: Develop a multiple cohort bioeconomic model; apply that model to the hard clam resource of Great South Bay to determine optimal harvest and age distribution. Compare optimal harvests and age distribution to current harvest and estimates of standing stock and suggest policies for moving the resource toward the optimal age structure.

APPROACH: Construction a dynamic optimization model of a reasonably general form. Specify particular functional forms. Identify bioeconomic parameters from literature and data on the hard clam (Mercenaria, Mercenaria). Solve dynamic optimization problem for study-state equilibrium harvest and age structure.

PROGRESS: 80/01 TO 80/12. A general model of a multiple cohort (year, class) fishery was developed. Management rules and equations describing a steady-state optimum were derived from a discrete time control problem which maximized the present value of net revenues subject to spawning and recruitment constraints. Biological and economic information was collected on the hard clam fishery in Great South Bay on Long Island, New York. This information will be used to identify optimal cohort stocks and yields, and to make recommendations on resource management.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

010.029 CEIS0082906
COSTS AND RETURNS IN THE OTTER TRAWL FLEET ON LONG ISLAND, NEW YORK

CONRAD J M; AGRI ECONOMICS; CORNELL UNIVERSITY,
ITHACA, NEW YORK. 14853.
Proj. No.: NYC-121383 Project Type: STATE
Agency ID: SAES Period: 23 JUL 80 To 30 SEP 83

OBJECTIVES: Identify fixed and variable cost elements for alternative vessel classes in the Long Island trawler fleet and determine those investments and procedures capable of significant cost savings. Determine expected catch functions for major finfish species by alternative vessel class. Identify static, declining and expanding fisheries and simulate the profitability of a select set of vessel/gear/species

combinations.

APPROACH: Analysis of NMFS trip data on catch, area fished, ex-vessel price and operating cost. Develop probability distributions for catch of a particular species in a particular area and for ex-vessel price received by fishermen. Develop a stochastic simulation model to predict costs and returns per trip.

PROGRESS: 80/01 TO 80/12. A stochastic model has been developed to simulate costs and returns for commercial trawler vessels. A questionnaire was developed and pretested on seven fishermen from Shinnecock and Mattituck inlets on Long Island, New York.

PUBLICATIONS: 80/01 TO 80/12
NO PUBLICATIONS REPORTED THIS PERIOD.

010.030 CEIS0083455
MANAGEMENT ECONOMICS OF NEW YORK'S MARINE INDUSTRIES

CONRAD J M; AGRI ECONOMICS; CORNELL UNIVERSITY,
ITHACA, NEW YORK. 14853.
Proj. No.: NYC-121385 Project Type: STATE
Agency ID: SAES Period: 01 SEP 80 To 30 SEP 83

OBJECTIVES: To study the industries engaged in harvesting, processing, and marketing of fish shellfish. Develop research programs to improve the management of firms within seafood related industries. To evaluate resource management programs and their impact on marine industries in New York State.

APPROACH: Collection and analysis of available secondary data on the harvesting, processing, and marketing of fish and shellfish in New York City and Long Island. Develop models to simulate financial returns within the otter trawl fleet on Eastern Long Island. This will entail a stochastic simulation model which characterizes trip costs, fixed costs, and probability distributions for catch and price. Multi-input/multi-output production function analysis will be applied to the seafood processing sector. Bioeconomic modeling of the hard clam (Mercenaria mercenaria) in Great South Bay will pool existing biological data on growth, mortality, and fecundity, with economic data on costs and returns to determine optimal age structure and, sustainable yield from each cohort (or year class).

PROGRESS: 80/01 TO 80/12. Research has focused on the identification of (1) the major commercial fisheries in New York's marine district, (2) the trends in the amount and value of landings, and (3) the analysis of current and alternative management strategies and their impact on the industry.

PUBLICATIONS: 80/01 TO 80/12
CONRAD, J.M. 1980. New York's Marine Fisheries: Situation and Outlook. A.E. Ext. 80-29. New York Economic Handbook: Agricultural Situation and Outlook. Dept. of Agr. Econ., Cornell Univ., Ithaca, N.Y. pp. 127-34.

010.031 CEIS0084032
AN ECONOMIC ANALYSIS OF THE ATLANTIC COAST STRIPED BASS FISHERY

CONRAD J M; AGRI ECONOMICS; CORNELL UNIVERSITY,
ITHACA, NEW YORK. 14853.
Proj. No.: NYC-121339 Project Type: STATE
Agency ID: SAES Period: 01 MAR 81 To 30 SEP 84

OBJECTIVES: To analyze the direct and induced impacts of expenditures by commercial and sport fishermen seeking striped bass. To determine the value (net benefits) from programs or policies designed to increase the stock of striped bass.

APPROACH: Estimate the expenditures made by alternative classes of sport and commercial fishermen as well as the value added as the product moves through the various marketing channels to the

consumer. These expenditures will be introduced into a regional econometric model which will estimate total, (direct plus induced), dollar impacts. A bioeconomic model including both sport and commercial effort will be constructed where the willingness-to-pay on the part of sport fishermen, and the harvest cost of commercial fisherman are stock dependent. By varying the stock across biologically feasible limits we can assess the value of programs designed to increase striped bass populations.

010.032 CRIS0067638
DEVELOPMENT OF A FISH MARKETING PROGRAM

GOODRICH D C JR; AGRICULTURAL ECONOMICS; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-121381 Project Type: STATE
Agency ID: SAES Period: 01 APR 75 To 30 SEP 81

OBJECTIVES: Study the current economic situation in fin fish, shell fish, and fish product marketing and identify specific and important problems capable of treatment through marketing research.

APPROACH: Publications dealing with fin fish, shell fish, and fish product marketing will be reviewed. Discussions will be held with researchers at institutions which have had programs in fish marketing. Conferences will be held with leading fish industry participants; facilities and operations which they manage will be observed.

PROGRESS: 80/01 TO 80/12. Results of limited test marketing of five new minced fish/seafood products indicate the probability of commercial success. However, unit sales of each new product relative to volumes of similar or closely competing items in the test stores were influenced by low prices for the test products. If the hypothesized low acquisition cost of the principal marine ingredient in these products proved to be elusive, the encouraging test sales results would have to be reexamined. Survey interviews with selected wholesalers of fresh and frozen seafood in New York City's Fulton Fish Market yielded information about characteristics of the market and certain practices of its sellers. An estimated 70 wholesale enterprises operate in the market, about 20 percent fewer than 10 years ago. Most operate as corporations. Somewhat more than half of them handle only fresh product. Nearly as many offer both fresh and frozen. Less than 10 percent specialize in frozen product. The majority of wholesalers specialize in finfish (58 percent). The next largest group offers finfish and shell fish (30 percent) and the smallest number specialize in shell fish (12 percent). An average of 30 species of finfish and 8 species of shell fish are offered by each firm. The great majority of wholesalers carry product harvested by Long Island fishers. Less than 10 percent engage in foreign trade. More firms import than export product. A final publication is in preparation.

PUBLICATIONS: 80/01 TO 80/12
GOODRICH JR., D.C. and WHITAKER, D.H. 1980. Retail Market Tests of Frozen Prepared Minced Fish. A.E. Res. 80-4. Dept. of Agr. Econ., Cornell Univ., Ithaca, N.Y. 9 pp.
GOODRICH JR., D.C. and WHITAKER, D.H. 1980. Retail Market Tests of Canned Minced Fish. A.E. Res. 80-5. Dept. of Agr. Econ., Cornell Univ., Ithaca, N.Y. 6 pp.

010.033 CRIS0067224
THE IMPACT OF SALMONID INTRODUCTIONS ON NEW YORK FISHERMEN AND COMMUNITIES

BROWN T L; NATURAL RESOURCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147381 Project Type: STATE

Agency ID: SAES Period: 01 JAN 75 To 31 DEC 76

OBJECTIVES: Provide data on use and economic impact of salmonid fishing in New York. Provide a recreation facilities and services inventory of the Salmon River corridor, and identify areas of unmet recreation service demand.

APPROACH: Assist N.Y.S.D.E.C. in development of creel census methodology and computer analysis of census data. Gather economic impact data from businesses in the Salmon River corridor. Analyze state-wide fishing survey to determine current interest in salmon fishing.

PROGRESS: 79/01 TO 79/12. A study of riparian owners along New York's Great Lakes tributaries showed that the posting rate of private properties was similar to that for the rest of New York (42%). Two-thirds of the landowners studied would not sell a fishing easement to the State if requested to, primarily due to the "in perpetuity" clause of the easement rather than the price offered. Other options which would not foreclose upon future use of the property seemed more viable for increasing recreational fishing access. For example, 60% of these riparian landowners indicated a willingness to post "Fishing by Permission Only" signs if such signs were made available to them.

PUBLICATIONS: 79/01 TO 79/12
BROWN, T.L. and DECKER, D.J. 1979. Access to Great Lakes Salmonid Fishing via Private Lands: A Study of New York's Riparian Landowners. In Recreation Impacts: The Great Lakes Ecosystem. Ontario Research Council on Leisure.
SCHUMAN, S.P., BROWN, T.L. and EUTHEIMER, M.W. 1979. The Roles of Research and Extension Education in the Developing Lake Ontario Salmonid Fishery. Fisheries 4(3):6-8.

010.034 CRIS0078493
APPLICATION OF MANAGEMENT STRATEGIES TO THE MID-ATLANTIC EXTENDED JURISDICTION RECREATIONAL FISHERIES

WILKINS H T; EVERHART W H; NATURAL RESOURCES; CORNELL UNIVERSITY, ITHACA, NEW YORK. 14853.
Proj. No.: NYC-147329 Project Type: STATE
Agency ID: SAES Period: 01 JAN 79 To 10 SEP 83

OBJECTIVES: Determine the recreation management strategies applicable to the Mid-Atlantic extended jurisdiction recreational fisheries. Identify advantages and disadvantages of each strategy. Determine the attitudes of the managers, fishermen and Council members to the suggested strategies and the impacts on them and the fishery.

APPROACH: Review the literature on recreational strategies. Develop criteria to evaluate the advantages and disadvantages of each strategy and their impact on the fishery. Survey the managers, fishermen and Council members to determine the acceptability of the alternate strategies.

PROGRESS: 80/01 TO 80/12. Under the Fishery Conservation and Management Act of 1976 the Regional Fishery Management Councils must develop plans for managing each fishery in the 3-200 mile offshore zone. In the second year of this study over 1,300 marine recreational anglers using the 3-200 mile offshore zone were interviewed during May through October to determine their reasons for fishing and their reactions to four promising management options (regulations) identified in the first year of the study. The survey was conducted in New York and Virginia in conjunction with the National Marine Fisheries Service's national 1980 Marine Recreational Fishery Survey. The data from these two surveys are being analyzed for publication in 1981.

PUBLICATIONS: 80/01 TO 80/12
DAWSON, C.P. and WILKINS, B.T. 1980. Social Considerations Associated with Marine Recreational Fisheries Management. Marine Fisheries Review 42(12):12-17.

010.035* CRIS0079845
FEASIBILITY OF CAGED FISH CULTURE IN NORTH CENTRAL
OKLAHOMA FARM PONDS

MAUGHAN O E; BOWMAN D E; LANGSTON UNIVERSITY,
LANGSTON, OKLAHOMA. 73050.
Proj. No.: ORLX-5085-15-5 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 79 To 30 SEP 84

OBJECTIVES: Study production and cost of caged fish in small ponds in Central Oklahoma, investigate and test the feasibility of caged fish in a normal farm or ranch operation.

APPROACH: Channel catfish will be grown in cages and fed pellets contng 30-35% protein, and Tilapia will be grown in cages and fed pellets contng 25-30% protein. Oxygen and temperature will be measured daily at feeding time to develop a profile as if they relate to growth. Record as to marketing and home consumptions and and cost will be kept to determine return on investment.

PROGRESS: 80/01 TO 80/12. Cage culture appears to be economically feasible in small (less than 2.0 ha) farm ponds and has potential for generating a small additional source of income (estimated to be \$744.00/ha) and/or producing low cost food for the farm family. Ponds that are clear (depth of visibility greater than 1.0 m) and shallow (depth less than 1.0 m over half of the pond) should probably not be used for cage fish culture unless aquatic vegetation control is implemented. Channel catfish fingerlings should be 150 to 200 mm in total length when stocked if a large proportion of marketable size fish are to be produced in one year in Oklahoma. Tilapia appear to stimulate channel catfish feeding and therefore increase production. The optimum ratio appears to be a very high ratio of catfish to tilapia. The optimum density of fish per cage appears to be about 400 fish per cubic meter with an anticipated harvest weight of 0.45 kg.

PUBLICATIONS: 80/01 TO 80/12

GEBHART, G.E. and MAUGHAN, O.E. 1980. Feasibility of Mixed Cage Culture of Tilapia and Channel Catfish. Inland Commercial Fisheries Association. 14 March 1980, Nashville, TN.

GEBHART, G.E. and MAUGHAN, O.E. 1980. Cage Fish Culture in Small Farm Ponds in Oklahoma. Oklahoma Academy of Science, November 14, 1980. Norman, Oklahoma.

010.036 CRIS0084107
AN ECONOMIC EVALUATION OF THE RECREATIONAL SALMON
FISHING IN THE KENAI/RUSSIAN RIVER REGION

GIBBS K C; RESOURCE RECREATION MANAGEMENT; OREGON
STATE UNIVERSITY, COEVALIS, OREGON. 97331.
Proj. No.: OEB-FR-159-B Project Type: STATE
Agency ID: OCI Period: 01 NOV 80 To 01 NOV 81

OBJECTIVES: Develop theoretical model for estimation of outdoor recreation demand to be applied to Salmon sport fishing. Estimate the magnitude and distribution of salmon sport fishing on Kenai and Russian Rivers. Estimate the economic demand for, and net economic value of, recreational Salmon fishing on Kenai and Russian Rivers.

APPROACH: Fishermen will be contacted personally and then a follow-up mailed survey will be sent to obtain information enabling the estimation of their effort, location, distance travelled, time spent fishing, success, etc. The methodology developed will then be used to estimate the demand for and net economic value of sport fishing in these two rivers.

010.037 CRIS0074229
AN ANALYSIS OF NEW ENGLAND FISHBERRIES INVESTMENT
BEHAVIOR

BOCKSTAEEL N E; RESOURCE ECONCMICS; UNIVERSITY OF
RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: RI00154 Project Type: BATCH
Agency ID: CSRS Period: 17 OCT 77 To 30 SEP 80

OBJECTIVES: Develop and extend current methodology for analyzing fishery investment behavior and estimate empirical relations of New England fishing firms' investment. The results will be used to assess the likely behavior of domestic fishermen under different scenarios regarding extended jurisdiction.

APPROACH: Multinomial logit analysis will be used to estimate the likelihood that an individual facing a set of discrete alternatives will choose a particular alternative as a function of the characteristics of the alternatives and the characteristics (e.g. socioeconomic) of the individual.

PROGRESS: 77/10 TO 80/09. A sequential multinomial logit model was developed to model fishery investment decision making, relating the probability of choosing different investment alternatives to the expected revenues and costs associated with these options. A two stage decision on optimal fishery of participation and optimal capital stock was estimated and was modified to reflect the fact that fishermen may systematically prefer one type of operation over another even when returns are equal. The model predicted well but indicated substantial inertia or the part of fishermen. A more successful specification of the model reflected fishermen's adverse reaction to risk. The model's value is the ability to predict participation rates and fleet composition in various fisheries. The implications for management are important. Regulations aimed at restricting effort will be self defeating if they reduce uncertainty and are not coupled with entry limitations. Additionally, large incentives must be provided to encourage fishermen to enter underutilized fisheries in order to overcome both inertia and the high level of uncertainty in these fisheries. Results suggest that information and training aimed at lowering the resistance to new fisheries has a potentially higher return to management than increasing direct economic incentives in these underutilized fisheries

PUBLICATIONS: 77/10 TO 80/09

NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

010.038* CRIS0065044
ECONOMICS OF SALMONID AQUACULTURE IN NEW ENGLAND

GATES J M; RESOURCE ECONOMICS; UNIVERSITY OF RHODE
ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: RI00144 Project Type: BATCH
Agency ID: CSRS Period: 01 JUL 74 To 30 SEP 80

OBJECTIVES: Compile and evaluate cost data associated with construction and operation of the system to determine capital requirements and production costs. evaluate potential economic gains for vertical integration in production (hatching-smolt production and grow out) systems as compared to separate or non-integrated systems. Project capital requirements and cost conditions to establish economically feasible commercial size operations and evaluate economics of integrated management of a joint commercial/sport fishery program based on a hatchery release program.

APPROACH: Study will be in 2 phases; economics of a pilot aquaculture system utilizing water re-use techniques would be analyzed. This would provide a firm data base for cost parameters; analysis of management measures for an integrated commercial/sport fishery program. Once capital requirements and production costs for the integrated system are known and evaluation will be made of the integrated and non-integrated system to determine any economic gains associated with each respective system. For analysis the integrated system will be broken down into two operations: hatching and smolt production; grow out. Capital requirements and production costs associated with each operation will be evaluated and projected to establish economically feasible full scale commercial operations.

PROGRESS: 80/01 TO 80/12. A polyperiodic or dynamic linear programming model was used which includes the age/size class structure of fish stocks. It also includes size specific "treatment" effects (such as thermal controls) on growth rates. It also includes optimum marketing and product possibilities. Decisions optimized over time include (1) the number of fish of each size to be cultured, (2) the temperature(s) at which to culture them, (3) the number of fish of each size to be harvested, (4) the size dependent products to produce, and (5) the number of recruits to purchase. The model was applied to Atlantic salmon and to salmon culture in a water reuse system. Marginal returns to risk ranged from 5 to 237% depending on species, discount rate, and the sensitivity analysis assumptions. The marginal return to risk is after all costs, including the opportunity cost of capital (varied from 10% to 30%). It is a measure of pure profit or return to marginal risks associated with the enterprise.

PUBLICATIONS: 80/01 TO 80/12

GATES, J.M., MACDONALD, C.R. and POLLARD, H.J. 1980. Salmon Culture in Water Reuse Systems: An Economic Analysis. Contribution No. 1853, RI Agricultural Experiment Station, URI, Marine Technical Report 78.

POLLARD, B.J. 1980. Optimizing the Production of Atlantic Salmon in Water Reuse Systems, M.S. Thesis.

010.039 CRIS0083321
ECONOMIC IMPACTS OF THE 200-MILE LIMIT ON RURAL
NORTHEASTERN COASTAL COMMUNITIES

GATES J M; RESOURCE ECONOMICS; UNIVERSITY OF RHODE
ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: RI00157 Project Type: BATCH
Agency ID: CSRS Period: 19 FEB 81 To 30 SEP 83

OBJECTIVES: Evaluate the degree to which expansion and growth of the offshore fishing industry will be able to absorb labor and capital from declining inshore fisheries.

APPROACH: The otter trawl fleet of New England will be studied. The fleet will be stratified by vessel size and possibly by port and for each strata a representative vessel or firm will be modelled. NMFS data on catch statistics by area, gear, season and financial records will be used. A linear programming model of each representative vessel will be constructed based on alternative objective functions such as maximum annual gross stock, maximum annual return to captain and maximum return to vessel owner. A systematic procedure (linear programming) will be developed by which rational foreign fee schedules could be approximated for such species as squid, whiting, mackerel, other hakes and butterfish inclusive of associated by-catches.

010.040 CRIS0071965
SOUTHERN NEW ENGLAND ECONOMIC IMPACT PROJECT

GRAGALUNAS T A; RESOURCE ECONOMICS; UNIVERSITY OF
RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: RI00152 Project Type: BATCH
Agency ID: CSRS Period: 20 DEC 76 To 30 SEP 80

OBJECTIVES: The level, composition & distribution of population & economic activity in the Southern New England Marine Region (SNEMR) have changed considerably since the last major socio-economic review of the region was reported (1967). Several major marine-related developments have been proposed for the near future. Examine the economic structure & importance of marine-oriented activities in the SNEMR; develop an economic framework, based on an interindustry or input-output approach which traces dollar flows of inputs & outputs among economic sectors of the economy; to assess the major economic and socio-economic changes that have taken place since 1976.

APPROACH: A questionnaire will be used to cover intermediate transactions with all marine sectors within the SNEMR & with "all other sectors"; sales by each sector to find demand within the region; net exports. Secondary data sources will be used also.

PROGRESS: 76/12 TO 80/09. The purpose of this project was to develop an input-output model which could be used to estimate the economic impacts of proposed marine-related policies or developments on the Southern New England Marine Region. Data from 390 interviews with marine establishments and from secondary sources were used to construct an input-output table with 20 industries. The marine industries in the model cover five categories of activity: commercial fishing, tourism, manufacturing, marine military, and research and education. The results indicate that in 1976, marine activity accounted for about \$4 billion of output and over 65,000 workers, with shipbuilding being the largest single employer. In the first phase, Type I and Type II output and income multipliers were estimated for each industry. Type I multipliers ranged from 6.1 to 1.07 and Type II from 8.6 to 1.51. Employment multipliers were estimated in the second phase of the study and ranged from 1.07 to 4.8 for the Type I and from 1.48 to 9.8 for the Type II multipliers. Those individuals concerned with developing policies for use of the ocean (e.g., the formulation of fisheries management plans) or for evaluating proposed developments often want to know the likely impact of the policy or development on the regional economy. The results of this study provide a tool which can be used to assess regional economic effects of marine-related decisions.

PUBLICATIONS: 76/12 TO 80/09
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

010.041 CRIS0076590
EFFECTS OF THE TAX REFORM ACT OF 1976 ON NEW ENGLAND
VESSEL OWNERS AND CREW

HOLMSEN A; RESOURCE ECONOMICS; UNIVERSITY OF RHODE
ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: RI00138 Project Type: STATE
Agency ID: SAES Period: 01 JUL 78 To 30 SEP 80

OBJECTIVES: The economic impact of the Tax Reform Act of 1976 on vessel owners and crew for different size vessels and different lays for the five coastal New England states will be determined. The confusion that exists in regard to interpretation and compliance with the Act will be studied and also the significance of the changes in the Capital Construction Fund by the Tax Reform Act.

APPROACH: Information will be obtained from the Internal Revenue Service, The Social Security Administration, and the Financial Assistance Division of the National Marine Fisheries Service. Primary data will be obtained from a sample of New England vessel owners, stratified by crew size, lay onboard and home state.

010.042 CRIS0068087
ECONOMIC ANALYSES OF FISHERIES MANAGEMENT ISSUES
ARISING FROM EXTENDED JURISDICTION OF NEW ENGLAND

BUEHT D L; BOCKSTAELE N E; RESOURCE ECONOMICS;
UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND.
02881.
Proj. No.: RI00136 Project Type: STATE
Agency ID: SAES Period: 01 JUL 75 To 30 JUN 82

OBJECTIVES: Develop methodologies useful for the analysis of policy issues arising from extended jurisdiction; provide information for U.S. policy decisions regarding the management of foreign effort in New England fisheries; estimate the investment response of the New England fishing industry to alternative foreign effort management schemes; provide guidance as to informational needs for improved fisheries management decisions; provide

estimate of the benefits and costs of alternative management strategies and the distribution of these benefits and costs between producers and consumers.

APPROACH: Analytical models of New England fisheries will be developed to provide the bases for evaluations of alternative management strategies. Econometric techniques will be utilized for the estimation of the parameters of the models and optimization techniques including dynamic programming and discrete time optimal control programming will be used to obtain policy implications for U.S. fisheries management off New England.

PROGRESS: 79/01 TO 79/12. This project was intended to support research designed to develop and apply economic methodologies useful for assessing the management of domestic fisheries under the Fisheries Management and Conservation Act of 1976 (FCMA). Several conceptual papers have been published or are under review dealing with welfare theory issues as applied to fisheries management problems. The work in these papers, e.g., the evaluation of consumer surplus in a multi-market framework, can be extended to many problems in resource economics. The project also has resulted in numerous research papers, publications and theses analyzing the market structure of the fishing industry; international competition and subsidies; the demand for groundfish; and public policy issues arising from the enactment of the FCMA. Individual publications have been listed in prior progress reports. There has been a change in personnel and a change in the issues of interest to researchers and public officials. Therefore this project is being terminated.

PUBLICATIONS: 79/01 TO 79/12
NO PUBLICATIONS REPORTED THIS PERIOD.

010.043 CRIS0083490
AN ECONOMIC ANALYSIS OF DECISION MAKING AND POLICY FORMULATION

SUTINEN J G; RESOURCE ECONOMICS; UNIVERSITY OF RHODE ISLAND, KINGSTON, RHODE ISLAND. 02881.
Proj. No.: RI00160 Project Type: STATE
Agency ID: SABS Period: 01 AUG 80 To 30 SEP 82

OBJECTIVES: To evaluate policy formulation processes developed by Regional Fisheries Management Councils (RFMC) and recommended to the Department of Commerce (DOC) as mandated by the Fisheries Conservation and Management Act (FCMA). Hypotheses to be tested are the more complex the fishery, the greater the informational needs and decision-making costs for the councils; the more complex the fishery, the narrower the range of informational concerns the RFMC can have; the greater the reliance on mutual-partisan-adjustment, the greater the amount of information on economic, social, and ecological issues which will be forthcoming; the more councils rely on mutual-partisan-adjustment the greater the delay in implementing the management plan; the greater the delay in implementing plan, the greater the decision costs for the DOC; the greater the potential for such costs, the higher the probability of conflict between the RFMC and the DCC.

APPROACH: Specialists in marine affairs, economics, sociology, and public administration will gather test data from six RFMC's, to study approaches to optimum yield, fishery complexity, information availability, weighting of decision factors.

010.044 CRIS0059426
ECONOMICS OF THE COMMERCIAL FISH INDUSTRY

GRIFFIN W L; LACEWELL R D; NICHOLS J P; AGRICULTURAL ECONOMICS; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX01866 Project Type: BATCH

Agency ID: CSRS

Period: 30 MAR 71 To 30 SEP 80

OBJECTIVES: For major fish and shellfish species. Establish production and processing requirements. Evaluate economic feasibility of alternative management programs. Estimate impact of environmental change. Evaluate the structure, performance and potential of the marketing sector.

APPROACH: Using breakeven analysis, minimum levels of production or processing required for alternative investment levels will be identified. An optimum resource mix in production and processing activities will be defined by marginal analysis. Large increments of increased investment and economic feasibility of experimental practices will be evaluated by budgetary analysis. A model will be developed to evaluate the feasibility of adopting new technology, determine economies of size and estimate the impact of specific changes in model variables. Questionnaires and surveys will be used to evaluate marketing aspects of major fish and shellfish species.

PROGRESS: 79/01 TO 79/12. The general purpose of this study is to initiate and perform economic evaluations relative to production, processing and marketing activities involving selected major fish and shellfish species which are found in the waters within and adjacent to Texas. A simulation model of the pink shrimp fishery was completed and proposed policy alternatives by the Gulf of Mexico Fishery Management Council were evaluated. Utilizing an economic welfare framework, almost every alternative appeared inferior to the simulation reflecting the status quo. The only exception was the simulation which attempted to maximize annual rent. Results of the study were utilized in the shrimp management plan. Closure of the Texas spring season was evaluated using an econometric model which resulted in a short run gain of \$10 million to gulf shrimpers at a cost of up to one million dollars to bay shrimpers. A study of the variation in dockside prices among ports in Texas was completed and results indicate a significant difference among ports depending on the type of pricing mechanisms used. A pack-out system with a telephone auction reported prices may be 10% higher than in other ports which use a box weight method.

PUBLICATIONS: 79/01 TO 79/12

BLOM, V., GRIFFIN, W. and NICHOLS, J. 1978. "Catch-Effort and Price-Cost Trends in the Gulf of Mexico Shrimp Fishery: Implications of Mexico's Extended Jurisdiction." Marine Fisheries Review, Vol. 40, NO. 7, August.
NICHOLS, J., GRIFFIN, W. and BLOM, V. 1978. "Economic and Production Aspects of the Gulf of Mexico Shrimp Fishery." Chapter in Drugs and Food for the Sea: Myth or Reality? The University of Oklahoma Press, Norman, Oklahoma, pp. 301-316.
GRANT, W.E. and GRIFFIN, W.L. 1979. "A Bioeconomic Model of the Gulf of Mexico Shrimp Fishery." Trans. Am. Fish. Soc., 108:1-13.
NICHOLS, J.P. and JOHNSTON, L. 1979. "The Influence of Alternative Pricing Methods in Exvessel Shrimp Prices, Department of Agricultural Economics", Texas A and M University, DIR 79-1, SP-8, August.
SWARTZ, A.N. and GRIFFIN, W.L. "The Effect of an Increase Price of Diesel Fuel on Gulf Shrimp Vessel Operations, DIR 79-1, SP-4, pp. 1-8.

010.045 CRIS0079265
ECONOMICS OF THE COMMERCIAL FISH INDUSTRY

GRIFFIN W L; NICHOLS J P; SWARTZ A N; AGRICULTURAL ECONOMICS; TEXAS A&M UNIVERSITY, COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06404 Project Type: BATCH
Agency ID: CSRS Period: 17 JUL 79 To 16 JUL 83

OBJECTIVES: For major fish and shellfish species, establish production and processing resource requirements, evaluate economic feasibility of alternative management programs, estimate economic effect on production and marketing of regulatory or biological environment, and evaluate structure, performance and potential of the marketing sector.

APPROACH: Budget will be constructed on an annual basis allowing breakeven analysis to determine minimum level of production and investment. Case studies and systems analysis will be employed to conduct problem oriented research for production, processing and marketing. Economic feasibility of management programs and methods for employing nontraditional species will be established by budgetary analysis. Economic response of output per vessel will be evaluated utilizing price elasticities of demand and budgetary analysis. Initial analysis of the marketing phase of commercial fish industry will be to differentiate and examine distribution channels of selected fish and fish products.

PROGRESS: 80/01 TO 80/12. A bio-engineering-model computer was developed that incorporates three water quality parameters into growth of shrimp: salinity, temperature and dissolved oxygen. Cost and return budgets were developed for bay boats in Texas. A decision not to fish or being excluded for some other reason from the spring season would cost the bay fisherman slightly less than \$2000 per boat. A mathematical model representing the movement and survival of white shrimp (*Peneaus setiferus*) in Galveston Bay was developed. A mathematical model representing the growth, movement and survival of brown shrimp (*Peneaus aztecus*) in Galveston Bay was developed. A simulation model was adapted to the Texas shrimp fishery and used to evaluate economic impacts of management policies for the Texas shrimp fishery and the conflict between users. Closing the offshore of Texas and landing all shrimp has an estimated net economic benefit to shrimping of \$20.29 million. Landing increased by 8.61 million pounds, culls reduced by 6.6 million pounds, and full time craft equivalence increase 280. The monthly demand by size of shrimp, within the range of data, is highly inflexible and demand for large shrimp is very high relative to other sizes. The following microcomputer programs on firm decision-making are now available to vessel owners: Motor vehicle cost analysis; Vessel cost analysis; Vessel fuel cost analysis; Marine loan analysis; Advances program; and Decision to fish analysis.

PUBLICATIONS: 80/01 TO 80/12

- WARREN, J.F. and GRIFFIN, W.L. 1980. Costs and Returns Trends in the Gulf of Mexico Shrimp Industry, 1971-1978. *Marine Fisheries Review*, 42(2):1-7. February.
- EIXON, R.F., BANLON, R.T., GILLEPSPIE, S.M. and GRIFFIN, W.L. 1980. Squid Fishery in Texas: Biological, Economic, and Marketing Considerations. *Marine Fisheries Review*, 42(7-8):44-50. July-August.
- SWARTZ, A.N. and ADAMS, C.M. 1979. The Economics of Rockport, Texas Bay Shrimping Vessels DIF 79-1, staff Paper No. 6. Department of Agricultural Economics, IAES, TAMU, August.
- NICHOLS, J.P. et. al. 1980. Marketing Alternatives for Fishermen. Texas A and M University, Sea Grant College Program, TAMU-SG-80-204. May. pp.2-6.
- ADAMS, C.M., GRIFFIN, W.L., NICHOLS, J.P. and BRICK, R.E. 1980. Application of a Bio-Economic-Engineering Model for Shrimp Mariculture Systems, *Southern Journal of Agricultural Economics*, 13(1). July.

010.046 CRIS0068760
ASSESSMENT OF COASTAL RECREATION RESOURCES

DITTON R B; RECREATION & PARKS; TEXAS A&M UNIVERSITY,
COLLEGE STATION, TEXAS. 77843.
Proj. No.: TEX06073 Project Type: EATCB
Agency ID: CSRS Period: 24 JUL 75 To 30 AUG 85

OBJECTIVES: To establish the extent, nature and distribution of coastal recreation participation by regional and statewide populations. To describe coastal recreation participants on the basis of their socio-economic characteristics, boat equipment, reasons for participation and levels of satisfaction. To identify the economic impacts generated by coastal recreation participants on regional economics and to develop a series of management case studies which may be useful in recognizing and reconciling coastal use

conflicts.

APPROACH: Two area wide surveys of the boat fishing population will be made to collect the needed data. One survey will focus on the 7 county Houston-Galveston-Texas City SMSA while the other will be statewide. A pretest will be conducted prior to each survey. Data collected will be analyzed using the SPSS and SAS programs available at the TAMU data processing center. Resource management implications of the collected data will be developed in a series of managerial case studies.

PROGRESS: 80/01 TO 80/12. In late 1979 we began a two year study of the statewide distribution of saltwater boat fishermen and their fishing and socio-economic characteristics with supplemental funding from the TAMU Sea Grant Program. In early 1980 a pilot study was conducted to validate the methodology and survey instrument. Using a screening phone interview and subsequent mail questionnaire with a stratified sample (coastal and non-coastal) of boat fishermen, our response rate was 74%. Pretest findings revealed that over 2/3 of the coastal boatowners used their boats for fishing in the past year. Of those coastal boatowners that fished, over half fished freshwater only. Slightly more than 47% of the coastal boat fishermen fished in Texas' bays or in offshore waters. Thirty-three percent of the sampled 455 coastal boatowners were saltwater fishermen. Fishermen were not as prevalent in the inland strata of owners. Although 60% of the inland boatowners used their boat to fish within the past year, less than 7% fished saltwater. Statewide, we found that 63% of all boat owners used their boats for fishery purposes while only 14% used their boats to fish in saltwater. Based on the pretest we made some modifications in an instrumentation. For the main wave of the study, we made 5,500 phone calls to locate 1,264 saltwater fishermen. Of these 859 or 68% responded to our mail questionnaire.

PUBLICATIONS: 80/01 TO 80/12

- GRAEFE, A.R. 1980. The Relationship Between Level of Participation and Selected Aspects of Specialization in Recreational Fishery. Ph.D. Thesis. Texas A and M Univ., College Station. 155 pp.
- DITTON, R.B., GRAEFE, A.R. and LAPOTKA, G. 1980. Economic Impacts of Recreational Boat Fishing in the Houston-Galveston Area of the Texas Coast. TAMU-SG-80-206. Texas A and M Univ. Sea Grant Program, College Station.
- DITTON, R.B., GRAEFE, A.R. and FELLER, A.J. 1980. Predicting Marine Recreational Fishing Patterns from Boat Characteristics and Equipment. *Transactions of the American Fisheries Society* 109:644-648.
- DITTON, R.B. 1980. The Buffalo National River Recreation Study: Year One. Tech. Rept. Prepared for the Office of Natural Res., Southwest Region, Nat. Park Serv., Santa Fe, New Mexico. 115 pp.
- EEDNAEZ, P. 1980. An Analysis of Use and User Characteristics at Padre Eallli County Park on Padre Island (Texas). Prof. Paper, Dept. of Rec. and Parks, Texas A and M Univ., College Station. 63 pp.

010.047 CRIS0073656
ECONOMIC ANALYSIS OF ALTERNATIVE VIRGINIA COASTAL
WETLANDS POLICY

BATIE S S; SEABMAN L A; LONG E F; AGRICULTURAL;
VIRGINIA POLY INST, BLACKSBURG, VIRGINIA. 24061.
Proj. No.: VA-0612325 Project Type: EATCB
Agency ID: CSRS Period: 04 OCT 77 To 30 JAN 80

OBJECTIVES: The current market situation of wetlands, determine motivations of owners of wetlands, identify the current and future services provided by wetlands, develop a framework for determining trade-off values between wetland services and estimate the values identified, and analyze existing and possible public policies.

APPROACH: Two or three Virginia counties will be selected. Necessary market and use information will be obtained from tax and deed records, personnel interviews and surveys. Technical data will be obtained from secondary data sources and will provide the data necessary for economic analyses.

PROGRESS: 79/01 TO 79/12. This project, which has as an objective the economic analysis of alternative management strategies for marine wetlands has resulted in first, a critique of previous attempts to provide economic values of natural coastal marine wetlands. Also, the current market situation with respect to Virginia wetlands has been identified by analyzing present ownership patterns, identifying present wetland use, and determining the value of past market sales. Present owners of wetlands have been surveyed as to their motivation for ownership of wetlands and their expectations of future wetlands exchange values and future use. A framework has been developed for determining the tradeoff values between the various services provided by wetlands. Economic values have been estimated for coastal wetlands services as (a) inputs in oyster production (b) inputs into residential housing in Virginia Beach, Virginia, (c) inputs into recreational lots in Accomack County, Virginia, (d) inputs in erosion control, and (e) inputs in nonpoint pollution control. Alternative management strategies investigated include the current system of permitting, zoning, tax and subsidy programs, and transferable development rights.

PUBLICATIONS: 79/01 TO 79/12

- SHABMAN, L.A. and BERTELSON, M. 1979. The development value of natural coastal wetlands: a framework for analysis of residential values. Land Economics. Vol. 55 (1) Feb. (Also published as Sea Grant Project Paper VPI-SG-77-08).
- PARK, W.M. and BATTIE, S.S. 1979. Methodological issues associated with estimation of the economic value of coastal wetlands in improving water quality. Sea Grant Project Paper VPI-SG-79-09.
- PARK, W.E. and BATTIE, S.S. 1979. A stochastic methodology for estimating the value of coastal wetlands in controlling nonpoint pollution. Abstracted in Am. Journ. of Agric. Econ.

010.048 CRIS0065833
CHARACTERISTICS, PREFERENCES, AND ATTITUDES CONCERNING PRIVATE FEE-FISHING OPERATIONS

LACKEY E T; GARLING D L; FISBERIES & WILDLIFE; VIRGINIA PCLY INST, BLACKSBURG, VIRGINIA. 24061.
Proj. No.: VA-0613234 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 74 To 31 OCT 79

OBJECTIVES: Determine selected demographic and other characteristics of anglers on selected fee-fishing operations in Virginia, determine and rank important factors affecting the perceived quality of a fishing experience on selected fee-fishing operations in Virginia, develop methodology for predicting man-days of use accruing to selected fee-fishing operations in Virginia. Test the above methodology as to its utility as a predictive tool.

APPROACH: Survey questionnaire to selected fee-fishing operations in Virginia. Regression analysis, linear programming, or simulation for developing predictive methodology, Validation through additional survey work.

PROGRESS: 74/07 TO 79/10. Research and survey resulted in publications which will aid the fee-fishing operator in establishing an economically viable operation through use of a formal planning process and adoption of sound management objectives and techniques. Procedures for economic and biological feasibility studies of proposed fish culture operations were described and used to evaluate commercial catfish culture and stocking stripped bass in fee-fishing ponds. Both are impractical in Virginia because of the short growing season (catfish) and poor survival and catchability (stripped bass). Three strains of channel catfish for fee-fishing pond stocking programs (Wild Lake Erie and Ohio River, and pond-reared Alabama) were

evaluated. Wild Lake Erie fish out-performed Wild Ohio River and pond-reared Alabama catfish. Pond stocking programs were described and commercial fish sources identified. Surveys of fee-fishermen preferences indicated they place higher value on environmental quality, manager attitude and companionship than on catch in the fee-fishing experience. Commercial aquaculture enterprises in Virginia were surveyed. Existing commercial operations are small but well established and profitable. Developing mariculture and fee-fishing establishments have the highest potential for expanding aquaculture in Virginia.

PUBLICATIONS: 74/07 TO 79/10

- ASHLEY, K. W. 1979. Use of silver nitrate marking and physiological markers for differentiating geographical stocks of channel catfish, *Ictalurus punctatus*. M.S. Thesis, VPI&SU, Blacksburg, Virginia. 65p.
- GARLING, D. L., JR and HELFELICH, L.A. 1979. Planning for commercial aquaculture. Virginia Cooperative Extension Service, VPI&SU. MT12B. 9 p.
- GARLING, D.L., JR. LACKEY, E.T., and SAUL, G. E. 1979. Use of selected strains of commercially available channel catfish in an intensively fished lake. NOAA 79/3-250-R. 23 p.

010.049 CRIS0078496
ECONOMIC PROFILE & REGIONAL ECONOMIC IMPACTS OF THE ALASKA SHELLFISH INDUSTRY

BUTCHER W R; PETRY G B; BUTEAU J; AGRI ECCNOMICS; WASHINGTON STATE UNIVERSITY, PULLMAN, WASHINGTON. 99164.
Proj. No.: WNP00436 Project Type: STATE
Agency ID: SAES Period: 01 OCT 78 To 30 SEP 80

OBJECTIVES: Determine the economic linkages (purchases and sales) between harvesters of Alaska shellfish and other sectors of the Alaska, Washington and Oregon state economies. Determine the economic linkages (purchases and sales) between the processors of Alaska shell fish and other sectors of the Alaska, Washington and Oregon economies. Incorporate the sectors primarily connected to the shellfish fishery into revised state economic input/output models and estimate economic impacts of potential permanent changes in the amount of fishing stocks available to the industry.

APPROACH: Available data on costs will be supplemented with data on expenditure patterns obtained by interviews with individual fishermen and by meeting with representative groups. Expenditure data will be used to form new detailed shellfish sectors for Alaska and Washington I/O models. Effects of fishery development and management policies will be traced through to calculate economic impacts.

PROGRESS: 78/09 TO 80/09. Data on shellfish harvesting costs, obtained from a previous study, were revised and recategorized by input supplying industry, as well as by subfleet and fishery being harvested. These data were inserted in an updated Alaska-Washington interregional (interstate) input/output model. Estimates of impacts throughout the Alaska-Washington economy that would follow from changes in the shellfish industries' deliveries to final demand varied only slightly. However, the share gained by Alaska households ranged from 0.44 for Alaska-based crab harvesters to 0.03 for Washington-based crab vessels. Washington always realizes considerable gain from expansion of Alaska shellfish harvesting, even if the harvests are carried out by Alaska-based vessels and the catch is processed through Alaska-based plants.

PUBLICATIONS: 78/09 TO 80/09
NO PUBLICATIONS REPORTED FINAL REPORT PERIOD.

REGULATION OF WISCONSIN'S LAKE MICHIGAN COMMERCIAL FISHERIES

BISHOP R C; AGRICULTURAL ECONOMICS; UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN. 53706.

Proj. No.: WIS02278

Project Type: STATE

Agency ID: SAES

Period: 01 JUL 76 to 31 AUG 78

OBJECTIVES: Phase I (1975-6) - Formulate an issue-oriented overview of Wisconsin Great Lakes Commercial Fisheries. Phase II (1976-7) - Complete a data base on Wisconsin's Great Lakes commercial fishermen which can be used to analyze the potential impacts of alternative forms of fishery regulation. Emphasis is placed on effects of fishery regulation on the fishing industry, consumers and society as a whole.

APPROACH: Phase I - Develop a socio-economic profile of Wisconsin's commercial fishermen from primary and secondary sources. Phase II - Use profile data base to investigate impacts from PCB contamination, forms of limited entry and other types of fishery regulation.

PROGRESS: 75/09 TO 78/08. The first step in the project was to clearly identify the conceptual framework to guide the study. Using welfare theory we concluded that the role of the economist should be to identify major potential impacts of alternative policies on consumers, commercial fishers, sports fishers, and others. Although some attention was given to consumers and recreationists, the most complex impacts of commercial fishery regulation fall on the commercial fishers and most of our work focused on this group. Two major data sources were utilized. One was records of the Wisconsin Department of Natural Resources, which contain much detailed information on individual fishing operations. These data were organized and analyzed for publication. They also provided a basis for developing a stratified sample of nearly 100 commercial fishermen of Wisconsin's Lake Michigan. A total of 93 personal interviews were completed covering a wide range of topics including fishing history, costs, attitudes concerning current policy issues, the economic effects of fishery regulations, job mobility, and other socio-economic aspects of commercial fishing. Results of the study are being made available to public decision makers in published form and on a personal basis. In addition, previously unavailable information on the fisheries and Wisconsin's experiences in fisheries management are now available to a broad audience of citizens, other economists, and fishery scientists through project publications.

PUBLICATIONS: 75/09 TO 78/08

BISHOP, R.C. and OTHERS. 1978. "Wisconsin's Limited Entry Experience." National Workshop on Limitation of Entry. Univ. of Wash., May 15-18, 1978. (Proceedings forthcoming).

BISHOP, R.C. and OTHERS. 1978. Wisconsin's Lake Michigan and Green Bay Commercial Fisheries: A Statistical Overview, Univ. of Wisc. Sea Grant Advisory Rept., No. 41E.

JOHNSON, V. and BISHOP, R.C. 1979. "Wisconsin's Commercial Fisheries: Present and Future," Economic Issues No. 29 (January).

BISHOP, R.C. and SAMPLES, E. 1978. "Sport and Commercial Fishing Interactions", Univ. of Wisc.-Madison, Dept. of Econ. Staff Paper No. 146, July 1978. Presented at Amer. Agr. Econ. Assoc., Blacksburg, Virginia, August 6-10.



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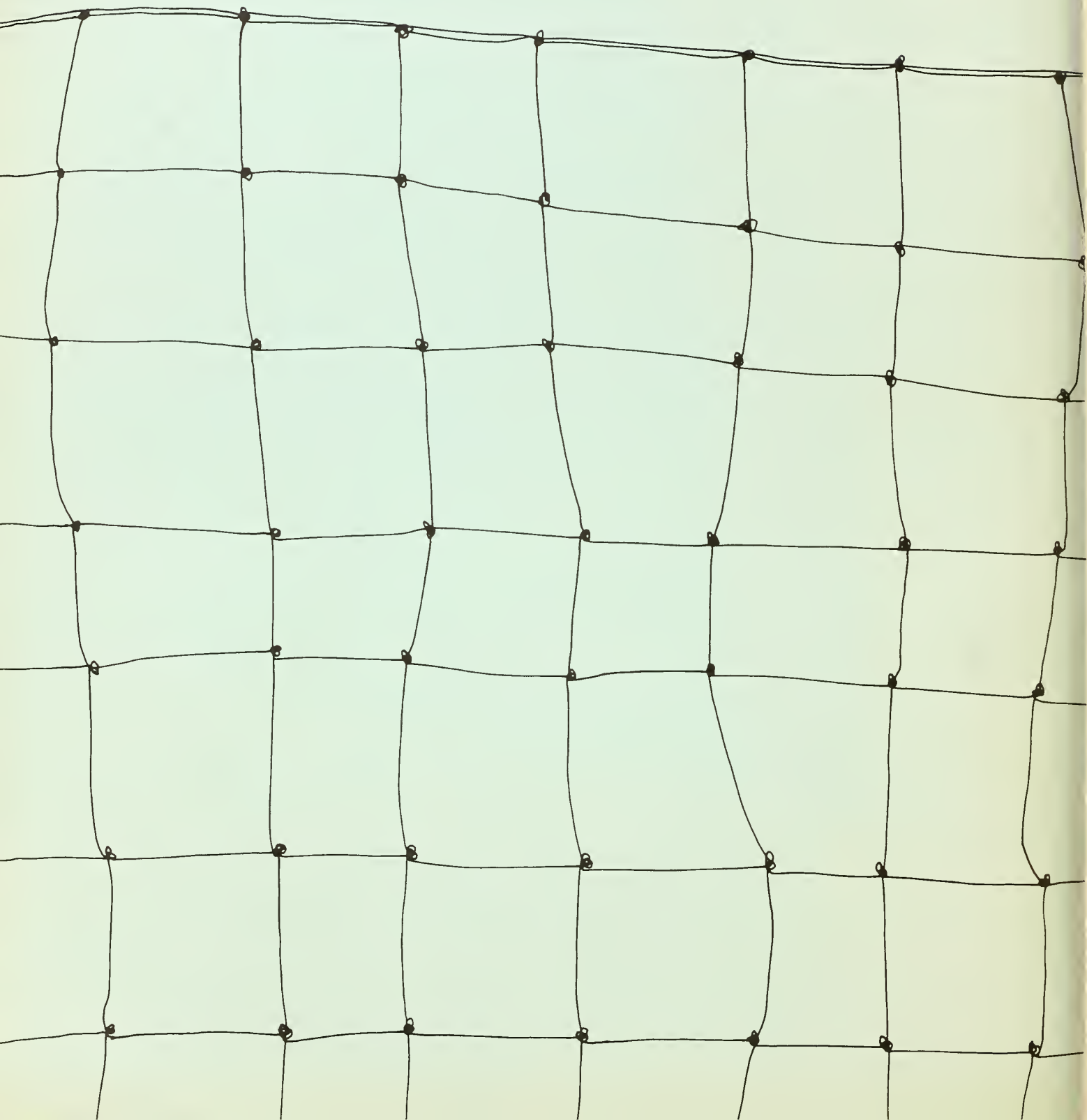
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