Umatilla Basin Natural Production Monitoring and Evaluation

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UMATILLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION

ANNUAL PROGRESS REPORT 1994-1995

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ABSTRACT

This report summarizes the activities of the Umatilla Basin Natural Production Monitoring and Evaluation Project (UBNPME) from September 30, 1994 to September 29, 1995. This program was funded by Bonneville Power Administration and was managed under the Fisheries Program, Department of Natural Resources, Confederated Tribes of the Umatilla Indian Reservation.

An estimated 36.7 km (22.6 miles) of stream habitat were inventoried on the Umatilla River, Moonshine, Mission, Cottonwood and Coonskin Creeks. A total of 384 of 3,652 (10.5%) habitat units were electrofished. The number of juvenile fish captured follows: 2,953 natural summer steelhead (including resident rainbow tout; *Oncorhynchus mykiss*), one hatchery steelhead, 341 natural chinook salmon (*O. tshawytscha*), 163 natural coho salmon (*O. kisutch*), five bull trout (*Salvelinus confluentus*), 185 mountain whitefish (*Prosopium williamsoni*), and six northern squawfish (*Ptychocheilus oregonensis*). The expanded population estimate for the areas surveyed was 73,716 salmonids with a mean density of 0.38 fish/m^2.

The following number of non-salmonids were visually estimated: 7,572 speckled dace (*Rhinichthys osculus*), 5,196 sculpin (*Cottus spp.*), 532 suckers (*Catostomus spp.*) and 191 redside shiners (*Richardsonius balteatus*). The gross estimated density of all non-salmonids combined was 0.84 fish/m^2. The estimated ratio of non-salmonids to salmonids was 2.4:1.

Relative salmonid abundance, seasonal distribution and habitat utilization were monitored at index sites throughout the basin. During index site monitoring, the following species were collected in addition to those listed above: american shad (*Alosa sapidissima*), smallmouth bass (*Micropterus dolomieu*), carp (*Cyprinus carpio*) and chiselmouth (*Acrocheilus alutaceus*). Thirty-nine sites were electrofished during the spring and summer seasons, while 36 sites were sampled in the fall season. Index sites with the highest mean salmonid catch/minute (fish/min.) during the three sample periods were located at the following sites: East Birch Creek (3.4 fish/min.), Boston Canyon Creek (3.2 fish/min.), Spring Creek (3.1 fish/min.) and upper Squaw Creek (3.0 fish/min.). The highest electrofishing catch rates were observed in the Umatilla River tributaries above river mile (RM) 70 in the August and September sample period (Table J-2 catalogs river miles with associated landmarks). During the November sample period, catch rates were highest in Birch Creek tributaries. Most salmonids were captured in slow water near the bank during the November and March sampling periods.

A study of the migration movements and homing requirements of adult salmonids in the Umatilla River was conducted during the 1994-95 return years. Radio telemetry was used to evaluate the movements of adult salmonids past diversion dams in the lower Umatilla River and to determine migrational movements of salmonids following upstream transport. Radio transmitters were placed in 30 summer steelhead, 15 spring chinook, nine fall chinook, and eight coho salmon. Salmon were released at Three Mile Falls Dam (TMD). An additional 11 summer steelhead and ten spring chinook salmon were tagged, hauled upstream, and released at either Barnhart, Nolin, Thornhollow, or Imeques C-mem-ini-kem. On average, summer steelhead required 36 days to successfully migrate from TMD to Stanfield Dam. Spring chinook required 18 days. Average passage times for summer steelhead (hours and minutes) at Westland, Feed Canal, and Stanfield Dams were 13:06, 83:24, and 2:58, respectively. Spring chinook salmon required 04:30 at Westland, 89:42 at Feed Canal, and 04:01 at Stanfield Dams. Migrational delays were observed at Feed Canal Dam at flows ranging from 563 to 1,601 cubic feet/second (cfs). Thirty-eight

percent of the fish used the fish ladder at Westland Dam, 75% at Feed Canal Dam, and 31% at Stanfield Dam. Average passage times at Feed Canal Dam (1995) were more than 15 times those at Stanfield Dam in 1994 and more than 20 times those at Stanfield Dam in 1995.

Data related to homing and passage needs of Umatilla River salmonids was investigated in an attempt to maximize homing to the Umatilla River. Straying rates of adult summer steelhead and spring chinook salmon were found to be low while coho and fall chinook salmon stray rates were high in some groups, particularly adult returns from subyearling smolt releases of fall chinook salmon.

Attraction flows of from the mouth of the Umatilla River of at least 150 cfs were required to encourage migration and reduce straying of fall chinook and coho salmon. Significant numbers of summer steelhead entered when flows exceeded 500 cfs. Spring chinook salmon entry was variable with fish entering at flows ranging from 150 to more than 2,000 cfs.

Adult anadromous salmonids potentially available to spawn above TMD from August 26, 1994 to June 27, 1995 included: 593 adult and 530 jack fall chinook salmon (1994 brood), 879 adult and 54 jack coho salmon (1994 brood), 784 natural and 509 hatchery summer steelhead (1995 brood), and 378 adult and 62 jack spring chinook salmon (1995 brood). During escapement surveys (fall of 1994), a total of 82 fall chinook salmon redds, 24 coho salmon redds and seven unidentified salmon redds (112 redds total, 2.6/mile) were enumerated along 42.3 miles of the mainstem above TMD. In 1995, we enumerated and flagged 126 summer steelhead redds (3.6 redds/mile) along 35.3 miles of lateral tributaries of the Umatilla River. Also enumerated were 90 spring chinook salmon redds (1.6 redds/mile) along 55.8 miles of the mainstem. Ninety-six percent of the adult fall chinook salmon carcasses examined had spawned while 94% of the coho had spawned; 66.8% of the spring chinook salmon carcasses examined had spawned. A total of 49.3% of spring chinook salmon released above TMD were sampled during spawning ground surveys and 60 coded wire tags (CWTs) were recovered from 78 adipose clipped fish.

The rotary screw trap in the Umatilla River (RM 76) operated 63 of 113 days from September 21, 1994 to January 13, 1995. The trap captured 596 juvenile steelhead with a mean trap efficiency rate of 9.9%. A total of 1,368 juvenile chinook salmon were captured with a mean trap efficiency rate of 28.8%.

The rotary screw trap at the Imeques C-mem-ini-kem site (RM 79.5) operated 43 out of 43 days from May 5 through June 16, 1995. The trap captured 304 natural juvenile steelhead with a mean trap efficiency rate of 6.6%. A total of 102 natural juvenile chinook salmon were captured with a mean trap efficiency rate of 10.5%.

The rotary screw trap at the Barnhart site (RM 42.2) operated 87 out of 125 days from March 3 to June 1, 1995. The trap captured 105 natural juvenile steelhead, 247 natural juvenile chinook salmon, five natural coho salmon, 6,265 hatchery juvenile chinook salmon, 467 hatchery steelhead and 16,844 hatchery coho salmon. Mean trap efficiency rates ranged from 2.3 to 5.7%

Harvest monitors estimated that tribal anglers harvested 25 hatchery and five natural summer steelhead during the spring of 1995. There was no spring chinook salmon fishery in the Umatilla River during 1995 because of the low number of returning adults.

Scale analysis determined that over 85.0% of naturally produced juvenile summer steelhead sampled during biological and index surveys were age 0+ or 1+. Naturally produced summer steelhead adults, returning to the Umatilla River in 1994-95, were mostly from the 1990 (46.4%) and 1991 (33.9%) brood years.

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INTRODUCTION

The Umatilla Basin Natural Production Monitoring and Evaluation Project (UBNPME) was funded by Bonneville Power Administration (BPA) as directed by section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P.L. 96-501) and pursuant of measure 703 (F)(1)(b) of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (NPPC 1987). This report summarizes work completed during the contract year September 30, 1994 through September 29, 1995. Work was conducted by the Fisheries Program, Department of Natural Resources, Confederated Tribes of the Umatilla Indian Reservation (CTUIR) in cooperation with the Oregon Department of Fish and Game (ODFW, see Appendix J, Table J-2 for abbreviation definitions). This project was one of several subprojects of the Umatilla River Basin Fisheries Restoration Master Plan (CTUIR 1984, ODFW 1986) orchestrated to rehabilitate salmon and steelhead runs; subprojects include:

- Natural Production Monitoring and Evaluation, and Adult Passage Facility Evaluations (this project);
- Watershed Enhancement and Rehabilitation;
- Hatchery Construction and Operation;
- Satellite Facility Construction and Operations for Juvenile Acclimation and Release and Adult Holding and Spawning;
- Trapping and Hauling of Juvenile and Adult Salmonids Around Dry Reaches Below Irrigation Diversions;
- Juvenile Passage Facility Construction and Operation;
- Juvenile Passage Facility Evaluations;
- Evaluation of Juvenile Salmonid Outmigration and Survival in the Lower Umatilla River Basin;
- Adult Passage Facility Construction and Operation, and
- Flow Augmentation to Increase Instream Flows Below Irrigation Diversions.

The Umatilla River Basin Fisheries Restoration Master Plan identified the following four critical uncertainties that the UBNPME project addressed:

1) What was the observed natural production success and estimated natural production potential for spring chinook, fall chinook and coho salmon, and summer steelhead in the Umatilla River Basin?
2) How effective were the adult passage facilities?
3) was supplementation enhancing natural summer steelhead populations?
4) was supplementation impacting the genetic diversity and life history characteristics of native salmonids?

The approach to monitoring and evaluating the natural production in the Umatilla River Basin includes three phases. Phase one includes collecting baseline data relating to life histories, distribution, abundance, survival and the current and potential production of anadromous salmonids from the Umatilla Basin. Phase two involves the creation of a streamlined monitoring program developed and tested through completion of tasks in phases one and two. Phase three consists of risk containment monitoring where the monitoring program will be employed. Phase one of the UBNPME plan was scheduled for 1992-97. Phases two and three are scheduled to begin in 1997 and 2004 respectively.

The UBNPME program's 1994-95 goals were to evaluate the implementation of the Umatilla River Basin Fisheries Restoration Plan with respect to natural production, adult passage and tribal harvest. This report follows the outline of the task list from the statement of work as required postliminarily. Project objectives are listed below.

Objective 1: Estimate the amount of existing and potential spawning and rearing habitat for summer steelhead, spring and fall chinook and coho salmon.

Objective 2: Determine distribution, species composition and densities of fish species throughout the Umatilla Basin.

Objective 3: Utilize radio telemetry to evaluate the passage of adult salmonids past the major irrigation diversion dams and associated passage facilities on the lower Umatilla River.

Objective 4: Utilize radio telemetry to evaluate the movements of adult spring chinook salmon and summer steelhead trapped at Three Mile Falls Dam and transported upstream.

Objective 5: Evaluate factors that influence homing and straying of returning adult salmonids into or out of the Umatilla River Basin.

Objective 6: Determine natural spawning success, spawning habitat utilization, prespawning mortality, and number of redds/adult spring chinook salmon passed above Three Mile Falls Dam. Determine, if possible, spawning distribution and timing of steelhead, fall chinook salmon and coho salmon.

Objective 7: Estimate natural smolt production and survival rates of anadromous salmonids at various life history stages.

Objective 8: Estimate tribal harvest of returning adult salmon and steelhead.

Objective 9: Determine salmonid age, growth and life history characteristics.

Objective 10: Determine the genetic and ecological effects of supplementation on native steelhead and resident trout in the Umatilla Basin (as planned, this objective was not directly addressed during the 1994-95 contract year).

Objective 11: Determine if hatchery supplementation enhances production of natural steelhead (as planned, this objective was not directly addressed during the 1994-95 contract year).

DESCRIPTION OF PROJECT AREA

Summer steelhead, chinook and coho salmon were abundant in the Umatilla River prior to the 1900's. Irrigation and agricultural development throughout the basin in the early 1900's was believed to be the primary cause of the decline of steelhead and the extinction of salmon (Bureau of Reclamation 1988). Since 1855, aquatic and riparian habitats have been degraded through irrigation diversions, water extractions, channelization, livestock grazing, logging, agriculture and urban development (Nielson 1950, NPPC 1987).

The Umatilla River Basin in northeast Oregon comprised 1,465,600 acres of the 6,400,000 acres of ceded CTUIR land (Figure A-1, A-2). The Umatilla River originated on the west slope of the Blue Mountains, east of Pendleton, and flows 115 miles in a northwesterly direction to the Columbia River at RM 289. The Umatilla River Basin, hydrologic unit number 17070103 (USGS 1989), had a drainage area of 2,290 square miles. The mouth of the Umatilla River at Umatilla, Oregon, was at approximately 270 feet elevation (above mean sea level). The headwaters were as high as 4,950 feet. Mean annual precipitation ranged from ten inches/year at Umatilla to 50 inches/year in the headwaters (Taylor 1993).

The basin can be roughly divided into two physiographic regions. The lower river, west of Pendleton, has cut a low valley into a broad upland plain called the Deschutes-Umatilla Plateau. Parent geologic materials of the plain were dominated by multiple layers of middle Miocene basalt flows, specifically, the Wanapum and Grand Ronde Basalts, originating 14 to 17 million years ago. Basalt bedrock outcroppings were common in the river channel and act as hydraulic controls that delay the deepening of the river channel and valley floor. On top of the Miocene basalts were Pleistocene and Holocene loess, alluvial and glaciofluvial deposits (NPPC 1990, Walker and MacLeod 1991). Currently, vegetation on the broad Deschutes-Umatilla Plateau includes dryland crops and sagebrush-grass communities. Historically, deciduous trees were abundant in riparian areas on the valley floor; however, land-use practices over the last hundred years have cleared most of these areas for irrigated agricultural and urban uses. Approximately 70 percent of riparian areas in the Umatilla River Basin were reported to be in need of improvement (ODFW 1987).

The region east of Pendleton was dominated by foot hills and the Blue Mountains. The Blue Mountains were created by lifting, faulting and folding of volcanic, sedimentary and metamorphic rock. The middle Miocene basalts of the lower river were also the dominant parent materials in the headwaters. The river and streams have cut steep sided canyons into the layers of rock that form the higher elevations of the Blue Mountains. Exposed basalt fractured into blocks and plates while unexposed layers remain fairly impervious to water (Walker and MacLeod 1991). The combination of steep canyon walls and impervious bedrock lends to poor ground water recharge (NPPC 1990). U.S. Geological Survey (USGS) flow data from 1904 through 1994 show stream hydrographs that reflect the various features of the basin as described above. High flows regularly occur during rain storms and snow melt conditions. Extreme low flows were common during summer and dry conditions. This effect was less pronounced in the near pristine North Fork Umatilla Wilderness Area, apparently because of the lack of human disturbance, higher elevation of the headwaters, developed soils, large woody debris and climax plant communities. Vegetation distribution patterns upstream from Pendleton were typical for the Blue Mountains. Grasses and small shrubs dominated the drier, south facing slopes. Conifers dominated the north facing slopes, higher elevations and moderately wet areas.

MATERIALS AND METHODS

OBJECTIVE 1: Habitat Surveys

Task 1.1: Habitat Surveys.

Methods developed by ODFW (Moore et al. 1993) were used to inventory stream habitat. Habitat surveys were conducted from June 20 to September 11, 1995 on the Umatilla River (RM 81.8 to 89), Moonshine Creek, Mission Creek, Cottonwood Creek and Coonskin Creek. A crew of two people worked upstream, dividing the valley into large scale reaches and the stream into individual habitat units. The same crew surveyed the entire stream to keep data as consistent as possible.

Reach classifications were made when major changes occurred in valley form, riparian composition or land use. A reach change could also be classified at fish passage barriers or when tributaries contributed a significant portion of flow to the stream being surveyed. At the beginning of a reach, we recorded specifics about land-form, valley-form, terrestrial vegetation, land use, water temperature, flow (high, medium or low) and valley floor width (VWI). VWI was the ratio of active channel width to valley floor width. Photographs were taken of the riparian area and the reach. Notes and additional photographs were taken throughout the survey to document landmarks, habitat problems, passage concerns, irrigation diversions and surface springs. The locations of landmarks such as bridges or tributaries were marked with a unit number on a photocopy of a 7.5 minute quadrangle topographic map. A record was kept with detailed information on each photograph. An Oregon Water Resources map of the Umatilla River Basin was used to approximate river miles.

Stream habitat units were classified with more detail than were the reaches. A habitat unit was a section of stream that had a distinct hydraulic characteristics from adjacent stream sections (exception: dry channel classification). Each unit was numbered sequentially then identified as a riffle with pockets, lateral scour pool or glide, etc. Surveyors overestimated the width of dry channel units which inflated area calculations of dry units. Normally the width of a habitat unit was the wetted channel width which was narrower than active channel width (wet during bank full flows). When dry units were measured, the entire active channel width was measured as there was no water/shore interface.

If a unit was overlooked by a habitat crew but identified by electrofishers, the area was measured and recorded as an unclassified unit. Side channels with springs contributing the majority of the water were classified as spring seeps. Water temperatures were recorded from springs and tributaries and from the mainstem up and downstream. Crews estimated the percentage of mainstem flow contributed by each spring and tributary.

The following data were recorded at each habitat unit: estimated mean length, width, depth (maximum for slow water units and mean for fast water units), slope, aspect, shade, substrate composition, boulder count (> 0.5 m in diameter), wood rating (based on benefit to fish), bank stability, bank composition, percent undercut bank, percent flow in channel(s) and channel type. The primary channel measurements were kept separate from secondary channels measurements. The percent composition of gravel substrate was multiplied by the total wetted area surveyed to estimate potential spawning habitat.

At every tenth unit the following data were also recorded: unit length and width, active channel height and width, VWI and terrace characteristics. The starting point of every tenth unit was marked with an orange flag by the habitat survey crew to enhance locating selected units during electrofishing. The number, habitat type and length of the unit was written on the flag.

Riparian communities were inventoried and photographed every 30 habitat units and at the start of each reach. A measuring tape was extended 30 m into the riparian zone, perpendicular to the stream, halfway between the upper and lower unit boundaries, and from the margin of the wetted and active channel. Three lateral transacts measuring ten m long by five m wide were inventoried on both sides of the stream. Within each transect, the following data were recorded: geomorphic surface features, ground slope; canopy closure; percent shrub cover; percent grass; tree groups (conifer or hardwood); tree count by breast height diameter (DBH) class, and pertinent notes. Grain fields and stubble were tallied as grasses. The percentages of exposed soil, rock, roads, secondary stream channels were noted.

Woody debris were tallied and described if they met minimum length (3 m) and diameter (15 cm) requirements. Root wads were tallied if they met the minimum diameter requirement (15 cm). Crews recorded tree group (conifer or hardwood), length class, diameter, configuration and location in the channel for woody debris.

Task 1.2: Monitor stream temperatures in the Umatilla Basin, and examine USGS flow data from active gages in the basin.

Temperatures

CTUIR, ODFW, U.S. Forest Service (USFS) and U.S. Bureau of Reclamation (BOR) coordinated the deployment of 32 thermographs and four HYDROMET stations in the Umatilla River Basin to maximize consistency and coverage without duplicating effort. Specifics regarding the location and deployment of these thermographs were summarized in Tables C-1 through C-5. CTUIR thermographs were initialized, downloaded and deployed in the field with the use of a portable computer. New batteries were installed and the seals and clamps were cleaned, inspected and changed as needed. Thermographs were sealed inside a waterproof housing and placed inside a small cage made of expanded steel. Steel chains or cables anchored the units to a large tree or boulder on the shore. Thermographs and cables were concealed to minimize tampering. Photographs were taken and detailed descriptions of the location of each thermograph were written at the time of deployment. Detailed vicinity maps were drawn and 7.5 minute topographic maps were marked.

Flow

We examined the correlation between flow and the number of adult natural summer steelhead returning to the Umatilla River (two years later) for 16 years of flow and return records (Hubbard et al. 1995, Suzanne Miller, USGS, personal communication). Adult steelhead returns prior to 1982-83 were not correlated to flows because counts were considered to be rough estimates (Jim Phelps, ODFW, personal communication). The number of returning adult natural steelhead was compared to mean annual and monthly flows at the Umatilla gage (RM 1.2). The flow year and steelhead return years were designated differently by convention and can be confusing. For example, the comparison between flows in Water Year 1990 (October 1989 to September 1990) and steelhead returns in 1992-93 (fall 1992 through spring 1993) was denoted as a two year lag. However, the actual number of months between spring flows during juvenile emigration and when the adult steelhead actually return to the river may range from 30 to 35 months. Correlation coefficients were calculated by using Pearson's product-moment correlation with Bonferroni adjustments on multiple tests (SYSTAT 1984).

Tasks 1.3 through 1.5: Obtain habitat data collected by other agencies. Digitize and summarize habitat data. Estimate total usable habitat by stream reach, drainage and entire basin.

Data from Habitat surveys conducted by ODFW were obtained on computer diskette. No additional data entry or summarization was required. Raw habitat data collected and recorded in the field by CTUIR was entered into a database program. Original data were copied and archived. Data were validated before and after entry. After the second validation, summary charts and tables were created and examined for a final validation.

Estimates of total usable habitat by stream reach, drainage and basin were calculated from surveys conducted during summer low flow periods (1993-95). Usable habitat was defined as the area of a stream surveyed that had adequate water with suitable temperatures ($<24^0$C Brett 1952, Black 1953). Expansions were made for reaches not surveyed by using data from adjacent streams of similar type. Wildhorse Creek, Butter Creek and several ephemeral streams were estimated to provide no anadromous salmonid habitat even though we have observed a few salmonids near spring seeps (Table B-1).

Task 1.6: Coordinate water quality monitoring efforts in the Lower Umatilla River with the Oregon Department of Environmental Quality.

Total maximum daily load (TMDL), water temperature monitoring, suspended sediment monitoring and water quality monitoring efforts in the basin were coordinated among Department of Environmental Quality (DEQ), ODFW, BOR, USFS, and CTUIR. Coordination was facilitated by the Umatilla Monitoring Evaluation and Oversight Committee (UMEOC) and the Umatilla Total Maximum Daily Load Technical Advisory Committee.

OBJECTIVE 2: Biological Surveys

Task 2.1: Conduct salmonid presence/absence surveys in the Umatilla River Basin.

Emphasis in conducting salmonid presence/absence surveys was minimized to allow completion of index site and quantitative biological surveys. Presence/absence surveys were conducted as time allowed to determine salmonid distribution. Several presence/absence sites were sampled in tributaries of the North Fork Umatilla River.

One electrofishing pass was made intermittently through several hundred meters of stream. Crews concentrated on areas where the probability of capturing salmonids was highest. The distance sampled was variable and could include multiple areas of a stream. Surveyors took photographs, marked the site on a map, recorded species and lengths of the catch, recorded site conditions and dimensions, and recorded effort (seconds of electrofishing).

Task 2.2: Electrofish and estimate salmonid densities in streams surveyed for habitat.

Backpack electroshockers and blocknets were used to sample fish from streams recently inventoried for habitat. Crews began electrofishing within several weeks of habitat surveys to best record relationships between habitat conditions and salmonid abundance. The units sampled for fish were selected in the field by the biological survey crew leader. Field selection was necessary because some units could not be sampled due to excessive depth, width, instream cover or absence of water. Every effort was made to minimize selective bias by stratifying the samples throughout the reach and by sampling approximately ten percent of the wetted area. Units with a variety of physical characteristics (i.e. braided and single channels, shaded or unshaded, cover or lack of cover) were sampled to represent the stream's habitat complexity. Care was taken to avoid startling fish from a unit before securing block nets. Water temperatures were recorded in all units sampled.

Salmonids were captured with dip-nets and removed on successive electrofishing passes until a depletion rate of at least 50% was achieved. The same individual electrofished in a similar manner for the same number of seconds (or slightly more) as the previous pass. This maximized equality of sampling effort between removal passes. Electroshocker settings (i.e. volts, pulse) remained constant for each pass. A second pass was not done if salmonids were neither captured nor observed during the first pass.

Captured salmonids were placed in a livewell until the completion of each pass. Fish were identified to species, measured (fork length, mm) and inspected for fin clips. Indicators of fish condition such as injuries, signs of disease or stress were noted. Bird bites were delineated as either puncture or scissor wounds.

Juvenile spring chinook salmon were not differentiated from juvenile fall chinook salmon nor were juvenile steelhead differentiated from resident rainbow trout. After examination, salmonids were released where captured or into a nearby area if conditions were significantly better.

Scale samples were taken from a portion of the total salmonids captured. A wide variety of sizes were sampled for age determination. Approximately 6-12 scales were removed from an area above the lateral line, posterior to the dorsal fin, and anterior to the adipose fin. Scale samples were taken from all salmonid mortalities. Scales were placed in clear mylar envelopes labeled with stream name, unit number, date, species and length.

Captured northern squawfish were sacrificed. Stomach contents were examined to determine the extent of predation on juvenile salmonids. Scale samples were taken from each squawfish and placed in mylar envelopes. Numeric estimates of all other non-salmonids observed during the first pass were recorded.

Estimates of salmonid abundance were calculated with a maximum-likelihood model (Van Deventer and Platts 1989) from the number of salmonids captured during successive electrofishing removal passes. Densities were estimated by dividing estimated salmonid abundance with estimated wetted channel area (estimated from habitat data). Low sample sizes required us to pool *Oncorhynchus* species to generate salmonid abundance estimates. Estimates for each species were calculated by multiplying the percent species composition by the expanded estimate for all salmonids. Mean density for a specific habitat type was calculated by dividing the sum of population estimates for each unit type by the area electrofished. The population estimates for each habitat type were added together to estimate the total population of the stream. Salmonid densities were also estimated for slow and fast water units. Densities for whitefish and squawfish were estimated only for habitat types where they were captured. Densities were also calculated from actual catch rather than from expanded abundance estimates. Densities of other non-salmonids were based on the number observed (not captured) divided by area. Expanded estimates of non-salmonid abundance were calculated by multiplying the total wetted habitat area by the estimated density.

Task 2.3: Electrofish permanent index sites during November, April and August.

We electrofished 40 permanent index sites located throughout the Umatilla River Basin to monitor salmonid relative abundance, seasonal distribution and habitat utilization. (Figure A-3). Stable sites were chosen with the intent to monitor changes in salmonid populations rather than salmonid's response to changes in habitat. Habitat at each site was evaluated using the same methodology as in our habitat surveys (Task 1.1).

A typical index site consisted of fast and slow water habitat type. A few sites had more than two habitat types. Meacham Creek (site 30) was the only site with only one habitat type.

The lower and upper boundary of each site was marked in the field with numbered tags to assist consistent sampling. Most tags were placed on living trees or on wooden posts outside of the active channel to avoid tag loss during high flows. Site measurements, photographs and a detailed description of tag and site location were taken to expedite locating the site. Each index site location was also marked on an Oregon Water Resources map of the Umatilla River Basin (Figure A-3).

Index sites were sampled during March, August and November. Specific time periods for sampling varied depending on environmental conditions. Floods, cold weather, de-watering and inaccessibility occasionally prevented the sampling of some sites. During each sampling period, the length, width and depth of each habitat unit was measured at each index site. We measured mean depth in fast water units and maximum depth in slow water units. The habitat was measured to monitor physical changes which may effect catchability, abundance and species composition. Crews took photographs and recorded water and air temperatures, weather, stream flow (low, medium or high), water clarity, visibility, and electrofishing effort and settings (voltage, pulse).

Index sites were electrofished upstream (single pass) without blocknets. One person operated a backpack electroshocker with a netted electrode while a second person captured fish with a dip-net. Methods for collecting fish data were consistent with the methods described in Task 2.2. Salmonid catch rate (fish/min.) was calculated for each index site. Except northern squawfish, non-salmonids were counted but not captured.

Task 2.4: Evaluate the use of snorkeling for enumerating salmonids.

We evaluated snorkeling as a technique to enumerate juvenile salmonids. We examined the comparability of snorkeling data to electrofishing data, suitability of snorkeling techniques to stream conditions, and expense and time of obtaining gear and training snorkelers.

Task 2.5: Scale Analysis

See Task 9.1.

Task 2.6: Estimate total number of salmonids in each stream reach, stream, and subbasin.

The total populations of juvenile summer steelhead and spring chinook salmon for the Umatilla River Basin were estimated by expanding quantitative electrofishing and habitat data collected during the summers of 1993-95 (as detailed in Tasks 1.1-1.6 and 2.1-2.3). Additional population estimates were made by comparing streams with empirical data to those not yet sampled quantitatively (Table B-1). We estimated populations for summer steelhead ages 0+ through 3+ and for spring chinook salmon ages 0+ and 1+ (age 1+ denoting a fish having one annulus and in its second season of growth).

OBJECTIVES 3 and 4: Adult Passage Evaluations

Tasks 3.1 and 4.1: Evaluate the upstream migration of radio tagged adult salmon and summer steelhead past the irrigation diversions in the lower Umatilla River, and evaluate movements of radio tagged adult spring chinook salmon and summer steelhead following upstream transport.

CTUIR initiated a study in 1992 to evaluate adult salmonid passage in the lower Umatilla River with radio telemetry. The first year of the project was intended to function as a feasibility study and was conducted on a small scale. This project has since expanded. Fixed-site receivers were installed at key locations and salmonid movement following upstream transport was evaluated.

Radio telemetry work on the Umatilla River encompassed the entire Umatilla River and tributaries upstream of TMD. Primary emphasis was given to five major irrigation diversion dams. These include Maxwell Dam (RM 15.2), Dillon Dam (RM 24.6), Westland Dam (RM 27.2), Feed Canal Dam (RM 28.2), and Stanfield Dam (RM 32.4; Figure A-2).

The radio telemetry portion of this project involves two separate evaluations of adult salmonid movements. The "passage evaluation" (Task 3.1) evaluates migration of adult summer steelhead, coho, and spring and fall chinook salmon from Three Mile Falls Dam (TMD) to above Stanfield Dam. The "upstream transport evaluation" (Task 4.1), evaluates the movements of summer steelhead and spring chinook salmon following upstream transport and release.

Fish utilized for the radio telemetry project were captured in the TMD adult trapping facility (east-side) and anesthetized with carbon-dioxide. Radio transmitters were inserted into the stomach. Individually tagged fish were either released in the forebay directly above TMD (passage evaluation) or placed in a truck for transport upstream (upstream transport evaluation). Transported fish were released at either Nolin (RM 33.6), Barnhart (RM 42.2), Thornhollow (RM 73.5), or Imeques C-mem-ini-kem (Fred Grays, RM 80).

Fish were radio tagged at various times depending on numbers returning to TMD. An attempt was made to radio tag a representative sample throughout the adult return period at low, medium, and high river flows. Coded transmitters were purchased from Lotek Engineering in Newmarket, Ontario, Canada. Radio transmitters were high frequency 150 MHz and varied in size depending on the species being tagged. Summer steelhead and coho salmon received transmitters measuring 4.5 centimeters long and 1.7 centimeters in diameter. Fall and spring chinook salmon transmitters were 8.2 centimeters long and 1.7 centimeters in diameter. All radio transmitters had a minimum operating life of approximately 250 days.

Tagged fish were radio-tracked with Lotek SRX 400 radio telemetry receivers. Both mobile and fixed-site tracking efforts were employed during the study. Fixed-site receivers (with memory capabilities) were installed at Westland, Feed Canal, and Stanfield Dams. An additional receiver was installed near the ODFW district office in Pendleton at RM 56 (ODFW site). Each fixed-site receiver (at diversion dams) included two antennas; one underwater antenna in the fish ladder, and one three-element yagi antenna. Receivers were programmed to alternately scan each antenna for six seconds. This arrangement allowed migrational route (fish ladder or over the dam crest) and arrival and departure times of individual fish at each diversion dam to be determined. Passage times at diversion dams for individual fish were calculated by comparing arrival and departure times. Passage duration through the diversion areas were found by comparing the release time at TMD to the last recorded time at Stanfield Dam (the uppermost diversion).

Most of the mobile radio tracking was conducted in a vehicle equipped with a four-element antenna. On occasion, particularly in areas inaccessible to vehicles, portions of the river were walked with a receiver and hand-held three-element antenna. Once determined, radio tagged fish locations were recorded to the nearest tenth of a river mile.

Migrational movements of radio tagged summer steelhead and spring chinook salmon in relationship to water temperatures and river flows were included in the study. Temperature and flow data were provided by Zimmerman and Duke (1995).

OBJECTIVE 5: Homing and Straying of Adult Salmonids

Task 5.1: Determine factors essential for homing and upstream migration of maturing salmonids.

Available data on returning adult coho, fall and spring chinook salmon, and summer steelhead were analyzed in an attempt to understand conditions necessary for successful homing to the Umatilla River. All information related to known Umatilla River origin fish was considered in the search. This included juvenile release data, CWT recoveries, and radio telemetry data. Water flow and temperature data were obtained from Zimmerman and Duke (1995). Homing and straying information represents estimated CWT recoveries from Rowan (1995).

OBJECTIVE 6: Spawning Surveys

Task 6.1: Determine final disposition of adult anadromous salmonids released above TMD.

Trap and Haul Project records were reviewed to determine the disposition of all salmonids enumerated at TMD and to determine if adult salmonids released at TMD, after being caudal punched, fell back over the dam. Radio telemetry data were also reviewed to determine if radio tagged adult salmonids fell back over TMD after tagging.

Tasks 6.2 and 6.3: Conduct prespawning, spawning, and post spawning surveys throughout the basin for each anadromous species and run; Estimate the number of successful redds and the adult/redd ratios (female/redd, female/male) of fish passed above TMD (adjusted for harvest and fall-back, if possible).

Spawning ground surveys to enumerate summer steelhead, spring and fall chinook and coho salmon redds and to sample mortalities were conducted in various reaches of the Umatilla River Basin. Repeated surveys were conducted in areas found to be important for spawning or holding. Other areas were surveyed fewer times or not at all because of low fish abundance observed during previous years or poor survey conditions. Surveyors wore polarized glasses to maximize fish observing capabilities. To minimize stress on prespawning salmonids, crews did not attempt to drive adults from cover for observation by probing debris jams or throwing rocks into pools. The majority of the surveys were conducted by two people, with additional surveyors paired with experienced surveyors during post spawning die-off. Three to four river miles were generally surveyed daily by each person, walking either along the margins of the smaller lateral tributaries. In larger tributaries, surveyors often traversed from bank to bank cover spawning areas and find carcasses.

Redds were judged to be complete (and thus spawning probably successful) based on redd size, depth, location and amount and size of rock moved. All redds were reviewed by our most experienced surveyors for consistency. Redds were marked with orange and white striped flagging. The date, location, species and number of males and females observed on or near the redd were written with permanent marker on the flagging. Writing on the flagging was at least three inches above the lower end of the flag because wind whip caused the ends of the flagging to deteriorate. Flags were placed in trees as close to the redd as possible and at least five feet off the ground to minimize disturbance by wildlife and livestock. In a data book, the surveyors recorded each redd as well as the stream name, location, date, sex and number of fish on or near the redd, carcasses sampled near the redd, and habitat type. Carcasses found during the survey were measured from the middle of the eye to the hypural plate (MEHP). Fork lengths were measured if severe caudal fin erosion had not occurred. Obvious injuries were described and attempts were made to determine the cause of death in prespawning salmonids.

Salmon and steelhead carcasses were cut open to determine egg retention of the females and spawning success of the males. We defined prespawning mortality as death before any spawning had occurred. We classified carcasses as prespawning mortalities only for females with intact skeins and 100% eggs retention and for males with full, corpulent, gonads. Tails of sampled fish were removed at the caudal peduncle to prevent re-sampling. Snouts were removed behind the orbit to recover CWTs from steelhead with both adipose and left ventral (pelvic or pectoral) fin clips, and salmon with adipose fin clips. Snouts were placed in plastic bags and given an individual snout number for identification. The snout card number linked the snout with other biological data collected from the individual fish. Snouts and accompanying biological data were sent to ODFW's Mark Process Center in Clackamas, Oregon, for CWT extraction and reading.

Task 6.4: Calculate fecundity of fish found on spawning grounds. Estimate the number of eggs/redd and total eggs deposited.

The potential egg deposition for natural spring chinook salmon in the Umatilla River was determined from fecundity data from Carson National Fish Hatchery multiplied by redds observed. Estimates of egg retention were subtracted from the total estimated egg deposition. Fecundity of summer steelhead, fall chinook and coho salmon were estimated by calculating mean fecundity of salmonids returning to the Umatilla River. Length versus fecundity data were not available for Umatilla River adult returns because eggs were pooled.

Task 6.5: Compare Umatilla Basin spawning survey findings with other salmonid populations in the region.

The standard unit of comparison of adult spawning success in Columbia River tributaries was the total number of redds observed per mile surveyed in index areas, by species.

OBJECTIVE 7: Smolt Trapping

Task 7.1: Install and operate rotary screw traps in Umatilla River below the mouth of Squaw Creek (RM 76) and below the mouth of Birch Creek (RM 48).

We employed two rotary screw traps, five-foot diameter, (E.G. Solutions, Inc. design) to capture emigrating juvenile salmonids. One trap was installed in the Umatilla River on September 21, 1994 at Tumla (RM 76) and was operated from September 21, 1994 to January 13, 1995. After the river channel at the Tumla site was altered by high flows, the trap was moved to the Imeques C-mem-ini-kem site (RM 79.5) where it was operated from May 5 to June 16, 1995. The second trap was installed in the Umatilla River near Barnhart (RM 42.2). The Barnhart trap operated from March 7 to June 1, 1995. The following data were recorded: trap site, date, time, number and species of fish captured, lengths, marks, clips, number of fish marked and released and comments regarding weather, stream flows and trap effectiveness. Scales were subsampled arbitrarily from captured salmonids. Non-salmonid species were counted. We estimates the number of dace and shiners when large numbers were trapped. During two occasions at the Barnhart site, the number of hatchery coho captured was estimated volumetrically with a small dip-net. We determined the number of coho/net from subsamples.

Task 7.2: Install and operate modified pipe traps in Birch Creek.

Pipe traps were not installed or operated in Birch Creek.

Task 7.3: Estimate trap efficiencies.

Trap efficiency rates were estimated by marking salmonids with one of 12 temporary marks. Fish were marked by clipping a notch in the margins of the caudal fin, anal fin, dorsal fin or a combination of clips. Marked salmonids were released approximately 100 to 300 m above the rotary traps. Recaptured salmonids were counted, measured and released below the trap. Additional marked juvenile salmonids were placed in the livewell for 24 hours to determine containment rates. Minimizing escapement from the livewell through containment monitoring (and immediate repair when necessary) increased effective catch rates. Depending on availability, we used one to 100 fish of a given species and size class for mark-recapture and containment trials.

Trap efficiency estimates and total migrants were calculated utilizing two methods. The first method estimated an average capture rate by dividing the number marked fish recaptured by the total number of marked fish released. An estimate of total fish migrating past the trapping site was calculated by dividing total catch by the mean catch rate. Using mean migration rates/day, estimates were generated for times when the trap was not operating. The second method used the average of multiple running means from catch, mark and recapture trials of three to 13 days. The estimate was expanded for times when the trap was not operating by incorporating flow and temperature data and using interpolation techniques.

Assumptions used to estimate trap catch rates and the number of salmonids migrating past the traps include: 1) marked and unmarked salmonids were actively migrating past the trap; 2) fish downstream of the trap did not return to risk capture again; 3) previously captured, handled and marked fish released upstream of the trap had an equal probability of capture as naive unmarked fish; 4) recaptured fish escaped from the livewell at the same rate as naive fish; 4) marks on recaptured fish were correctly recognized and recorded by samplers, and 6) no mortality of marked fish occurred between the release site and the trap.

Task 7.4: Freeze brand fish for interrogation in the lower Umatilla and Columbia Rivers in coordination and cooperation with ODFW and the Fish Passage Center.

In agreement with ODFW, freeze branding fish for interrogation in the lower Umatilla and Columbia Rivers was postponed until the fall of 1995. Information will be reported in the 1995-96 progress report.

Task 7.5: Reconstruct emigration timing and minimum survival rates.

Emigration timing was estimated from trapping operations during the past several years. Survival rates were not estimated because Task 7.4 was postponed until the 1995-96 trapping season.

Task 7.6: Design and conduct a mark retention study.

The mark retention study was postponed until the fall of 1995 as it was linked to Tasks 7.4 and 7.5.

OBJECTIVE 8: Tribal Harvest

Tasks 8.1 and 8.2: Design and implement creel and phone surveys to estimate tribal harvest of adult anadromous salmon.

CTUIR fisheries personnel monitored the tribal harvest of adult steelhead in the Umatilla River from December through April, 1995. A roving creel survey was incorporated for harvest monitoring. Survey design followed the work of Malvestuto et al. (1978) and Malvestuto (1983). Surveyors recorded the time, location and number of anglers, and the number of fish caught. In addition, we conducted a selective phone survey with tribal steelhead anglers after the season. There was no tribal season on spring chinook salmon during 1995. Harvest of fall chinook and coho salmon was not monitored systematically during the 1994-95 contract year because of the low number of adult salmon and minimal angler effort.

OBJECTIVE 9: Age and Growth

Tasks 9.1 and 9.2: Age analysis of adult and juvenile salmonids.

From adult salmon and steelhead we collected approximately five scales from the preferred area (two rows above the lateral line on the left side of the fish in a diagonal line between the posterior edge of the dorsal fin and the anterior edge of the anal fin). Additional scales were taken two rows below the lateral line and from the right side of the fish in the same areas. Adult scales were mounted on gum cards and pressed in cellulose acetate. In addition to MEHP lengths, we measured fork lengths of adult fish without severe caudal fin erosion. Approximately ten scales were collected from juvenile salmonids sampled in the preferred area. Scales were mounted between strips of mylar that had been folded in half. Species, fork length, date and area captured were written on the left hand edge of the mylar strips with permanent marker. Adult and juvenile scales were analyzed under a microfiche reader at magnifications of 42x and/or 72x. Scales were aged using the European Method of age designation (i.e. age 1.2 was a fish that migrated from freshwater during its second year of life, spent two winters rearing in the ocean, and returned to freshwater to spawn at total age four). Scales were read by one or two scale readers. Both readers reviewed scales that were difficult to interpret. Differences in age interpretation were discussed, and if the readers could not agree on an interpretation, the scale was eliminated from the sample. The numbers of circuli to the freshwater annulus were determined for 20 known hatchery and 20 unmarked spring chinook salmon in the 1995 escapement in an attempt to separate hatchery from natural returning fish. Age data were collected from a sample of juvenile salmonids captured during biological surveys (all fish were measured). We estimated ages of all juvenile salmonids captured (by five mm increments) from the length and age data of fish subsampled.

OBJECTIVE 10: Genetic and Ecological Effects of Supplementation

Task 10.1: Establish a genetic baseline database from native steelhead.

CTUIR, and Currens and Schreck (1993 1995) sampled juvenile steelhead from 14 locations in the Umatilla River during the fall of 1992 and 1994. Workers collected 20-75 steelhead from each location. Currens and Schreck (1995) examined numerous allozymes, mitochondrial DNA, and meristic characteristics.

Task 10.2: Review literature on effects of hatchery-reared salmonids on naturally produced salmonids

Literature regarding salmonid interactions was examined.

Task 10.3: Identify acceptable levels of impact from hatchery supplementation on natural steelhead and native trout.

Researchers and managers worked in cooperation during UMEOC meetings to identify methods for measuring, developing criteria for, and monitoring impacts on natural steelhead from supplementation activities.

Tasks 10.4 and 10.5: Examine the utility and feasibility of observing behavior and performance response of naturally produced salmonids in treatment and control areas before and after, and with and without releases of hatchery smolts. Examine the need to study residualization of hatchery smolts and the potential effects on naturally produced salmonids.

Researchers and managers, during several UMEOC meetings, examined the utility and feasibility of conducting residualization studies and monitoring behavioral responses of naturally produced salmonids subjected to hatchery releases in comparison to control groups. Findings of similar work recently conducted in the Columbia River Basin were discussed.

OBJECTIVE 11: Supplementation Effects on Natural Steelhead

Task 11.1: Combine, examine and summarize data gathered in objectives 1-10 that would indicate enhancement of natural steelhead through hatchery supplementation.

We examined production and release data of hatchery steelhead in the Umatilla Basin and examined the numbers of returning natural and hatchery adult steelhead. We estimated the number of additional natural steelhead that would have been produced if natural adult spawners had not been taken for hatchery brood stock. Production of natural adults was based on ratios of natural adult spawners to resultant natural adult returns to TMD from 1981 through the spring of 1995 (36% to 500%.). No compensatory factors were applied to the estimate as only a five to ten percent increase in adult spawners would have occurred. The proportion of the progeny of each brood year recruiting to subsequent brood years was derived from adult steelhead age data (Table H-2, and I-1, CTUIR et al 1994, Contor et al. 1995).

Task 11.2: Examine potential tests to better evaluate supplementation.

Potential methods to evaluate the effects of supplementation were examined and discussed with experts throughout the pacific northwest and at the UMEOC meetings.

RESULTS AND DISCUSSION

OBJECTIVE 1: Habitat Surveys

Task 1.1: Habitat surveys.

Umatilla River

Habitat surveys were conducted from the upper Umatilla Indian Reservation Boundary (RM 81.8) to the mouth of the North Fork of the Umatilla River (RM 89.6) from July 18 to August 7, 1995 (Tables D-1 through D-8). Habitat crews surveyed 151,949 m^2 of stream area. Elevation ranged from 1,880 feet at the upper reservation boundary to 2,320 feet at the forks (56 feet/mile). Crews classified and inventoried 639 habitat units. Nine additional habitat units totaling 2,053 m^2 were identified later by electrofishing crews. These obscure units were isolated pools lateral to the mainstem. The streambed slope averaged 1.4%. The highest water temperature recorded during habitat surveys was 32°C (89.6°F) at Bingham Hot Springs near RM 86.6. The second highest water temperature recorded was 21°C (70°F) near RM 84.8 while the lowest was 10°C (50°F) near RM 85.6. Water temperature and habitat conditions were suitable for salmonids throughout the river section excluding Bingham Hot Springs.

Fast water habitat accounted for 60.3% of the wetted area surveyed. Riffle habitat comprised the most fast water habitat followed by riffles with pockets, rapids over boulders and rapid over bedrock. The average depth of fast water habitat was 0.27 m. Slow water habitat comprised 38.5% of the area. Lateral scour pools comprised the most slow water habitat followed by straight scour pools, glides, and isolated pools. The average maximum depth of slow water habitat types was 0.65 m. Dry channel accounted for 0.3% of the area surveyed (Table D-3).

Secondary (braided) channels accounted for 31.4% of the channel length and 12.8% of the total area surveyed. The average width of the active channel was 2.0 times that of the wetted channel width. The average width to depth ratio of the wetted channel was 22.6:1. The width to depth ratio for riffles was 35.4:1. The streambank was undercut 8.6% and eroded 7.1% (by length; Table D-2). Gravel (2-64 mm) was the most abundant type of substrate, comprising 35% (53,182 m^2) of the wetted streambed area. Spawning gravel abundance does not limit salmonid natural production.

The ground cover in the riparian zone was 39% shrubs, 35% grasses and 26% bedrock and exposed soil (Table D-6). Low terraces were dominant and high terraces were secondary in riparian transects. Many of the high terraces were roads and dikes. The artificial terraces constrain the channel and disrupt the meandering and energy distribution of the river. The stream's power was no longer diffused throughout the flood plain during floods. The concentration of flows by channelization contributes to increased scour and bank erosion. Scouring of redds was suspected to frequently cause mortality of fall chinook and coho salmon eggs in the mainstem Umatilla River.

Hardwoods were the most abundant trees in the riparian zone (71.8%), but tree density was low (3.3 trees/100 m^2). Most trees (77%) were 3-15 cm in diameter at breast height (DBH) while only 14.9% were 30 cm DBH or more (Table D-6). Riparian canopy ranged 28 to 31% while percent open sky averaged 49%. The harvest and clearing of trees reduced canopy in this reach. Large woody debris in the river channel averaged only 1.5 pieces/100 m and provided little fish habitat (Table D-5).

A total of 27 surface springs (3.5/mile) were observed. Nineteen provided off channel salmonid habitat. Eight smaller springs contributed cold water to the mainstem. The highest concentration of springs (9.1/mile) was between RM 85.5 and 86.6. Bingham Hot Springs (RM 86.6; 36°C; 96.8°F) contributed about 2% (one cfs) of the mainstem flow. Five small, screened, irrigation pumps extracted water directly from the river (RM 81.9 to 87.6; Tables D-7 and D-8).

Moonshine Creek

Habitat surveys were conducted on Moonshine Creek from the mouth to the forks (RM 4.4) from August 28 to September 5, 1995 (Tables D-1, D-2 and D-9 through D-13). The total stream area surveyed was 11,213 m^2. Elevation ranged from 1,400 feet at the mouth to 2,590 feet at the forks (270 feet/mile). Crews classified and inventoried 594 habitat units. Streambed slope averaged 2.7%. The highest water temperature recorded during habitat surveys was 23°C (73.4°F) while the lowest was 10°C (50°F). Habitat was marginal for salmonids throughout the entire 4.4 miles.

The stream channel was mostly dry (58% by area), followed by slow and fast water habitat (23 and 18% respectively). Lateral scour pools were the most abundant slow water habitat, followed by beaver dam pools, glides, straight scour pools and puddled areas (0.24 mean maximum depth). Riffles were the most abundant fast water habitat followed by riffles with pockets and rapids over boulders (0.07 m mean depth).

The stream was often confined by terraces and had few braided channels (3.9% by length 2.1% by wetted area). The active channel width was 3.4 times the wetted channel width. The wetted width to depth ratio averaged 8.9:1 for all units and 20.0:1 for riffles. The streambank was undercut 6.0% and eroded 6.0% (by length). Gravel was abundant and comprising 36% (4,037 m^2) of the wetted streambed area. Spawning gravel abundance does not limit salmonid natural production (Table D-11).

Ground cover in the riparian zone was 51% grasses, 44% shrubs, and 4% exposed soil. Grain fields and stubble were recorded as grasses so the riparian area was in poorer condition than indicated. Agricultural soils are often exposed during winter and spring when erosion potential is highest. Erosion from agricultural fields appeared to be the primary source of sediment to the creek. Riparian canopy was lowest (6 to 27%) farther from the stream. The ground farthest from the stream (riparian transect zones two and three) had often been cleared for agricultural uses. Percent open sky averaged 44%. High terraces were the most abundant landform within the riparian zone. Most terraces were recently formed by bank erosion and down-cutting (Tables D-11 and D-12).

The trees in the riparian area (3.2 trees/100 m^2) were mostly hardwoods (99%). Most trees were small (68%, 3-15 cm DBH), only 16.3% were 30 cm DBH or more (Table D-12). The low tree density in the riparian zone correlated with the low woody debris count (1.2 pieces/100 m) and the deficiencies of instream structure and salmonid habitat (Table D-11). A total of 27 surface springs were identified (6.1/mile; Table D-). These springs contributed cold water to the stream but were too small to provide any off-channel salmonid habitat.

The following three passage barriers were found: a natural bedrock step 0.9 m in height (RM 0.4); a 0.7 m step formed by a concrete road bridge support near RM 1.0, and a 0.9 m step formed by a log near RM 1.3 (Table E-23). Fish passage might be improved with channel or structure modifications at these locations.

Mission Creek

Habitat surveys were conducted on Mission Creek from the mouth to the forks RM (4.3) from August 15 to September 11, 1995 (Tables D-1, D-2 and D-14 through D-18). The total stream area surveyed was 9,994 m^2. Elevation ranged from 1,270 feet at the mouth to 2,200 feet at the forks (216 feet/mile.). Crews classified and inventoried 872 habitat units. The average slope was 2.8%. The highest water temperature recorded during habitat surveys was 14°C (57.2°F) while the lowest was 6°C (42.8°F). Habitat was marginal for salmonids throughout the entire stream.

Dry channel accounted for 76.3% of the area surveyed. Slow water habitat accounted for 12.0% of the area surveyed. Lateral scour pools were the most abundant slow water type, followed by straight scour pools and puddled channels. Maximum depth of slow water habitat averaged 0.18 m. Fast water habitat accounted for 11.4% of the area. Riffles comprised the most area, followed by rapids over boulders and riffles with pockets. The average depth of fast water habitat types was 0.05 m (Table D-14).

Secondary (braided) channels accounted for 3.0% of the channel length and 2.3% of the wetted area. Active channel width averaged 2.5 times wetted channel width. Width to depth ratio of all units averaged 9.3:1 and 32.9:1 for riffles. The streambank was undercut 8.2% and eroded 21.3% (by length). Gravel was the most abundant wetted substrate (4,394 m^2, 44% of the area; Tables D-15 and D-16). Fines comprised 24% of the wetted area. Spawning gravel abundance does not limit salmonid natural production.

The ground cover in the riparian transects averaged 58% grasses, 18% shrubs and 24% exposed soil. Grain fields and stubble were recorded as grasses so the riparian area was in poorer condition than indicated. Agricultural fields are often exposed during winter and spring when erosion potential is highest. Erosion from agricultural fields and effects from livestock grazing appeared to be the primary source of sediment. Riparian canopy was lowest (4-23%) farther from the stream. The percent open sky averaged 38% (Table). High terrace and hill-slope were the most abundant landform in the riparian zone (Tables D-16 and D-17). Most high terraces were recently formed by bank erosion and down-cutting.

Hardwoods were the most abundant tree type (94.6%) in the riparian area, but tree densities were low (2.9 trees/100 m^2). Most trees (77.3%) were in the 3-15cm DBH range, only 10.0% were 30 cm DBH or more (Table D-17). Low tree density in the riparian zone correlated with the low woody debris count (6.6 pieces/100 m) and inadequate instream structure for salmonid habitat (Table D-16). Twenty-one surface springs were identified (4.9/mile). The springs were too small to provide off-channel salmonid habitat but contributed cold water to the stream (Table D-18).

No water diversions were observed. However, two wells near RM 0.5 and 4.1 may affect instream flows. The temperature of the well water was 10.5°C (50.9°F), whereas the temperature of the creek was 12.5°C (54.5°F). The impacts of these wells to stream flows remains unknown.

Seven potential passage barriers were found. Four were artificial structures and three were natural (Table E-23). It appeared that the barriers would significantly impede migration at moderate to high flows and completely block it at low flow. Improvements in fish passage might be achieved through installation of log check dams or structure modification. The most severe artificial barriers were at the bridge near RM 1.4 and at the culvert near RM 3.3.

Cottonwood Creek

Habitat surveys were conducted on Cottonwood Creek from the mouth to the forks (RM 4.1) from June 20 to August 1, 1995 (Tables D-1, D-2 and D-19 through D-23). The total stream area surveyed was 15,431 m^2. Elevation ranged from 1,330 feet at the mouth to 2,200 feet at the forks (212 feet/mile). Crews classified and inventoried 912 habitat units. The average slope was 3.3%. The highest water temperature recorded during habitat surveys was 27°C (80.6°F) while the lowest was 10.5°C (51°F). Habitat was marginal for salmonids throughout the entire survey area.

Dry channel accounted for 49.2% of the area surveyed while slow water habitat accounted for 28.9%. Isolated pools were the most abundant slow water habitat, followed by beaver dam pools, lateral scour pools, puddled channels and glides. The average maximum depth of slow water habitat types was 0.22 m. Fast water habitat accounted for 21.5% of the area. Riffles were most abundant, followed by riffles with pockets and rapids over boulders. The average depth of fast water habitat was 0.08 m (Table D-19).

Secondary (braided) channels accounted for 7.0% of the channel length and 9.3% of the wetted area. Active channel width was 2.6 times wetted channel width. Width to depth ratio of the wetted channel averaged 8.9:1 and averaged 20.8:1 for riffles. The streambank was undercut 10.9% and eroded 12.1% (by length). Gravel comprised 37% (5,709 m^2) of the wetted streambed area (Tables D-20 and D-21). Spawning gravel abundance does not limit salmonid natural production. Fines comprised 32% of the wetted streambed which effects the quality of spawning habitat.

The ground cover in the riparian zone was 53% grasses, 28% shrubs and 19% exposed soil. Grain fields and stubble were recorded as grasses so the riparian area was in poorer condition than the data indicate. Agricultural fields are often exposed during winter and spring when erosion potential is highest. Erosion from the crops fields and the consequences of livestock grazing appeared to be the primary sources of sediment. Riparian canopy was lower (14-41%) farther from the stream. Trees near the stream had often been cleared for agricultural development. Percent open sky averaged 47% (Tables D-21 and D-22).

High terrace and hill-slope were the most common landform in the riparian zone. Many of terraces had recently formed from bank erosion and down-cutting. Hardwoods were the most abundant trees (84.9%), but tree density was low (7.3 trees/100 m^2). Most trees (86.8%) were in the 3-15cm DBH range, and only 4.6% were 30 cm DBH or more (Table D-22). The lack of trees in the riparian zone correlated with the lack of large woody debris in the channel (3.4 pieces/100 m) and provided little fish habitat (Table D-21). Twenty-three surface springs were identified (5.6/mile). The springs were too small to provide off-channel habitat, but contributed cold water to the stream (Table D-23).

Three potential passage barriers were found. These were probably barriers for smaller fish at medium to low flows. A culvert formed a 0.8 m drop at the road crossing near RM 0.6. Near RM 0.9 a concrete structure protecting a water pipe formed a wide shallow area above a 1.1 m drop. The concrete bridge near RM 1.3 formed a 0.7 m drop (Table E-23). The modification of each structure to improve fish passage at low flow would aid juvenile salmon and steelhead to find refuge when water temperatures and flows become unsuitable in some sections of the stream.

Coonskin Creek

Habitat surveys were conducted on Coonskin Creek from the mouth to the forks (RM 2.0) from June 21 to July 17, 1995 (Tables D-1, D-2 and D-24 through D-28). The total stream area surveyed was 5,860 m^2. Elevation ranged from 1,420 feet at the mouth to 1,890 feet at the forks (235 feet/mile). Crews classified and inventoried 626 habitat units. Streambed slope averaged

3.1%. The highest water temperature (29°C) was recorded at the mouth of an un-named tributary near RM 0.9 while the lowest (11°C) was recorded in three springs (RM 0.8, 1.2 and 3.7).

Fast water habitat accounted for 63.2% of the area. Riffles were the most abundant fast water habitat, followed by riffles with pockets and rapids over boulders. The depth of fast water habitat types averaged 0.10 m. Slow water habitat accounted for 36.2% of the area. Lateral scour pools comprised the most area, followed by straight scour pools and glides. The maximum depth of slow water habitat types averaged 0.28 m (Table D-24). Only 0.2% of the stream area was dry. Sampling Coonskin Creek earlier in the summer than the adjacent tributaries may explain the low percent of dry channel area. Water temperature and habitat was marginal for salmonids throughout the stream.

Secondary (braided) channels accounted for 7.9% of the channel length and 10.4% of the wetted area. The width of the active channel was 2.5 times the wetted width. The width to depth ratio of all units averaged 7.6:1 but averaged 19.2:1 for riffles. The streambank was undercut 11.2% and eroded 13.2% (by length). Gravel was the most abundant type of substrate and comprised 34% (1,992 m^2) of the wetted streambed area followed by fines (31%; Table D-25 and D-26). Spawning gravel abundance does not limit salmonid natural production.

The ground cover in the riparian zone was 49% grasses, 43% shrubs and 8% exposed soil. Many of the grasses were actually grain crops. While crops stabilize fields during the growing season, agricultural soils are often exposed during winter and spring when erosion potential is highest. Erosion from agricultural fields appeared to be the primary source of sediment. Riparian canopy (15-31%) was lower further from the stream. Clearing of trees from the riparian area for agricultural uses was common. Percent open sky averaged 41% (Tables D-26 and D-27).

Low and high terraces were the most common landform in the riparian transects. Many of the terraces recently formed from bank erosion and down-cutting. Hardwoods were the most abundant trees (98.8%) but tree density was low (2.8 trees/100 m^2). Most trees (73.5%) were in the 3-15cm DBH range, and only 15.7% were 30 cm DBH or more (Table D-27). The lack of trees in the riparian zone correlated with the lack of large woody debris (1.6 pieces/100 m) and the deficiencies in fish habitat (Table D-26). Crews observed 17 springs contributing cold water to the stream (8.5/mile; Table D-28). The springs were too small to provide off-channel salmonid habitat.

Eleven passage barriers were found. Most barriers resulted from down-cutting of the channel below clay layers. We estimate that the barriers impeded migration at high and moderate flows and completely blocked migration at low flow. The barriers ranged from 0.65 m to 1.65 m in height. Near RM 0.4 a concrete structure (0.8 m high) protecting Pendleton's water pipe was recently modified so that it further diminished fish passage (Table E-23).

Task 1.2: Stream temperatures and stream flow in the Umatilla Basin.

Temperatures

Stream temperature profiles collected throughout the Umatilla River Basin were plotted in Appendix C (Figures C-1 through C-9). Water temperatures became unsuitable (above 20°C, 68°F) for salmonids during the summer below RM 70 in the Umatilla River and in the lower ends of many of the tributaries. For example, in the Umatilla River at RM 42.5 and 49, waters temperatures were well above 20°C (Figures C-1 through C-3). In Wildhorse Creek at RM 1.5, water temperatures were above 25°C (77°F) in July and August. Higher in the basin, temperatures were suitable for salmonids throughout the year. In Mission Creek, at RM 3, water temperatures did not exceed 16°C (61°F) during July and August 1995. In several locations, a spring or cool tributary infused enough cool water to provide suitable flows and temperatures for several hundred feet to several miles downstream. The North Forks of the Umatilla River and Meacham Creek are examples of this.

The riparian canopy along many reaches in the Umatilla River Basin was minimal and provided little shade to the streams. Direct solar radiation and total water volume play the greatest roles in stream temperature dynamics (Brown 1983). Removing large trees from stream areas has been shown to increase maximum stream temperatures in test streams from a maximum of 15.6°C (60°F) before vegetation removal to 30°C (86°F) after removal. Control reaches had no significant changes during the same time period (Brown and Krygier 1970). Shallow, unshaded pools and glides are typical to much of the Umatilla River and function as efficient solar energy collectors and water temperatures can become too warm for salmonids (Brett 1952, Black 1953).

Flow

A strong correlation existed between mean annual (r=0.913) and spring flows (r=0.869) at the Umatilla gage (RM 1.2) and the number natural adult steelhead returning two years later from return years 1982-83 to 1994-95 (Figures B-1 and B-2). Assuming the relationship between spring instream flows and the number of returning adult steelhead remains consistent, approximately 2,000 adult natural and hatchery steelhead will return during the 1995-96 season with 1,400 and 1,800 steelhead expected to return during the 1996-97 and 1997-98 seasons respectively.

Tasks 1.3 through 1.5: Obtain habitat data collected by other agencies. Digitize and summarize habitat data. Estimate total usable habitat by stream reach, drainage and entire basin.

Data from habitat surveys conducted by ODFW in 1991 and 1992 on Umatilla River Basin tributaries were obtained on computer diskette. No additional data entry or summarization was required. Raw habitat data collected and recorded in the field were entered into a data base program. Habitat data summaries were listed in Appendix D.

Estimates of salmonid summer rearing habitat by stream reach, drainage and basin were summarized in Table B-1. Approximately 30% (233 of 770 stream miles) of the salmonid habitat in the Umatilla River Basin is suitable for natural production. De-watering, sedimentation, poor water quality and/or excessive water temperatures were the primary reasons 70% of the 770 miles were rated unsuitable. We do not know how much habitat was available historically for salmonid production. We speculate that 70% (540 of 770 stream miles) of the drainage may have been suitable for summer rearing of salmonids. The remaining 30% of the streams include portions of subbasins such as Wildhorse Creek, Butter Creek, Alkali Canyon, Spear Canyon and Coombs Canyon. Currently, these streams (many are ephemeral) flow from desert uplands and presumably never supported salmonids during the summer.

Task 1.6: Coordinate water quality monitoring efforts in the Lower Umatilla River with the Oregon Department of Environmental Quality.

Water quality monitoring is currently being conducted by CTUIR, ODFW, USFS, DEQ and BOR. CTUIR monitors temperatures and sediment through this project, the Habitat Project and the Artificial Production Program (Appendix C). ODFW, BOR and USFS also monitor water temperatures in the Umatilla River Basin. DEQ monitors several sites in the Umatilla River for 45 heavy metals, conductivity, pH, total alkalinity, nitrogen, total organic carbon, phosphorous, hardness and others. DEQ and CTUIR, in cooperation with the Umatilla Basin Watershed Council, will begin more intensive water quality monitoring in April, 1996. As data are collected and examined, recommendations regarding point source and non-point source pollution allocation and management for reducing pollutants will come from the newly formed Umatilla River Total Maximum Daily Load Technical Advisory Committee.

OBJECTIVE 2: Biological Surveys

Task 2.1: Conduct presence/absence surveys in the Umatilla River Basin.

A fish survey was conducted in Coyote Creek and in an un-named tributary that enters the North Fork Umatilla River from the north at RM 1.5 (March 24, 1995). Time and personnel constraints limited additional presence/absence surveys.

Coyote Creek (4°C; 39.2°F) was electrofished for 380 seconds from the mouth to approximately 300 m upstream. Pools with adequate cover for fish were sampled. Crews captured seven steelhead (61 to 148 mm) in poor condition. Approximately ten sculpin were sighted. Stream and riparian habitat conditions appeared excellent for salmonids. Pools and large instream woody debris were abundant.

The un-named tributary (5°C; 41°F) was electrofished for 180 seconds from the mouth to 200 m upstream. Pools and pockets were sampled. One steelhead was captured (99 mm). No other fish were sighted. Riparian conditions appeared good and stream habitat appeared fair for salmonids. Rapids were the most common habitat type.

Task 2.2: Estimate salmonid densities in streams where habitat has been surveyed by electrofishing.

<u>Umatilla River</u>

The Umatilla River was subsampled for fish from the upper Umatilla Indian Reservation Boundary (RM 81.8) to the mouth of the North Fork of the Umatilla River (RM 89.6) from August 8 to August 25, 1995. Salmonids were captured from RM 81.9-89.3. The highest water temperature recorded in the mainstem during fish surveys was 19°C (66.2°F) near RM 83.2 while the lowest was 9.5°C (49°F; RM 88.3). Based on salmonid densities, this section of the Umatilla River appeared to be an important rearing area for juvenile steelhead, chinook salmon and mountain whitefish.

We sampled 72 of 643 habitat units (11.1% by units, 6.7% by area). Thirteen of 17 habitat types were electrofished (dry units and steps were excluded). A total of 2,234 of the following salmonids were captured: 1,899 (78.5%) natural steelhead trout; 327 (13.5%) juvenile natural chinook salmon; 185 (7.6%) mountain whitefish, and five (0.2%) bull trout. The bull trout were captured from pools or pocket water between RM 87.7 and 89.2.

The expanded population estimate was 69,116 salmonids with a mean density of 0.45 salmonids/m^2 (s/m^2; Tables E-1 and E-11). Juvenile salmonid densities in slow water units averaged 0.52 s/m^2 and averaged 0.40 s/m^2 in fast water units (Table E-6). Lateral scour pools had a mean density of 0.87 s/m^2, and a single dam pool had a density of 1.77 s/m^2. An increase in pool and pocket water habitat would likely increase natural production of salmonids.

Fork lengths of captured salmonids ranged from 29-258 mm for natural steelhead trout, 65-127 mm for natural juvenile chinook salmon, 116-440 mm for mountain whitefish, and 170-265 mm for bull trout (Table E-12, Figures E-1 and E-2). Fifty-six percent of the whitefish captured were from slow water habitat where mean density was twice as high as in fast water habitat. The highest mean density of whitefish was estimated in plunge pool habitat (0.1273/ m^2). Whitefish were captured from RM 82.2-88.7, most were near RM 87.7.

Electrofishing and handling caused observed mortality of 2.8% of the captured natural chinook salmon juveniles, 1.9% of natural steelhead and 0.5% of mountain whitefish. Scissor and puncture wounds from avian predators were observed on a few salmonids (0.11 to 2.2%) including three chinook (mean length 88 mm), two steelhead (208 mm), and four mountain whitefish (336 mm).

The population estimate of non-salmonid was 151,511 fish. The ratio of non-salmonid to salmonid was 2.2:1. Speckled dace and redside shiners were the most abundant of non-salmonids (comprising 98.9%, Table E-17). Six northern squawfish (112-170 mm) were captured in an isolated pool with a spring seep; their stomachs contained insects, sculpins and snails.

Moonshine Creek

Salmonids were captured by electrofishing in Moonshine Creek from the mouth to RM 4.4 (September 18 to 21, 1995). The highest water temperature recorded was 18.5°C (65.3°F) near RM 1 while the lowest (11.5°C, 52.7°F) was recorded from a spring near RM 0.1. Moonshine Creek appeared to be an important rearing area for steelhead and of lesser importance to coho and chinook salmon.

The following numbers of juvenile salmonids were captured: 369 (97.46%, 48-240 mm) natural steelhead trout; six (2.4%, 88-95 mm) natural coho salmon, and one (0.3%, 88 mm) natural chinook salmon (Tables E-2, E-13 and Figure E-3). Juvenile coho and chinook salmon likely migrated into the creek from the mainstem Umatilla River. All salmon were captured from one scour pool near RM 0.2.

Fourteen habitat types and 89 of 526 habitat units were sampled (15.0% by units and 9.9% by area). The expanded population estimate was 1,169 salmonids and mean density was 0.10 s/m^2 (Table E-7). The salmonid density of slow water units was 2.1 times higher than in fast water units. Plunge and trench pools had mean densities of 2.22 and 1.86 s/m^2, respectively. The density of salmonids in riffles with pockets was 12.5 times as high as in riffles. Increase in pool and pocket water habitat would likely increase salmonid production.

Electrofishing and handling caused observed mortality of 0.81% of the captured natural steelhead. A scissor bite was observed on one steelhead (165 mm). The expanded population estimate of non-salmonids was 10,340 fish. The ratio of non-salmonid to salmonid was 8.8:1 (Table 18). Suckers were the most abundant non-salmonids and were concentrated near the confluence with the Umatilla River. Sculpins and speckled dace were not as numerous, but were distributed throughout the stream.

Mission Creek

Fish surveys were conducted in Mission Creek from the mouth to the forks (RM 4.3) from September 5 to 13, 1995. Salmonids were captured from RM 0.4-4.2. The maximum water temperature recorded was 21°C (70°F) near RM 0.6 while the lowest was (11.5°C, 52.7°F) from a spring near RM 4.1. Mission Creek appeared to be important for juvenile steelhead and of moderate value to coho salmon. Ten habitat types and 65 of 641 habitat units were sampled (7.5% by units and 4.4% by area). The expanded population estimate was 903 salmonids with mean salmonid density of 0.093 s/m² (Table E-3). The density of slow water units was 14 times as high as in fast water units. Plunge pools had the highest density of any habitat type with an estimated density of 1.62 s/m² (Table E-8). Salmonid density in riffles with pockets was six times higher than in riffles. Increasing pool and pocket water habitat would likely increase the salmonid natural production.

Crews captured 202 natural steelhead trout (90.2%; 56-290 mm), 21 natural coho salmon (9.4%, 88-95 mm) and one hatchery steelhead (0.4%, 230 mm). This was the only hatchery steelhead captured during any of the biological surveys conducted from June 29 to September 21, 1995 (Table E-14 and Figure E-4). All coho salmon were captured in pools near RM 0.5. Juvenile coho and chinook salmon presumably migrated into the creek from the mainstem Umatilla River where spawning has been documented.

Electrofishing and handling caused observed mortality of 0.50% of the captured natural steelhead. The population estimate of non-salmonids was 10,326. The ratio of non-salmonid to salmonid was 11.1:1 (Table E-19). Speckled dace (76.9%) were the most abundant non-salmonid followed by sculpins and redside shiners.

Cottonwood Creek

Fish surveys were conducted in Cottonwood Creek from the mouth to the forks (RM 4.1) from July 5 to August 1, 1995. Salmonids were captured from RM 0.0-3.1. The highest water temperature recorded was 24°C (75.2°F) near RM 2.9 while the lowest was 8.5°C (47.3°F) from a spring near RM 0.2. Cottonwood Creek appeared to be an important rearing area for steelhead and of moderate value to coho salmon.

The following juvenile salmonids were captured: 172 natural steelhead trout (78.2%, 37-340 mm); 47 natural coho salmon (21.4%, 69-103 mm), and one natural chinook salmon (0.46%, 63 mm). Juvenile coho and chinook salmon may migrate from the mainstem Umatilla River where spawning has been documented. Ninety-eight percent of the salmon captured were found in pools in the lower 1.1 miles of the creek (Table E-4, E-15 and Figure E-5).

Fourteen habitat types were sampled from 70 of 769 units (7.7% by number and 18.3% by area). The expanded population estimate was 626 salmonids. The mean density estimated for the entire area of stream was 0.04 s/m² (Table E-9). The mean salmonid density in slow water units was 2.1 times higher than in fast water units. The density of salmonids in riffles with pockets was 4.2 times higher than in riffles. This suggested that an increase in the amount of pool and pocket water could increase the number of salmonids in the stream section.

Electrofishing and handling caused observed mortality of 1.74% of the captured natural steelhead. A scissor bite was observed on one steelhead (211 mm). The population estimate of non-salmonids in the survey section was 8,937. The ratio of non-salmonid to salmonid was 11.9:1 (Table E-20). Speckled dace (85.1%) were the most abundant non-salmonid followed by sculpins, redside shiners and suckers.

Coonskin Creek

Salmonids were captured in Coonskin Creek from the mouth to RM 3.7 (June 29 to July 18, 1995). The highest water temperature recorded was 27.5°C (81.5°F) near RM 0.8 while the lowest was 11°C (51.8°F) near RM 0.4. Near RM 0.1, the water temperature was 11.5°C (52.7°F) under a developed canopy but was 17.5°C (63.5°F) only 30 m upstream where a wheat field directly bordered the stream. Coonskin Creek appeared to be an important rearing area for steelhead and coho salmon and of moderate value to chinook salmon (Table E-5).

The following numbers of juvenile salmonids were captured: 311 natural steelhead trout (76.0%, 42-327 mm); 86 natural coho salmon (21.0%, 64-90 mm), and 12 natural chinook salmon (2.9% 74-90 mm). Eighty-one percent of the salmon captured were found in pools between RM 0.1 and 0.2 (Table E-10, E-16 and Figure E-6). Juvenile coho and chinook salmon may migrate into the creek from the mainstem Umatilla River where spawning has been documented.

Twelve habitat types were sampled from 88 of 592 units (14.1% by number and 15.4% by area). The population estimate in the survey area was 1,875 salmonids. The mean density estimate for the entire stream was 0.320 s/m^2 (Table E-10). The mean salmonid density in slow water units was 5.9 times higher than in fast water units. The density of salmonids in riffles with pockets averaged 1.8 times higher than riffles. Increasing in the amount of pool and pocket water might increase salmonid natural production.

Electrofishing and handling caused observed mortality of 8.33% of the captured natural chinook salmon juveniles, 2.32% of natural coho salmon juveniles and 0.64% of natural steelhead. A puncture wound was observed on one natural steelhead (151 mm). The population estimate of non-salmonids was 1,955 fish. The ratio of non-salmonids to salmonids was 1:1 (Table E-21). Speckled dace (71.2%) were the most abundant non-salmonid followed by sculpins.

Task 2.3: Electrofish permanent index sites during November, April and August.

Index sites with the highest average catch rate during the three sample periods were: East Birch Creek (3.4 fish/min.); Boston Canyon Creek (3.2 fish/min.); Spring Creek (3.1 fish/min.), and Squaw Creek (site 27, 3.0 fish/min.). Ryan Creek had a high catch rate (5.1 fish/min.) but was only sampled once (Table E-22). In general, the highest catch rates during August were in the upper tributaries of the Umatilla River. During November, tributaries of Birch Creek had the highest catch rates. Most salmonids were captured in slow water, near the bank, during March and November.

During index surveys, crews captured steelhead, chinook salmon, coho salmon, mountain whitefish, american shad, speckled dace, redside shiners, northern squawfish, chiselmouth, suckers, sculpins, smallmouth bass and carp. Several passage barriers were found during index surveys and were listed in Table E-23. Modifications to some barriers would allow salmonids access to additional rearing area.

<u>March and April</u>

Field conditions were generally poor for sampling at most sites during March and April because of moderate to high flows. Sampling was often restricted to the stream margins. Low catch rates were frequent. The Ryan Creek index site (37) was not sampled because of poor accessibility.

Natural steelhead were not collected in the spring at index sites downstream of RM 74 (site 8) nor were natural chinook salmon collected below RM 88 (site 10). No natural coho salmon were observed; however, 44 hatchery coho salmon were collected at RM 9 (site 2). One mountain whitefish (167 mm) was collected at RM 25 (site 3). The highest salmonid catch rates were in Line Creek (3.3 fish/min.), Boston Canyon Creek (2.7 fish/min.), East Birch Creek (1.9 fish/min.), and the Umatilla River, RM 9.0 (site 2; 1.9 fish/min.).

August and September

Field conditions were good for sampling during August and September. The Ryan Creek site (37) was not sampled. Seventy-eight young-of-the-year (YOY) shad, 33 YOY carp and 14 smallmouth bass were captured at RM 1.5 (site 1). Five naturally produced coho juveniles were captured from an isolated pool with a spring seep at RM 38 (site 4).

During summer index monitoring, natural steelhead were not observed below RM 50 (site 5) nor were natural chinook salmon collected below RM 88 (site 10). Natural coho salmon were not collected below RM 67.5 (site 7). The highest catch salmonid rates were in Squaw Creek (site 27; 6.7 fish/min.), Meacham Creek (site 34; 5.3 fish/min.), East Meacham Creek (4.0 fish/min.), and the South Fork Umatilla River (site 13; 4.0 fish/min.). Boulders to improve salmonid habitat altered the site in East Birch Creek (RM 4.5, site 19).

November

Field conditions were poor for sampling during November due to high flows. In most cases, sampling was restricted to the stream margin. Most salmonids were captured in slow water, with undercut, root wads or woody debris. Many of the fish appeared to have been actively feeding. The following sites were not sampled in November due to flooding: South Fork Umatilla River (site 13), North Fork Meacham Creek (site 33), East Fork Meacham Creek (site 35) and Shimmiehorn Creek (site 40). Four adult fall chinook salmon, one adult steelhead, three mountain whitefish and many adult suckers were present in the isolated pool at site one. We did not electrofish over the salmon redds at site one. Many large cottonwood trees in the riparian area at site three had been cut down and removed. An adult fall chinook salmon was observed at site three. A fall chinook or coho salmon was occupying a redd at site four. Numerous YOY squawfish were rearing in the backwater pool with a spring seep at site four.

During fall sampling, natural steelhead were not observed below RM 50 (site 5) nor were natural chinook salmon collected below RM 88 (site 10). Natural coho salmon were not collected below RM 67.7 (site 7). The streams with the highest catch rates were Ryan Creek (5.1 fish/min.), Bear Creek 5.0 fish/min.), East Birch Creek (4.9 fish/min.), and Pearson Creek (4.4 fish/min.). Salmonid habitat improvement projects (gravel removal and boulder placements) altered the index sites in Birch Creek (RM 10, site 16) and West Birch Creek (RM 2, site 17).

Task 2.4: Evaluate the use of snorkeling for enumerating salmonids.

Snorkeling as a technique to enumerate juvenile salmonids has been used successfully by a researchers in Oregon, Washington and Idaho (Petrosky and Holubetz 1987, Bugert et al. 1990, Kucera et al. 1991, Angradi and Contor 1989, Hillman and Mullan 1989, Mullan et al. 1992, Cannamela 1993, Contor and Griffith 1995). However, we found that snorkeling techniques would not meet our data needs and were impractical for many of the streams in the basin. Salmonid density estimates from snorkeling techniques would not be directly comparable to existing electrofishing data. Many of the juvenile salmonids captured by electrofishing were extracted from substrate interstitial spaces and would not have been visible to snorkelers estimating salmonid abundance. Water was often too shallow (often less than 15 cm) or too turbid for snorkeling enumeration techniques. Snorkeling would also require extensive training and evaluation, yet not provide opportunities to take scales, lengths and weights from salmonids.

Task 2.5: Scale Analysis.

See Task 9.1.

Task 2.6: Estimate total number of salmonids in each stream reach, stream, and subbasin.

The populations of natural juvenile summer steelhead (ages 0+ to 3+) and spring chinook salmon (ages 0+ to 1+) in the Umatilla River Basin were estimated to be near 725,000 and 52,000 respectively. The majority of steelhead rear in Birch Creek (170,000), Meacham Creek (265,000), Squaw Creek (40,000), and the upper Umatilla River (216,000). Natural chinook reared primarily in the North Fork and the upper mainstem (RM 70 to 89.6) of the Umatilla River (41,000) and Meacham Creek (10,000). The estimates should not be considered static or accurate and were based on limited quantitative data (Table B-1). More refined estimates will be possible as additional data are collected. Recognize, that the available habitat and associated salmonid populations expand and contract depending on factors such as, snow pack, summer precipitation, flow and water temperatures.

OBJECTIVE 3: Adult Passage Evaluations.

Task 3.1: Evaluate the upstream migration of radio tagged adult salmon and steelhead past the irrigation diversions in the lower Umatilla River.

<u>Fall Chinook Salmon and Coho Salmon</u>

A total of nine fall chinook salmon were radio tagged and released at TMD between October 6 and 20, 1994. Of these, three successfully migrated over Westland Diversion Dam and one (of the three) successfully negotiated Feed Canal and Stanfield Dams. The remaining six salmon all remained below Westland Dam (RM 27.2).

Between October 12 and 26, 1994, a total of eight coho salmon were radio tagged and released at TMD. Three of these passed Westland Dam and one of the three passed Feed Canal and Stanfield Dams. Of the remaining five coho salmon, one regurgitated the radio transmitter and four remained below Westland Dam.

Peak migration for fall chinook and coho salmon over McNary Dam on the Columbia River has typically occurred in September. Entry dates at TMD have varied but generally follow flows exceeding 150 cfs (Volkman 1994). Umatilla River coho and fall chinook salmon broodstock have typically spawned in early November (Rowan, CTUIR, personal communication). In 1994, flows in the Umatilla River began to increase in early October and most fall chinook and coho salmon arrived in mid to late October. By this time, coho and fall chinook salmon were entering advanced stages of maturation and reduced physical condition. The potential for these fish to successfully migrate to headwater sections of the Umatilla River Basin was remote.

Telemetry data collected in 1994 were indicative of sexually mature fish and portrayed the movements of fish at or near spawning. Evidence that these fish were near spawning was demonstrated by ripe adults at TMD and numerous fall chinook and coho salmon spawning below TMD each fall. If fall chinook and coho salmon are released at TMD in October and November, most will spawn within 20 miles of the release point. Unfortunately, most of the lower Umatilla River does not contain quality spawning and rearing conditions, particularly for coho salmon. If natural production of these species is desired, trapping and hauling may be the best solution until flows are made available in early September.

Summer Steelhead

A total of 30 summer steelhead were radio tagged between October 31, 1994 and May 16, 1995. Of these, 16 provided data past all of the major diversion dams (TMD to above Stanfield Dam), seven could not be located after release, and seven regurgitated the radio transmitter. On average, 36 days were required to migrate from TMD to above Stanfield Dam (Table F-1). Twenty-five days were required to complete this distance in 1993-94. Average migrational passage time (hours and minutes) required to negotiate Westland, Feed Canal, and Stanfield dams were 13:06, 83:24, and 2:58 respectively (Table F-1). This compares to 1:30, 48:54, and 1:23 in 1993-94 (Figure F-1). . Percent of fish migrating through the ladder at each diversion was 38% at Westland, 75% at Feed Canal, and 31% at Stanfield (Table F-1, Figure F-2).

Average migrational passage time between TMD and Westland Dam, Feed Canal Dam, Stanfield Dam, and the ODFW site, were 27.2, 29.2, 36.4, and 48.5 days, respectively (Table F-2). Passage times between diversion areas are provided in Figure F-3.

Flow ranges encountered during adult passage were 707 to 2650 cfs at Westland Dam, 531 to 2448 cfs at Feed Canal Dam and 662 to 3420 cfs at Stanfield Dam. Migrational delays were documented at Feed Canal Dam at flows ranging from 563 to 1,601 cfs (Table F-1). Some minor delays also occurred at Westland and Stanfield Dams in the 1,200 to 1,400 cfs range (Table F-1). Water temperatures encountered during passage for each diversion are presented in Table F-1.

During the last three years, average passage times required to migrate from TMD to above Stanfield Dam have been similar. In 1993, 1994, and 1995, 30 days, 25 days, and 27 days were required, respectively. Passage times through the Umatilla River were longest for summer steelhead entering early in the migrational period (September through December). Fish entering later in the period, and thus closer to spawning, such as in March or April, migrated through the system more quickly (Figures F-6 and F-7).

In the last two years, nine summer steelhead (22%) could not be located following release at TMD. Although it's possible the radio transmitter failed or the fish were captured, fall-back out of the system is more likely. This may suggest that TMD counts for summer steelhead were inflated. Several studies have been conducted at TMD to evaluate fall-back levels. Unfortunately, these experiments only enumerate recaptures. In an effort to understand this uncertainty, CTUIR will install an additional telemetry receiver downstream of TMD for the 1995-96 evaluation.

Migrational delays were again observed at Feed Canal Dam. Passage times in 1994-95 (83:25) were considerably longer than those observed in 1993-94 (48:54). Although some increased delay was likely in response to high flows and gravel accumulations at the dam, poor facility design remains the primary problem. Feed Canal Dam was designed for water diversion, not fish passage. The large apron on the downstream side of the dam creates false attraction for ascending adults and prevents fish from jumping over the crest of the dam. Because of this, the ability of fish to locate the fish ladder entrance at Feed Canal Dam was of paramount importance. In 1994-95, 75% of the radio tagged summer steelhead passing the facility used the fish ladder. In comparison, 38% used the ladder at Westland Dam and 31% at Stanfield Dam.

Data indicated that upstream migrants could not locate the ladder entrance at Feed Canal Dam. The large expanse of the dam compared to the small fish ladder entrance was likely responsible. Strong attraction flows toward the fish ladder may reduce this problem. This, however, would only be a solution during low flows. During high flows, water spills over the entire crest, thus creating attraction away from the fish ladder and again passage delays.

The effect of delay below Feed Canal Dam on upstream migrants is unknown. For summer steelhead returning early in the migrational period, a small delay is probably insignificant. Late returning steelhead, however, and spring chinook, fall chinook, and coho salmon were likely impacted. Timing for these fish is critical. Migrational delay and repeated attempts to negotiate the structure may be tapping into vital energy reserves needed for spawning. This, in turn, may promote prespawn mortality and impact distance migrated and spawning sites chosen. It should be noted that passage times for Feed Canal Dam only represent fish that successfully negotiate the structure. In each of the last two consecutive years, several radio tagged fish have been unable to negotiate Feed Canal Dam. These fish were thus forced to choose spawning sites downstream of the dam.

Several solutions concerning delays at Feed Canal Dam have been suggested. These include various combinations of additional spill gates, jump pools and fish ladders. Given the continual problems associated with Feed Canal Dam, however, reconstruction or dam removal is likely the best option. In 1994-95, Feed Canal Dam experienced severe gravel accumulation problems. Gravel accumulations compounded existing passage concerns and required the Irrigation District to conduct instream work several times during the migrational period. Its important to understand that gravel accumulations were not directly responsible for passage delays at Feed Canal Dam but rather facility design. Until major modifications are made to Feed Canal Dam, most upstream migrants will be severely delayed with some migrants completely unable to negotiate the structure.

Figure F-3 illustrates that the reach of river did not cause delay but rather the diversion dams within the reach. Clearly, summer steelhead display little difficulty ascending sections of the river without diversion dams. Once encountering sections with dams, migrational movements were considerably reduced. It's interesting that summer steelhead appeared willing to migrate at marginal water temperatures of 4.4 to 6.1°C (40 to 43°F) through sections of the river without diversion dams, but upon encountering sections with dams, migration either stops or passage time increases.

Spring Chinook Salmon

Between April 10 and 26, 1995 a total of 15 spring chinook salmon were radio tagged at TMD. Of these, nine provided data past Stanfield Dam, two regurgitated the radio tag, three fell back and were recaptured at TMD, and one migrated up to but not past Stanfield Dam. Average time needed to migrate from TMD to above Stanfield Dam was 18 days (Table F-3). Twelve days were needed to complete this distance in 1993-94. Average passage times (hours and minutes) at Westland, Feed Canal, and Stanfield dams were 04:30, 89:42, and 04:01, respectively (Table F-3). In 1993-94, 01:30, 48:54, and 01:23 were required to complete this distance (Figure F-4). Forty percent of the fish chose to use the fish ladder at Westland, 60% at Feed Canal, and 11% at Stanfield (Table F-3, Figure F-5).

Flows encountered during passage were 796 to 911 cfs at Westland Dam, 689 to 2772 cfs at Feed Canal Dam, and 675 to 3,781 cfs at Stanfield Dam. Migrational delays occurred at Feed Canal Dam at flows ranging from 700 to 2,772 cfs. One chinook salmon was also delayed at Westland Dam at average flows of 796 cfs (Table F-3). No flow-related delays were documented for spring chinook salmon at Stanfield Dam. Water temperature information is provided in Table F-3.

In 1995, spring chinook salmon required an average of 18 days to migrate through the diversion areas (TMD to above Stanfield Dam) compared to 36 days for summer steelhead. Most of the difference in passage time occurred between TMD and Westland Dam. Spring chinook salmon required on average six days to complete this section while summer steelhead required 27 days.

Like summer steelhead, it appears that gravel accumulations coupled with increased flows greatly affected spring chinook salmon passage at Feed Canal Dam in 1995. In 1994, average passage time (hours and minutes) for spring chinook salmon at Feed Canal Dam was 11:58. This number increased to 89:42 in 1995. It's interesting that average passage time for summer steelhead at Feed Canal Dam was nearly identical at 83:24. During 1994, flows (encountered during passage) at Feed Canal Dam ranged from 346 to 1,563 cfs. In 1995, flows ranged from 689 to 2,772 cfs. During moderate to high flow events, such as those experienced in 1995, much of the flow spilled over the crest of the dam and was directed away from the fish ladder. By itself, false attraction will increase passage times. Compound this with gravel accumulations that prevent migration toward the fish ladder and passage times increase dramatically. This occurred at Feed Canal Dam in 1995. During low flow events, as in 1994, most of the flow was directed toward the irrigation canal headworks and toward the fish ladder. Under these circumstances, ascending adults homed in on the fish ladder and passage times reduced accordingly. This does not suggest that spring chinook were without migrational difficulty at Feed Canal Dam during low flow conditions. Average passage times at Feed Canal Dam were more than 15 times higher than those at Stanfield Dam in 1994, and more than 20 times those at Stanfield Dam in 1995.

OBJECTIVE 4: Adult Passage Evaluations Following Upstream Transport.

Task 4.1: Evaluate movements of radio tagged adult spring chinook salmon and summer steelhead following upstream transport.

Summer Steelhead

A total of 11 summer steelhead were radio tagged between November 10, 1994 and April 7, 1995 as part of the upstream transport evaluation. Following release at either Barnhart or Nolin, nine migrated upstream (seven into the Umatilla River, one into Birch Creek, one into McKay Creek), one fell back below TMD and was recaptured and hauled upstream, and one regurgitated the radio transmitter. On average, fish released at TMD traveled at a rate of 4.1 miles/day (5.9 miles/day in 1993-94) between Stanfield Dam and the fixed-site at ODFW (Table F-4). By comparison, fish hauled upstream traveled an average of 1.7 miles/day (5.2 miles/day in 1993-94) between the release site (Barnhart or Nolin) and the ODFW site (Table F-5).

In 1995, ten summer steelhead provided data following upstream transport and release. All but one migrated upstream following release at either Barnhart or Nolin. Although similar in 1994, migrational rates through the same section of river for fish released at TMD versus those hauled upstream were different in 1995. Some discrepancy in miles moved per day can be explained by differences in release dates. Variation between years was likely a result of changing flows and water temperatures. Migrational differences in these two release groups was not critical but does provide a means of comparison. What does matter is whether summer steelhead successfully migrate to spawning locations following upstream transport. In the last two years, 94% (17 out of 18) of the summer steelhead evaluated successfully migrated upstream following upstream transport and release.

Spring Chinook Salmon

Beginning on May 16 and concluding on June 16, 1995, a total of ten spring chinook salmon were radio tagged at TMD and released at either Thornhollow (RM 73.5) or Imeques C-mem-ini-kem (RM 80). After release, six remained at or near the release location until time of spawning, one fell back to Stanfield Dam and then returned upstream (above the ODFW site, RM 56), two fell back to Westland Dam and then returned upstream, and one regurgitated the radio transmitter.

Because all spring chinook salmon were released above the uppermost receiver (ODFW site), no 1994-95 migrational comparisons of upstream transport versus passage evaluation are available. Comparisons for 1993-94 and passage evaluation information for 1994-95 is provided in Tables F-6 and F-7.

During the last two years, a total of 18 spring chinook salmon (nine each year) have provided migrational data following upstream transport and release. All 18 have successfully migrated to or remained at spawning locations. Most salmon in 1995 (six out of nine) remained at or near the release location (Thornhollow, Imeques C-mem-ini-kem) until spawning. Three, however, fell back into the diversion sections of the Umatilla River (one to Stanfield Dam and two to Westland Dam) before returning upstream. Although some fall-back following release was expected, these fish fell back an average of 46.5 miles. All three fish fell back during late May and early June. At this time, flows in the lower section of the river, particularly below the major diversion points, were extremely low and water temperatures were extremely high.

In recent years, adult counts on spawning surveys in relationship to release numbers at TMD have suggested spring chinook salmon are falling back into the lower Umatilla River and potentially out of the basin. As recent as 1993, an estimated 43% of the spring chinook salmon released above TMD were unaccounted for (CTUIR 1994). It's possible that the Umatilla River received strays from other systems. Once released above TMD, they fell back over the dam to continue migration to their stream of origin. To better understand these questions, this project will focus on the movements of spring chinook salmon in 1996.

OBJECTIVE 5: Evaluate Homing and Straying of Adult Salmonids

Task 5.1: Determine factors essential for homing and upstream migration of maturing salmonids.

<u>Fall chinook Salmon and Coho Salmon</u>

Consistent with mainstem passage information (Table F-8), CWT data demonstrate that Umatilla River fall chinook salmon first enter the John Day Pool during the period of August 24 to 30 with peak migration occurring in mid September (Kissner 1992, Wagner 1990). In 1992, significant numbers of fall chinook salmon entered the Umatilla River when flows reached 150 cfs (Figure F-8). Large numbers of fall chinook salmon entered at 200 cfs in 1993 and 1994 (Figures F-9 and F-10).

Homing rates for Umatilla River fall chinook salmon (all release groups) during the last four return years have ranged from a low of 24% in 1992 to a high of 59.5% in 1990 (Table F-9). Average attraction flows exiting the Umatilla River in early September (September 1-15, 1990-94) ranged from a low of 1.5 cfs in 1992 to a high of 78 cfs in 1993 (Table F-9). Acclimated versus direct release experiments of fall chinook salmon (Table F-10) show weighted average homing rates of 52.1% and 55.3% respectively. Homing rates versus age at release for Umatilla River fall chinook salmon were highest for age 1+ fish. Age 1+ fish had weighted average homing rates of 67.9% while spring and fall releases of subyearlings (0+,0++) averaged 48.4% (Tables F-11 and F-12).

Although coho salmon enter the Columbia River later than fall chinook salmon, entry timing at TMD was similar. In 1992, coho entered TMD when flows reached 150 cfs (Figure F-8). Two-hundred cfs was required to encourage significant numbers in 1993 and 1994 (Figures F-9 and F-10).

Many coho salmon released in the Umatilla River return to their rearing facility at Bonneville Complex (Table F-13). Stray rates above McNary Dam were essentially zero. Homing rates for coho salmon (all release groups) during the 1987-91 return years have ranged from a high of 100% to a low of 58.3%. Weighted average homing rate for these same years was 73.1% (Table F-13). Weighted average homing rates to the Umatilla River for acclimated versus direct releases of coho salmon were 70.4% and 72.1%, respectively (Table F-14).

Entry for fall chinook salmon at TMD hinges on availability of attraction flows. Phase I of the Umatilla Basin Project provided minimum flow levels below TMD beginning in 1993. These flows, however, have not been significant enough to encourage migrational entry. Data clearly demonstrate that at least 150 cfs was required to encourage movement of both fall chinook and coho salmon into the Umatilla River. Without attraction flows from the mouth of the Umatilla River in late August and early September, straying and late entry of fall chinook salmon is inevitable.

Regardless of attraction flow levels, it may be discovered that some fall chinook salmon naturally migrate upstream of the mouth of the Umatilla River. Migrational behavior of this type has been documented for both Umatilla River origin summer steelhead and spring chinook salmon at attraction flows far exceeding those experienced during the fall chinook salmon migration (Volkman 1994). Fall chinook salmon above the mouth of the Umatilla River may simply be "testing" for Umatilla River water with the intention of dropping back if the Umatilla River is not detected. Once over McNary Dam however, they find passage back through the dam difficult and thus spend days if not weeks in the McNary pool and forebay before successfully falling back and entering the Umatilla River. Typically, a Umatilla River origin fall chinook salmon above McNary Dam was considered to be straying. In reality, this may be a natural part of the migrational process of these fish.

It would be interesting to observe entry dates of fall chinook salmon at flows exceeding 500 cfs in early September. Given these conditions, mainstem straying and thus delay may be significantly reduced. One might argue that historically flows at the mouth of the Umatilla River were not 500 cfs in early September. Historically, however, the Columbia River was not a reservoir as it is today. Lake-like conditions and thus poor water mixing in the mainstem may demand attraction flows far greater than previously required. The construction of mainstem dams has also made it more difficult for fish to ascend and fall-back to their respective tributaries. At this time, attraction flow levels in the Umatilla River are not fully understood. Until more information is gathered, minimum attraction flows should not be set.

Summer Steelhead

Coded wire tag data analyzed by Kissner (1992), found summer steelhead in the mainstem Columbia River (Zone 6) from August 1 through October 31. Entry timing at TMD varies and may extend over ten months. Though large numbers of summer steelhead have entered the Umatilla River in November and December, typically the largest number of fish enter in February, March, and April.

In each of the last three return years, peaks of over 500 cfs (over 1,000 cfs in some years) were necessary to encourage significant numbers of summer steelhead to enter TMD (Figures F-11, F-12 and F-13). Water temperatures above 4.4°C (40°F) generally do not delay entry. Stray rates for summer steelhead were low. Coded wire tag data analyzed by Rowan (1994) uncovered one Umatilla River origin summer steelhead above McNary Dam. However, some Umatilla River summer steelhead were known to migrate over McNary Dam prior to falling back and ascending the Umatilla River (Wagner 1990, Wagner and Hillson 1991).

Entry timing for summer steelhead at TMD can begin as early as late August and extend into late May. Native summer steelhead have survived in the Umatilla River because of their ability to wait long periods of time, if necessary, between mainstem entry and spawning (Kissner 1992). Stray rates associated with summer steelhead were extremely low. Unlike salmon, summer steelhead migrating above McNary Dam can have as long as ten months to fall-back, relocate, and successfully ascend the Umatilla River.

Large flows were necessary to attract significant numbers of summer steelhead into the Umatilla River. Flows exceeding 500 cfs were required in most cases and as much as 1,500 cfs in some years. This does not suggest migrational entry will not occur at flows less than 500 cfs. Summer steelhead will enter the Umatilla River under low flow conditions, but when available, most enter during moderate to high flows.

Spring Chinook Salmon

Spring chinook salmon migration in the Umatilla River begins in early April and typically peaks in May. Migrational entry of spring chinook salmon versus flows varies greatly year to year (Figures F-14, F-15 and F-16). Migration to TMD will occur at flows ranging from 200 cfs to over 10,000 cfs (Volkman 1994). In both 1993 and 1995, 2,000 cfs was necessary to encourage migration (Volkman 1993). In 1994, 500 cfs was required.

Umatilla River spring chinook salmon stray rates remain low. Coded-wire tag homing data (all release groups) for the recovery years of 1990-94 have ranged from 92.4% in 1994, to 99.9% in 1991 (Table F-15).

Recommendations

Modification of Feed Canal Dam is the highest priority. Telemetry data have identified this dam as the only significant barrier to upstream migrants (from above TMD to above Stanfield Dam) under adequate flow conditions. In the absence of modifications at Feed Canal Dam, large delays and impasse will occur. As mentioned previously, additional jump pools and fish ladders may help. The design of this facility, however, encourages false attraction and will likely continue to cause problems. Complete reconstruction or removal of the dam is likely the best option for upstream migrants at this facility.

Plans for the 1995-96 Adult Passage Evaluation

Radio telemetry has provided valuable information regarding the migrational movements of adult salmonids in the Umatilla River. Each year, a better understanding of the movements of anadromous fish is being assembled. For 1995-96, CTUIR will conduct a study similar in size and scope to the study conducted previously. An additional receiver will be installed below TMD. Migrational patterns following release at TMD will be evaluated for all four species of anadromous salmonids in the Umatilla River. Summer steelhead and spring chinook salmon will be evaluated following upstream transport. Greater effort will be designated to increasing the sample size for both evaluations.

OBJECTIVE 6: Spawning Surveys

Task 6.1: Determine the final disposition of adults salmonids released above TMD.

Summer Steelhead

The estimated disposition of 875 natural and 656 hatchery summer steelhead trapped at TMD from September 26, 1994 and June 22, 1995, follows: 86 natural and 68 hatchery adults taken for broodstock; 33 hatchery adults sacrificed for CWTs, five natural and 25 hatchery adults harvested by tribal members (Task 8.2), and 21 hatchery adults harvested by non-tribal anglers (Mike Hayes, ODFW, personal communication). The remaining 784 natural and 509 hatchery adult steelhead were available for spawning. Prior to release at TMD, adult steelhead were marked. Five marked summer steelhead fell back over the dam and were recaptured again.

Spring Chinook Salmon

The disposition of 388 adult and 108 jack spring chinook salmon trapped at TMD from March 29 to June 27, 1995 entails ten adults and 46 jacks sacrificed for CWTs and 378 adults and 62 jacks released above TMD for spawning (Table G-5). Prior to release at TMD, adult salmon were marked. Seven marked spring chinook salmon fell back over the dam and were recaptured again.

Fall Chinook and Coho Salmon

At the adult trap at TMD, 688 adult and 604 jack fall chinook and 984 adult and 62 jack coho salmon were trapped between August 26 and December 5, 1994. Crews collected CWTs from 95 adult and 74 jack fall chinook and 105 adult and eight jack coho salmon. The remaining salmon were released above TMD to spawn and included 593 adult and 530 jack fall chinook and 879 adult and 54 jack coho salmon.

Tasks 6.2 and 6.3: Conduct prespawning, spawning, and post spawning surveys throughout the basin for each anadromous species and run. Estimate the number of successful redds and the adult/redd ratios (female/redd, female/male) of fish passed above TMD (adjusted for harvest and fall-back, if possible).

Summer Steelhead

During summer steelhead escapement surveys, we observed 35 adults on redds, six adults holding (peak counts) and 87 redds (3.3/mile) along 26.5 miles of lateral tributaries of the upper Umatilla River (Table G-1). ODFW conducted escapement surveys on 8.8 miles of Birch Creek tributaries and enumerated 39 redds (4.4/mile; Tim Bailey, ODFW, personal communication). Scales were sampled from three carcasses, three adults trapped in the rotary screw trap (RM 42.2) and three from the water intake at TMD. Most biological data (age, sex, length and scales) were obtained from the natural brood trapped at TMD and held at Minthorn Springs. If desirable, additional adults could be sampled at Westland when the Trap and Haul Project operates.

Conditions for surveys were generally excellent in the smaller tributaries from March 8 through April 18. Heavy rains and high water in late April made survey conditions poor through May. A survey of Squaw Creek (May 18) indicated that previously marked redds were no longer visible. Escapement surveys of summer steelhead were terminated for the year.

Summer steelhead redd data can not be utilized as an annual index of abundance because conditions for observing the escapement vary too much from year to year. Summer steelhead redds are perhaps the most difficult of *Oncorhynchus* to enumerate because of the variation in the size of spawning fish and the number of false redds. Resident rainbow trout also spawn at the same time and often in similar substrates.

Steelhead escapement surveys in years with low snow pack and low precipitation can yield valuable information. Some trends can be documented for smaller systems and surveys can assist biologists in quantifying fishery values of streams. Single surveys once a year to enumerate steelhead redds were of limited value in the Umatilla River Basin. Detection of redds has been difficult just two weeks after redd construction. Furthermore, substrate movement during freshets can conceal redds. Because of the variables discussed above, and factors such as harvest, there was not a good correlation between summer steelhead released above TMD and redds/mile (Table G-2).

Surveys during low flow years indicate that Meacham Creek and tributaries are probably the most important summer steelhead spawning areas in the Umatilla River Basin followed by Squaw Creek (Table G-3, Figure A-4). Based on CTUIR and ODFW surveys, East Birch Creek and Pearson Creek are also important summer steelhead spawning tributaries.

Spring Chinook Salmon

During spring chinook salmon escapement surveys, we enumerated 90 redds (1.6/mile) sampled 217 carcasses along 55.8 miles of the Umatilla River Basin between May 30 and October 2, 1995 (Table G-4, Figure A-4). We recovered 49.3% of the 440 spring chinook salmon released above TMD. A total of 60 CWTs were removed from 78 adipose clipped spring chinook salmon found during surveys. Dispositions of spring chinook salmon enumerated at TMD from 1989-95 are presented in Table G-5.

Survival to spawning of spring chinook salmon above Pendleton varied greatly between areas. Survival of adults to spawning was again highest in the colder headwaters and decreased downstream as water temperatures increased. Survival to spawning (based on carcass examination) was 92.9% in the North Fork of the Umatilla River, 81.4% between the Forks and Fred Gray's Bridge (RM 90-80), 63.2% from Fred Gray's Bridge to the Meacham Creek confluence (RM 80-79), and 37.7 % from the confluence of Meacham Creek to Thornhollow Bridge (RM 79-73.5) (Tables G-6 and G-11). The percentage of the carcasses sampled this year that had successfully spawned was the lowest observed to date, 66.8%. Zimmerman (CTUIR, personal communication) noted that approximately 33% of the spring chinook salmon enumerated at TMD during April through June, 1995, were injured. To assist the rapid development of a naturally sustaining population of spring chinook salmon, adults should be hauled to Corporation (RM 89) for the next five years (one cycle). Spring chinook salmon released in the lower river have often failed to migrate to the cold, relative pristine, headwaters. Many chinook died before spawning because of high water temperatures (Brett 1952, Black 1953). Others spawned in locations where survival of their progeny was likely poor because of high incubation temperatures. This has been especially evident in Meacham Creek and the mainstem Umatilla River below Meacham Creek. Hauling adults to the headwaters would increase egg deposition into quality habitat. Egg to fry and fry to parr survival would improve because of the cooler incubation temperatures and better rearing conditions.

Fall Chinook and Coho Salmon

Adult returns in the fall of 1994 included 711 fall chinook salmon (greater than 610 mm) (688 at TMD and 23 below) and 1,003 coho salmon adults (greater than 457 mm; 984 at TMD and 19 below; Table G-7, Figure A-4). Fall chinook and coho salmon escapement surveys were conducted from October 27 through December 19, 1994. Eighty-two fall chinook redds, 24 coho salmon redds and seven unidentified salmon redds (112 total redds, 2.6/mile) were enumerated. Forty-nine fall chinook and 41 coho salmon carcasses were sampled along 42.3 miles of the mainstem Umatilla River above TMD (Table G-8). During past years, the majority of adult fall chinook and coho salmon were nearly ripe when captured at TMD. After being hauled to the Yokum or Barnhart release sites, most spawned immediately in the general area. The fall of 1994 was the first year significant numbers of adult fall chinook and coho salmon were released above TMD well before reaching maturity. The majority of fall chinook and coho redds were observed from Mission to Thornhollow Bridge (RM 60.0-73.5) with the highest concentration from Mission to Minthorn Springs (RM 60.0-63.8). Fall chinook and coho salmon still spawned in the vicinity of Barnhart and Yokum, but water clarity was poor for accurate surveys. Surveys were not conducted from TMD to Echo Bridge (RM 26.3) because of poor conditions. Below TMD, redds were not enumerated because of poor water clarity. Twenty-five fall chinook and 19 coho salmon carcasses were sampled (Table G-9).

Enumerating adult fall chinook and coho salmon redds and carcasses does not a provide a good indicator of spawning distribution or success because survey conditions were too poor during late fall. Radio telemetry may be a better tool to determined spawning distribution of fall chinook and coho salmon.

Task 6.4: Calculate fecundity of fish found on spawning grounds. Estimate the number of eggs/redd and total eggs deposited by stream reach, stream and drainage.

The potential egg deposition of spring chinook salmon in the Umatilla River (above RM 51) during 1995 was approximately 90 redds x 4,376 (average fecundity, Table G-10), minus 3,607 (eggs retained) = 390,233. Based on previous surveys, we assume few spring chinook salmon successfully spawn below the mouth of McKay Creek. Few spring chinook salmon carcasses have been found below RM 51. Furthermore, the potential for natural production of spring chinook salmon in this reach is minimal because of high water temperatures.

Estimates of egg deposition by summer steelhead, fall chinook and coho salmon were difficult to calculate because of poor survey conditions during spawning season. However, previous surveys indicated that prespawning mortality for these species has been minimal (CTUIR research records). During the fall of 1994, survival to spawning above TMD was estimated from carcasses at 95.7% for fall chinook and 94.3 % for coho salmon. Egg deposition by fall chinook females would be about 1,076,000, assuming 95.7% spawning success, 301 females above TMD and a mean fecundity of about 3,735 eggs/female. Egg deposition by coho would be approximately 884,000 based on 94.3% spawning success, 398 females and a mean fecundity of 2,356 eggs/female.

Steelhead egg deposition of approximately 4,887,000 was derived from 862 females (887 released above the TMD minus 51 adults harvested, with a 50-50 sex ratio) with a mean fecundity/female of 5,669, and assuming survival through spawning near 100%. While this provides an estimate of potential egg deposition, a better measure of reproductive success may be derived from estimating fry abundance the following summer.

Task 6.5: Compare Umatilla Basin spawning survey findings with other salmonid populations in the region if available.

In the Umatilla River redd index area (RM 78.9 to 89.9), we observed an average of 5.8 (3.9 to 8.7) spring chinook salmon redds/mile during the last five years. In Catherine Creek during the same period, spring chinook redds averaged 8.6/mile and ranged from 2.0 and 16.5 redds/mile. The Upper Grande Ronde index area redd counts averaged 3.5 redds/mile and varied between 0.4 and 8.6 redds/mile from 1991 to 1995. The Imnaha redd index ranged from 2.5 to 27.5 redds/mile and averaged 10.8 during the same period. Only spring chinook salmon redd counts could be compared because of inconstant methods and variable survey conditions associated with spawning surveys for fall chinook salmon, coho salmon and summer steelhead.

OBJECTIVE 7: Smolt Trapping

Task 7.1: Install and operate rotary screw traps in Umatilla River below the mouth of Squaw Creek (RM 76) and below the mouth of Birch Creek (RM 48).

The rotary screw trap in the Umatilla River at Tumla (RM 76) operated 63 of 113 days from September 21, 1994 through January 13, 1995. High flows, ice buildup and damage to the trap prevented continuous operation of the trap at this site. The trap captured 596 juvenile steelhead. Mean trap efficiency rate was 9.9% for juvenile steelhead (51 recaptured from 516 marked and released). A total of 1,368 juvenile chinook salmon were captured. Mean trap efficiency rate was 28.8% for juvenile chinook (347 recaptured out of 1,207 marked and released; Table H-1, Figures H-1 Through H-4). On January 14, 1994, the trap and mooring systems were damaged during high flows and the river channel changed making the Tumla site unsuitable.

The rotary screw trap at the Imeques C-mem-ini-kem site (RM 79.5) operated 43 out of 43 days from May 5 to June 16, 1995, and captured 304 juvenile steelhead. Mean trap efficiency rate was 6.6% for juvenile steelhead (18 recaptured from 273 marked and released). A total of 102 juvenile chinook salmon were captured. Mean trap efficiency rate was 10.5% for juvenile chinook (11 recaptured out of 95 marked and released; Tables H-1). Peak catches of juvenile steelhead and chinook salmon occurred in October, April and May.

The rotary screw trap at the Barnhart site (RM 42.2) operated 87 out of 125 days from March 3 to June 1, 1995. The trap captured 105 natural juvenile steelhead, 247 natural juvenile chinook salmon, five natural coho, 6,265 hatchery juvenile chinook salmon, 467 hatchery steelhead and 16,844 hatchery coho. Mean trap efficiency rates for salmonids ranged from 2.3% to 5.7% (Table H-1).

Several uncertainties affect the evaluation of trap data regarding naturally produced smolts emigrating from the basin. These uncertainties include large day to day variation in trap catch rates, lack of recaptures, low catch, winter mortality of fish moving past the trap in the fall before they leave the basin in the spring, the unknown number of salmonids passing the trap during the days the traps were not operated and the unknown proportion of the steelhead captured that were resident trout.

Nineteen bull trout were captured in the traps from October 4, 1994 to June 5, 1995 (Table I-5). In comparison, 139 bull trout were trapped during the previous season (fall of 1993 and the spring of 1994). This was likely because of trapping at RM 76 during the fall of 1994 as apposed to RM 79.5 during the fall of 1993 (Table I-5). The 15 bull trout trapped in October and November, 1994, averaged 279 mm (fork length; SD 50.3 n=15) in contrast to the four trapped in

May and June, 1995, which averaged 152 mm (SD 12.9). The trend of larger fish being captured in the fall was similar during the previous two years.

Task 7.2: Install and operate modified pipe traps in Birch Creek.

The pipe traps were not installed or operated in Birch Creek.

Task 7.3: Estimate trap efficiencies.

See Task 7.1.

Task 7.4: Freeze brand fish for interrogation in the lower Umatilla And Columbia Rivers in coordination and cooperation with ODFW and the Fish Passage Center.

Freeze branding was postponed until the fall of 1995.

Task 7.5: Reconstruct emigration timing and minimum survival rates.

Emigration from the headwaters (past RM 79.5) by juvenile steelhead and chinook salmon during the last two years peaked in October and again during April and May (Figures H-5 through H-10, CTUIR 1994, Contor et al. 1995). Fish continue to move downstream throughout late fall and winter at lower rates. Apparently, portions of the population move out of the headwaters in the fall to utilize habitat made available as water temperatures drop below 20°C (68°F). Considerably more juveniles (11,035 to 1,093) were estimated to have emigrated past Tumla in the fall than past Imeques C-mem-ini-kem in the spring. This disparity was only partly explained by the difference in trapping duration in the fall and the exclusion of Meacham Creek migrants in the spring. Peak migration during the fall from the headwaters was consistent with the previous trapping season in the Umatilla River (Contor et al. 1995) and in Lookingglass Creek (Lofy and McLean 1995a, 1995b). Chinook captured in the fall at Tumla (RM 76) averaged 20 mm longer than those captured in the spring at Imeques C-mem-ini-kem (RM 79.5; Figure H-1). During the fall, chinook lengths at Tumla were similar to those captured at Barnhart (RM 42.2) in the spring. Survival rates were not estimated because Task 7.4 was postponed.

Task 7.6: Design and conduct an eight month mark retention study.

The mark retention study was postponed until 1995-96.

OBJECTIVE 8: Tribal Harvest

Tasks 8.1 and 8.2: Design and implement creel and phone surveys to estimate tribal harvest of adult anadromous salmon.

Tribal steelhead angling in the Umatilla River was monitored 550 hours during 44 days from December, 1994 through April, 1995. Thirty-five tribal anglers were interviewed one or more times either while fishing or during telephone interviews. Thirty adult steelhead were estimated to have been harvested (25 hatchery and five natural) by tribal anglers. They reported catching and releasing another 12 steelhead. Reported catch rates for tribal anglers ranged from 80 hours/fish to 7.5 hours/fish. Mike Hayes (ODFW, personal communication) estimated non-tribal anglers harvest an additional 21 steelhead (below the reservation boundary). There was no tribal season on spring chinook salmon during 1995. Harvest of fall chinook and coho salmon was minimal as very little angling effort was observed as a result of poor returns.

OBJECTIVE 9: Age and Growth

Tasks 9.1 and 9.2: Age analysis of adult and juvenile salmonids.

Based on scale analysis, 46.4% of Umatilla River natural adult summer steelhead returning to spawn in 1995 were from the 1990 brood year, 33.9% were from the 1991 brood year, and 19.6% were from the 1989 brood (Tables I-1 and I-2). Sixty-four percent of the steelhead sampled reared for two years in fresh water before emigrating while 36% reared three years (Table I-3).

During 1995, we collected and aged scales from 448 natural juvenile steelhead from Coonskin, Moonshine, Cottonwood, and Mission Creeks, and the Umatilla River (RM 81.8-89.6). An additional 303 scale samples were collected during index surveys.

Juvenile steelhead were the most abundant salmonid captured during biological surveys. From 87.7 to 96.2% of steelhead sampled were 0+ or 1+ while 3.8% to 12.3% were age 2+ or 3+. Only one 4+ fish was sampled. Age structure of steelhead sampled in 1995 was similar to 1993 and 1994 findings (CTUIR 1994, Contor et al. 1995). Mean length, range and standard deviation by age class of sampled juvenile steelhead, and an expansion of age classes (by length) for all steelhead are presented in Table I-4. Age structure of 272 steelhead collected from index sites was 26.6% 0+, 48.5% 1+, 22.8% 2+, 1.5% 3+ and 0.7% 4+. Scales from spring chinook carcasses indicated that 91.4% of adults returning in 1995 were from the 1991 brood and 8.6% were from the 1990 brood.

Attempts were made to separate hatchery and natural spring chinook salmon adults by examination of freshwater growth, circuli counts to the first (freshwater) annulus. A total of 20 scale samples of adipose clipped and coded wire tagged adult spring chinook salmon were compared with 20 scale samples of unmarked adult returners.

Most freshwater circuli counts from hatchery spring chinook salmon ranged from 20-40 while most unmarked salmon ranged below 16. However, 40% of the freshwater circuli counts from CWT spring chinook salmon released during November in 1992 (1991 Bonneville brood) overlapped with circuli counts from unmarked salmon. Since 100% of salmon from the 1991 Bonneville brood were not marked, we could not use circuli counts to determine the origin of the unmarked salmon.

Limited scale analysis indicated that most bull trout were age three and four years old (2+ and 3+, Table I-5). Ten bull trout (165 to 290 mm) were age three and six were age four (225 and 320 mm). Scales patterns indicated that growth was slow during the first two years and then increased rapidly. Most of the bull trout captured in the rotary trap at RM 79.5 have been captured in late October and November. Many had crooked but healed lower caudal fin rays, indicating that they apparently spawned at least once. None of the bull trout observed or sampled during the fall at the rotary screw trap were sexually mature.

OBJECTIVE 10: Genetic and Ecological Effects of Supplementation

Task 10.1: Establish a genetic baseline database from native steelhead.

This work was conducted and reported by Currens and Schreck (1993, 1995). Their efforts provided a genetic baseline for future comparisons.

Task 10.2: Review literature on effects of hatchery-reared salmonids on naturally produced salmonids.

The primary goal of "supplementation" as applied to steelhead in the Umatilla River Basin Restoration Project was to increase natural production and produce surplus adults for harvest (CTUIR 1984, ODFW 1986). The effects of releasing hatchery reared salmonids sympatric to wild and natural salmonid populations has been explored from a variety of perspectives. Strategies to examine this topic have ranged from monitoring genetic heterozygosity and the persistence of unique alleles to evaluating the performance of hatchery and wild salmonids spawning naturally. Some researchers have suggested that hatchery programs may decrease the production of natural salmonids (Nickelson et al. 1986, Vincent 1987, Leider et al. 1990, Flemming and Gross 1991). Others have advised using supplementation to restore and enhance natural populations (CTUIR 1984, ODFW 1986, Bowles and Leitzinger 1991).

The effects of supplementation on the genetics of natural populations has been of prime concern in the fisheries literature (Reisenbichler and Phelps 1989, Meffe 1992, Steward and Bjornn 1990). Research in stock genetics has demonstrated that hatchery spawning practices can have a variety of effects on population genetics. Allendorf and Phelps (1980) found hatchery cutthroat trout (*Oncorhynchus clarki*) had lost genetic variation over time. Reisenbichler and Phelps (1989) found significant genetic differences between hatchery and wild steelhead in northwest Washington. They attributed these genetic differences to hatchery broodstock selection and spawning practices. Ferguson et al. (1991) found ancestral and descendent rainbow trout had no significantly different allelic frequencies when modern breeding techniques were practiced. Byrne et. al (1992) modeled the genetics of steelhead supplementation strategies using an equally fit broodstock with different alleles. He demonstrated that often "supplementation of native stocks with hatchery fish caused replacement, not enhancement of native fish." Byrne's et. al (1992) and Meffe (1992) both emphasized that to enhance natural steelhead, carrying capacity of the rearing and migratory habitat must be restored and maintained.

The Umatilla hatchery program minimizes genetic risks by breeding primarily endemic, naturally produced steelhead with modern techniques (matrix spawning). Currently, we estimate there are few risks to the genetic integrity of the natural steelhead population.

Supplementation may impact survival, growth and behavior of natural salmonids through predation, competition, disease transmission, and behavior modification. Predation on natural salmonids by hatchery juveniles occurs when larger sized hatchery smolts are introduced in systems with natural salmonid fry and parr. Predation by hatchery fish on wild fry has been documented, however researchers report that hatchery steelhead smolts prey primarily on macroinvertebrates (Parkinson et al. 1989, Hillman and Mullan 1989, Steward and Bjornn 1990, Cannamela 1992). However, Horner (1978) found some hatchery steelhead became highly piscivorous with salmonids comprising 50% of their diets. Cannamela (1993) examined the stomachs of 6,700 hatchery steelhead smolts for predation on naturally produced chinook fry. Cannamela estimated hatchery smolts preyed on chinook fry at low rates (0.00148 fry/smolt).

However even at the low rates, 24,000 fry were estimated to have been eaten in 1992 by 744,000 hatchery steelhead smolts released into Idaho's upper Salmon River.

Competition and displacement occurs when individuals compete for limited resources (Chapman 1966, Everest and Chapman 1972). Evidence for increased competition of food and space was minimal in the Umatilla Basin. Hatchery releases generally occur during moderately high flows when space and food do not appear limiting. Furthermore, hatchery salmonids released into the Umatilla River begin their down stream migration directly after release. During electrofishing surveys (1993-95), few residual hatchery fish have been captured. Boston Canyon Creek, near the Bonifer Acclimation Facility was an exception. We estimated 1,100 hatchery steelhead residualized there in 1993. Natural steelhead over 75 mm appeared to have been displaced by hatchery steelhead. Researchers report that most residuals remain near the point of release (Cannamela 1992, 1993, Hillman and Mullan 1989). Hatchery residuals in the Umatilla Basin exhibit the same behavior. We estimated that approximately 4,000 hatchery steelhead residualize each year in Boston Canyon Creek, Meacham Creek, Minthorn Springs Creek and in the mainstem Umatilla River (Appendix E, CTUIR 1994, Contor et. al 1995). This was a residualization rate of 2.7% and represents 0.6% of the total juvenile steelhead in the basin. Residualization rates in the Umatilla were similar to Viola and Schuck's (1991) findings in southeast Washington (9.9% in early summer to 0.8% in October).

Hillman and Mullan (1989) observed altered behavior of natural chinook fry in the presence of hatchery reared chinook. Natural chinook fry not subject to the hatchery releases showed no change in behavior. However, natural chinook fry behavior did not change when hatchery steelhead were released. Vincent (1987) demonstrated dramatic increases of natural brown trout (*Salmo trutta*) and rainbow trout populations once stocking hatchery rainbow trout ceased. Vincent reported that stocking increased the natural mortality rates of wild trout. Bachman (1984) observed frequent and long antagonistic encounters between hatchery reared trout and wild trout which often resulted in exhaustion of the wild trout and disruption of the stable social structure. Poor survival, excessive activity and energy expenditure for "unnecessary aggressive behavior" by hatchery trout was also reported by Mesa (1991). Except for limited effects at the highest stocking rates, Petrosky and Bjornn (1988) found that stocking rainbow trout did not change the abundance, survival and growth of wild rainbow and cutthroat trout. Competition, predation and behavioral affects on natural salmonids from hatchery releases were estimated to be low in the Umatilla Basin. We estimated that effects were low because management limited the duration of temporal and spacial overlap of hatchery and naturally produced salmonids. Furthermore, the overlap does not appear to occur during summer low flow periods when food and space appear most limiting.

Task 10.3: Identify acceptable levels of impact from steelhead supplementation on natural steelhead and native trout.

Preliminary levels of acceptable impact from supplementation were determined and include the following: 1) small genetic changes are acceptable if they are near the scale of background genetic drift; acceptable levels would be near Nei's genetic differences of 0.02 (Nei and Roychoudhury 1974) and nucleotide diversity of 0.0003 as these levels would be impossible to differentiate from background noise currently found during two years of sampling (Currens and Schreck 1995); 2) residualization rate of five percent or less, and 3) a 10% decline in the number of natural spawners. Approximately 100 natural adults (5-10% of the run) are currently taken for artificial production each year. During poor return years, we supplement the natural brood stock with hatchery adults (Rowan 1995). Management has defined the acceptable reduction of natural adults, by practice, at approximately 5-10% of the run. To date, no evidence exists that shows supplementation has significantly changed the number of returning natural adults. The relationship between adult returns and flows two years earlier has remained consistent since substantial supplementation efforts began in the mid 1980s (Figure B-1 and B-2). Supplementation was expected to increase the natural returns. While an increase in natural adult steelhead was not evident, neither was there a marked decrease. Our findings in the Umatilla Basin appear to concur with carrying capacity theory and with Byrne's (et al. 1992) and Bowles and Leitzinger's (1991) suggestions that natural rearing and migrational habitat must be restored and maintained to increase natural production.

Tasks 10.4 and 10.5: Examine the utility and feasibility of observing behavior and densities of naturally produced salmonids in treatment and control areas before and after releases of hatchery smolts, and the extent of residualization of hatchery smolts and the effects on naturally produced salmonids.

The options of conducting residualization studies and monitoring behavioral responses of naturally produced salmonids to hatchery releases were examined and found to be feasible but of lower priority. Electrofishing data indicate that most hatchery fish move out of the summer rearing areas soon after release (Appendix E, CTUIR 1994, Contor et al. 1995). Based on the research findings and as discussed above in Tasks 10.1-10.3, managers and researchers on the UMEOC did not recommend conducting steelhead behavior or residualization studies at this time.

OBJECTIVE 11: Supplementation Effects on Natural Steelhead

Task 11.1: Combine, examine and summarize data gathered in objectives 1-10 that would indicate enhancement of natural steelhead through hatchery supplementation.

Production and release of hatchery steelhead in the Umatilla River Basin from 1981 to 1991 has returned 3,306 adult hatchery steelhead to TMD (as of June, 1995). From 1981 to 1990, 1,174 naturally produced adult steelhead were taken for hatchery broodstock. We estimate that 2,844 natural steelhead would have been produced from those adults. To date, supplementation has returned approximately 462 additional adult steelhead to TMD (Table H-2). Assuming hatchery steelhead spawn and produce natural progeny equally as well as natural steelhead, the supplementation project would be considered marginally successful. There was some doubt that hatchery steelhead can naturally reproduce at the same rate as natural steelhead. Chilcote et al. (1986) and Campton et al. (1991) concluded that hatchery steelhead reproduced at 28% and 15% the rate of natural steelhead, respectively. Leider et al. (1990) found that the progeny of hatchery steelhead did not survive as well as progeny from natural steelhead. Nickelson et al. (1986) found that supplementing hatchery coho salmon reduced the number of wild coho juveniles but did not increase the number of adult returns. We speculate that Umatilla River hatchery adults reproduce at higher rates than Campton's et al. (1991) estimates because Umatilla steelhead are progeny of natural steelhead bred with modern techniques. However, we have no data to confirm this supposition.

The benefits to natural steelhead from supplementation appear to be limited at this time, probably because hatchery steelhead have not returned favorably. Smolt to adult survival estimates of hatchery steelhead (1987 to 1991 brood) ranged from 0.02 to 0.94% with at mean of 0.39%

(Rowan, CTUIR, personal communication). Since 1991, smolt quality and down stream passage has greatly improved and subsequent adult returns are expected to reflect these advancements. However, there remains a distinct probability that at least as many natural adult steelhead would have been produced without supplementation efforts. As Byrne (et al. 1992) suggests, supplementation may replace natural steelhead with hatchery steelhead. This would be expected if Chilcote's et al. (1986) and Campton's et al. (1991) findings hold true for Umatilla River hatchery steelhead spawning success.

We also explored carrying capacity theory in relation to the effects of supplementation on the natural production of steelhead. Adult steelhead taken from the natural spawning population for broodstock may have been surplus. Under this scenario, their loss did not affect natural production because carrying capacity in the Umatilla Basin had already been reached (under current habitat conditions). Some evidence of a carrying capacity has been found and was summarized in Appendix E and reported in previous progress reports (CTUIR 1994, Contor et al. 1995). Densities of juvenile steelhead were often as high as 100 fish/100 m^2 and have been as high as 222 fish/100 m^2. Areas surveyed with few or no steelhead had poor environmental conditions. Additional steelhead produced through supplementation efforts would probably not have survived in the poor habitat any better than existing steelhead. Therefore, no net increase in natural production would be expected. Furthermore, the flow/steelhead relationships plotted in Figures B-1 and B-2 indicate that additional spawners may not produce more adults unless rearing and passage conditions improve. The fact that high steelhead densities exist in even moderately suitable habitat throughout the Umatilla Basin suggests that habitat may already be fully seeded. Under a fully seeded scenario, supplementation designed to increase natural production would have marginal success and would simply replace natural steelhead with steelhead of hatchery origin (Byrne et al. 1992). Supplementation has produced hatchery steelhead for harvest and allowed natural fish to become protected under catch and release regulations. Aggressive habitat improvement projects (past, present and future) are expected to increase suitable habitat throughout the Umatilla River Basin. In summary, available data (through 1995) does not indicate that steelhead supplementation has reduced the number of natural adult steelhead spawning in the Umatilla Basin.

Task 11.2: Examine potential tests to better evaluate supplementation.

Managers expect positive results from supplementation efforts and would like to document results for effective evaluation. Identifying levels of acceptable risk and negative impacts requires adequate measurement. However, researches and managers concur that it is difficult to develop reliable methods to measure supplementation effects. Setting up replicate tests with effective experimental controls in the field is challenging. Furthermore, moderate affects of supplementation may be difficult to separate from effects of environmental stochasticity.

A management paradox may evolve if natural populations begin to decline. Increased supplementation would probably be implemented to "rescue" the natural runs. However, without a good measurement of supplementation effects, there remains a probability that supplementation replaces natural steelhead with hatchery steelhead as predicted by Byrne (et al. 1992). Increased supplementation could either solve the problem or magnify it.

Managers need reliable measurements of supplementation's effect on natural steelhead. Several strategies were examined that would assist in monitoring and evaluating the effects of supplementation on natural steelhead. Several of these strategies are being implemented and include monitoring genetic and phenotypic variation, adult returns, smolt production and smolt to adult survival. However, the complicated effects of multiple environmental factors could mask effects of supplementation.

Additional strategies include tests with controls and treatments. Weirs could be used to control the number and type of adults allowed to attempt spawning in Meacham Creek (supplementation) and Birch Creek (natural). However, weirs are expensive, sometimes ineffective at high flows, and may impede or prevent beneficial (natural) movements of salmonids between subpopulations.

A new technique to mark steelhead progeny may be available soon. Unique, benign, biologically compatible compounds would be used as artificial markers of female spawner's progeny. The process would be similar to Rieman's work (Bruce Rieman, USFS, personal communication) with natural levels of selenium. Based on selenium concentrations in otoliths, he was able to determine if juvenile sockeye salmon in Redfish Lake, Idaho, were progeny from resident or anadromous female parents. For supplementation evaluations, a compound would be injected into adult hatchery females collected at TMD. The compound would bio-transfer to the gametes before the female spawned naturally in the wild. The indicator would be permanently incorporated into the progeny's otolith. Each progeny would retain the mark throughout life. The proportion of the naturally produced steelhead with this mark would indicate the level of success from supplementation efforts (adjusted by on marking and retention rates). Approximately 200 adults could be sampled each year from brood stock, from carcasses found during spawning surveys and from spawned out adults collected at TMD and Westland Dam. Juveniles collected at downstream migrant traps could also be sampled. While the technique has been met with optimistic expectations when discussed with researchers throughout the region, no compound or delivery technique has been developed and tested. CTUIR and UMEOC will continue to discuss and coordinate various approaches and techniques to evaluate supplementation.

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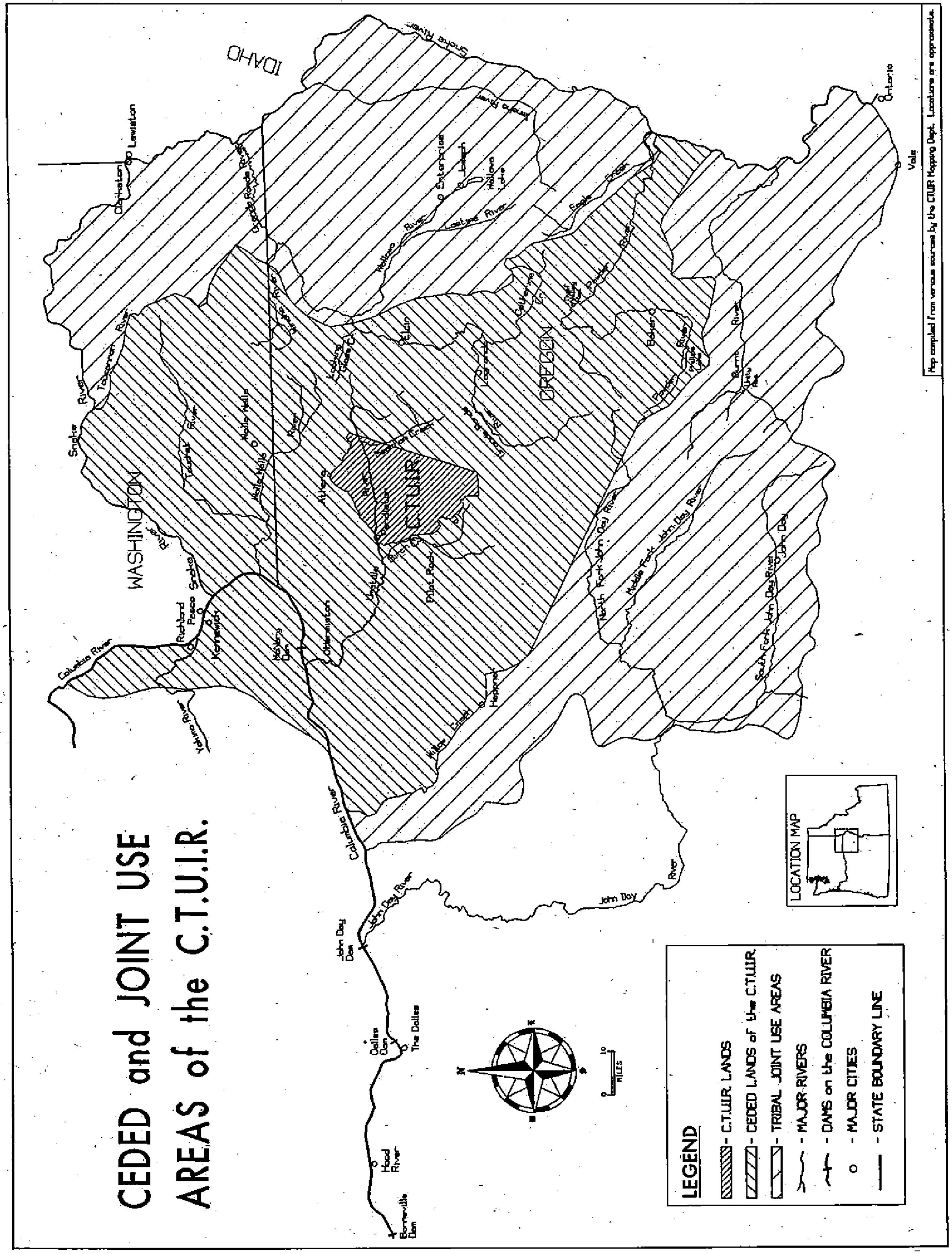


Figure A-1. Map of Reservation and Ceded Lands of the Umatilla Indian Reservation in Northeast Oregon and

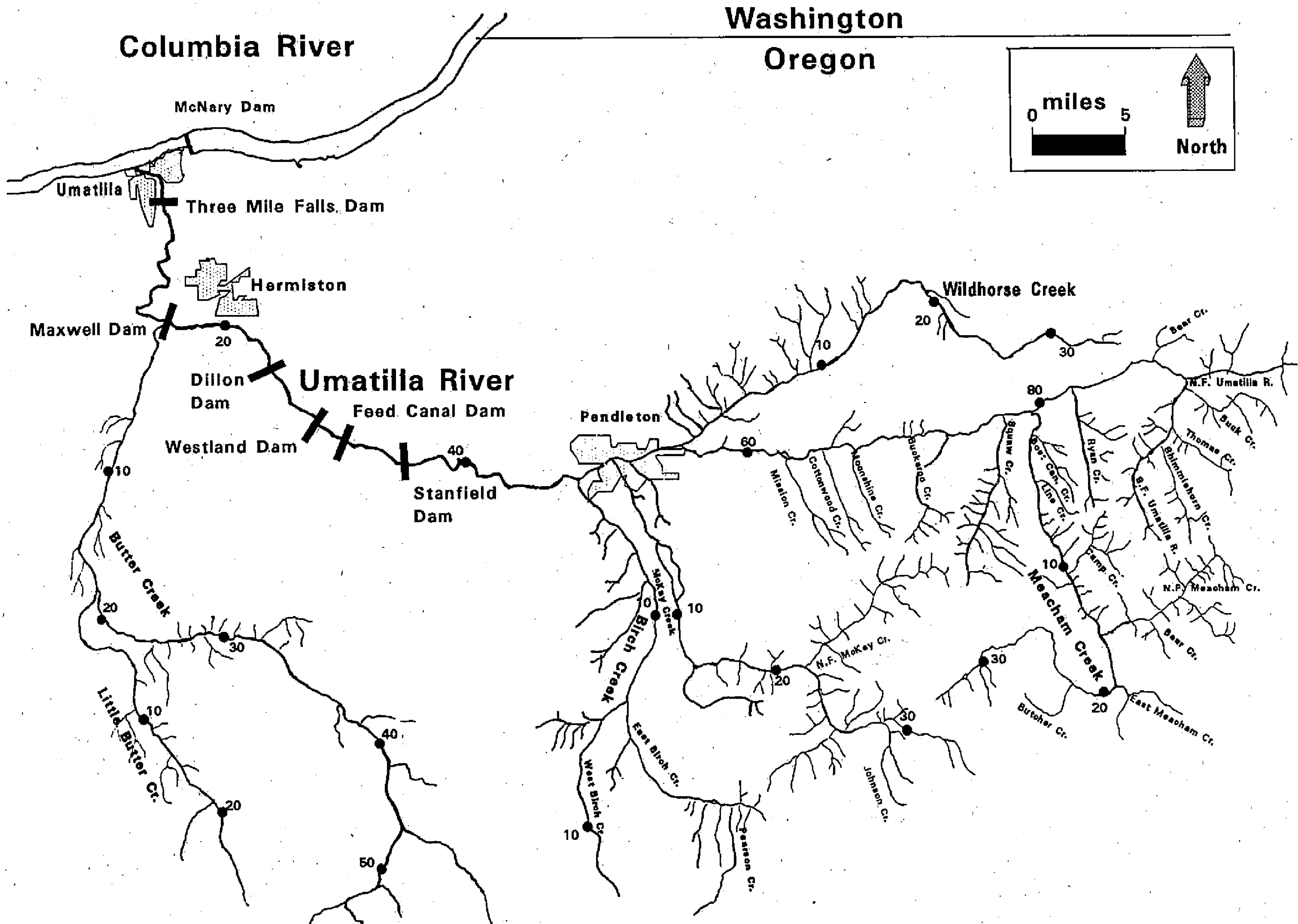


Figure A-2. Map of the Umatill River Basin with River Miles Denoted.

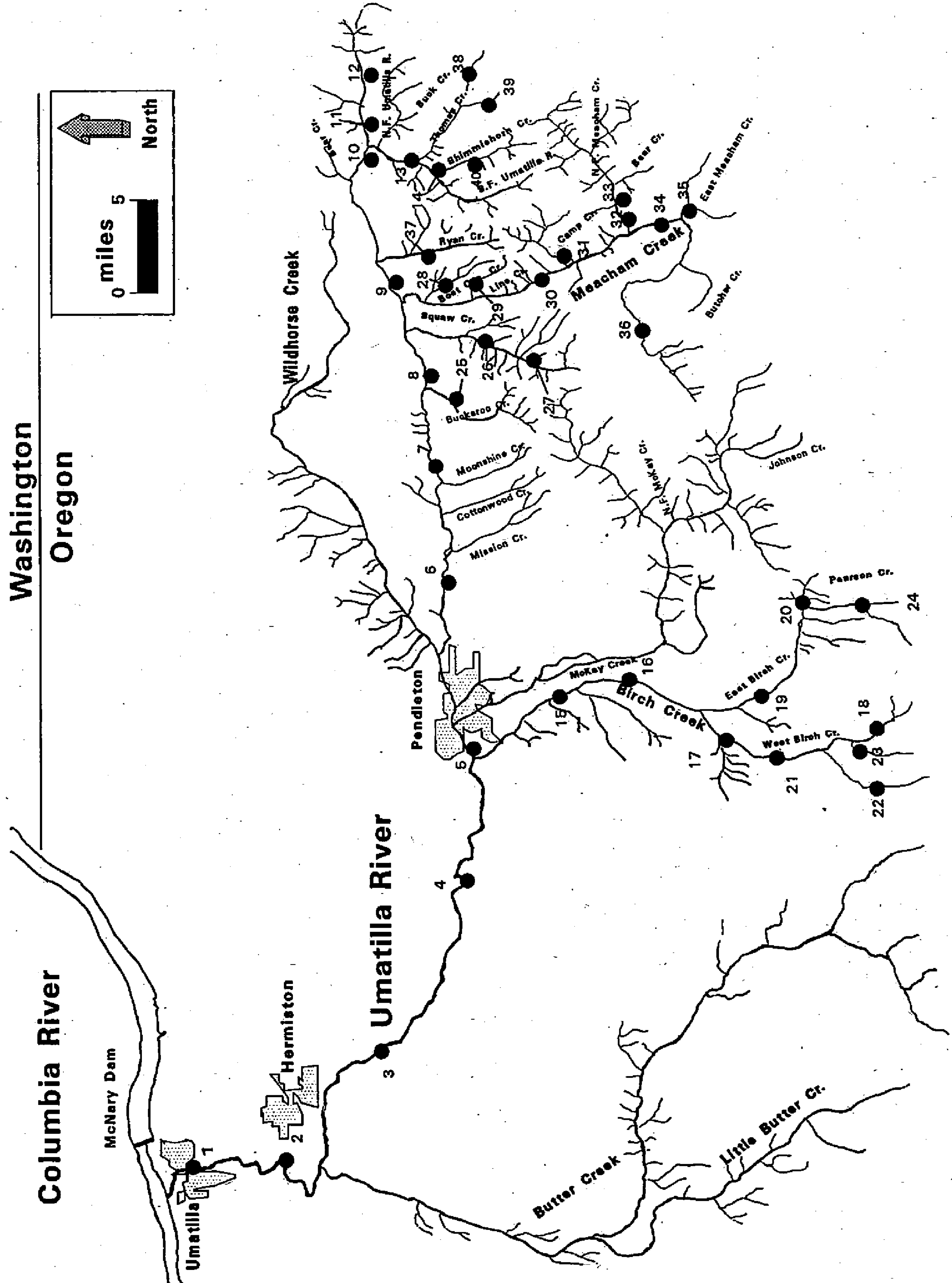


Figure A-3. Map of Index Site Locations in the Umatilla River Basin.

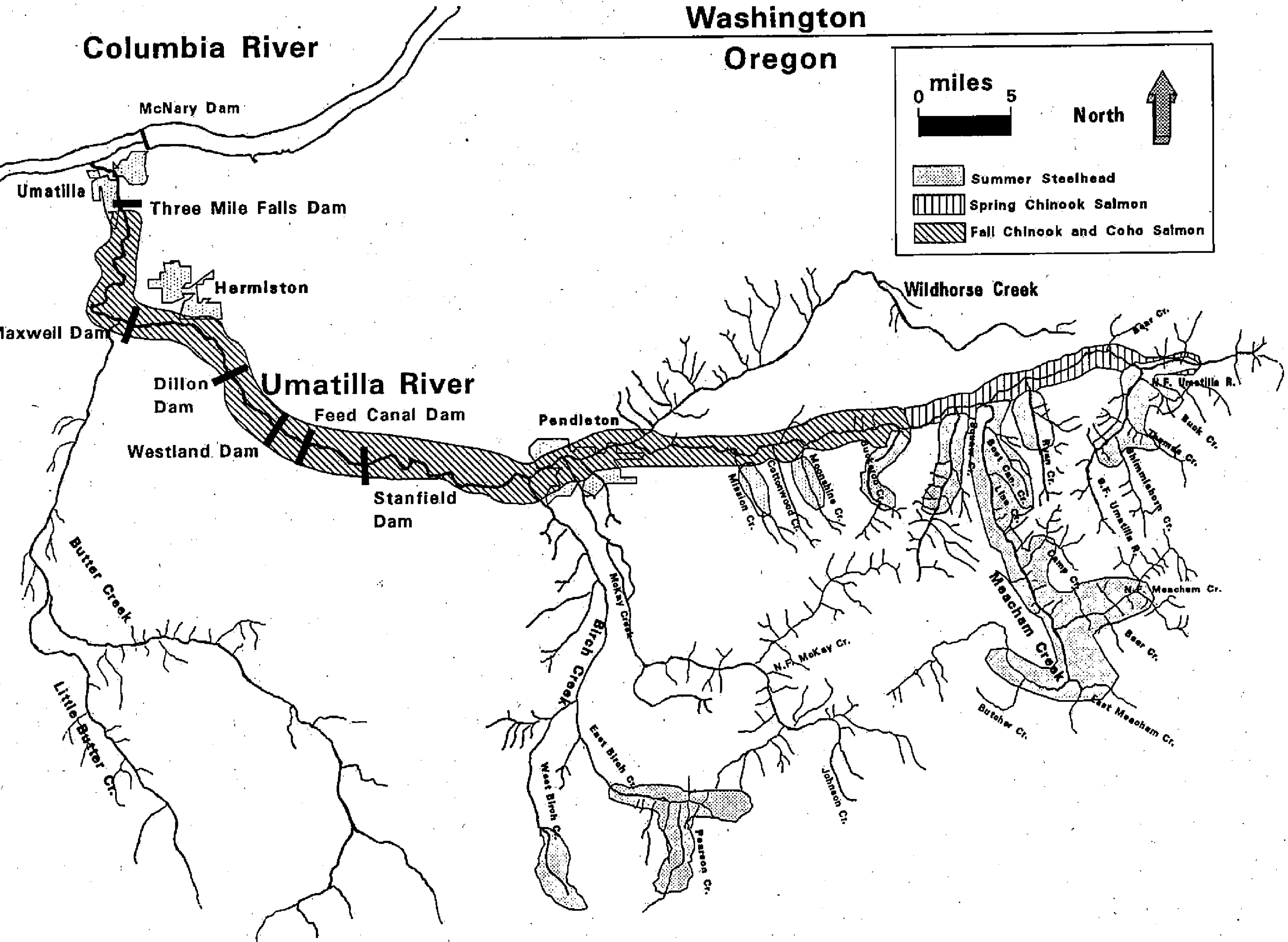


Figure A-4. Map of Spawning Areas.

Table B-1. Estimated Natural Populations of Summer Steelhead and Spring Chinook Salmon in the Umatilla River Basin.

Mainstem Reaches and Tributaries in the Umatilla River Basin	Reach Miles	Suitable Miles (STS)	STS/ Mile	Total STS	Suitable Miles (CHS)	CH/ Mile	Total CH
Umatilla River: RM 0-27.2	27.2	0.5	1'000	500	0.5	50	25
Umatilla River: 27.2-54	28.9	0.5	1'000	500	0.5	50	25
Umatilla River: 55.3-60.8	5.5	0.1	0	0	0	0	0
Umatilla River: 60.8-64.2	3.4	*1.6	*22	*35	*0	*0	*0
Umatilla River: 64.2-81.8	17.6	*17.6	*1,650	*29,040	*17.6	*1,250	*22,000
Umatilla River: 81.8-89.6	7	*7	*8,392	*58,744	*7	*1,441	*10,087
Subtotal	89.6	28.2	0	88,819	25.6		32,137
Butter Creek	95	0	0	0	0	0	0
Alkali Canyon	20	0	0	0	0	0	0
Spear Canyon	12	0	0	0	0	0	0
Coombs Canyon	18	0	0	0	0	0	0
McKay Creek	80	0	0	0	0	0	0
Tutuilla Creek	12	0	0	0	0	0	0
Patawa Creek	16	0	0	0	0	0	0
Wildhorse Creek	90	*0	*0	*0	*0	*0	*0
Subtotal	343	0		0	0		0
Birch Creek	16	0	0	0	0	0	0
Stewart Creek	12	0	0	0	0	0	0
West Birch Creek	20	16	*1,509	*24,144	*0	*0	*0
Bridge Creek	9	3	100	300	0	0	0
Bear Creek	13	10	500	5,000	0	0	0
Stanley Creek	6	4	100	400	0	0	0
Willow Spring Can.	7	4	500	2,000	0	0	0
East Birch Creek	18	15	*4,916	*73,740	*0	*0	*0
Wagner Creek	8	0	0	0	0	0	0
Spring Hollow	7	0	0	0	0	0	0
California	6	0	0	0	0	0	0
CreekPearson Creek	12	11	4'500	49,500	0	0	0
South Canyon Creek	5	4	1,000	4,000	0	0	0
Westgate Canyon	2	2	5,500	11,000	0	0	0
Subtotal	141	69		170,084			
Mission Creek	7	*3	*279	*837	*0	*0	*0
Cottonwood Creek	5	*2	*292	*584	*1	*22	*22
Moonshine Creek	4	*2	*567	*1,134	*1	*0	*0
Coonskin Creek	4	*2	*712	*1,424	*1	*9	*9
Buckaroo Creek	6	*3.3	*1'200	*3,961	*0	*0	*0
Subtotal	26	12.3		7940			31
Squaw Creek	10	*8.75	*4,367	*38,211	*8.75	*126	*1,102
Batchelor Creek	3	1	1,000	1,000	1	50	50
Little Squaw Creek	4	1.5	1,000	1,500	1	50	50
Subtotal	17	11.25		40,711	10.75		1,202
Meacham Creek, Lower 15 miles	15	*12.9	*5,576	*71,930	*12.9	*500	*6,450
Boston Canyon Creek	4	*2	*1,650	*3,300	*0	*0	*0
Line Creek	3	*2.4	*1,931	*4,634	*0	*0	*0
Camp Creek below falls	3.1	*3.1	*2,144	*6,646	*0	*0	*0
Camp Creek above falls	0.2	*0	*0	*0	*0	*0	*0
Camp Creek tributary	2	*0	*0	*0	*0	*0	*0
North Fork Meacham Creek	10	8	4,500	36,000	4	1000	4,000
Bear Creek	4	3	1,000	3,000	0	0	0
Pot Creek	5	4	1,000	4,000	0	0	0
Subtotal	46.3	35.4		171,220	16.9		10,450
Meacham Creek, Upper 21 miles	21	17	4,500	76,500	0	0	0
East Meacham Creek	4	3	3,000	9,000	0	0	0
Owsley Creek	7	4	1,000	4,000	0	0	0
Butcher Creek	4	2	1,000	2,000	0	0	0
Beaver Creek	9	3	1,000	3,000	0	0	0
Subtotal	45	29		94,500	0		0
Ryan Creek	6	5	4,500	22,500	3	100	300
Bobsled Creek	3	1	1,000	1,000	0	0	0
Bear Creek	3	1	1,000	1,000	0	0	0
Subtotal	12	7		24,500	3		300
North Fork Umatilla	10	9	5,500	49,500	3	1,500	4,500
Coyote Creek	5	3	1,500	4,500	1	50	50
Woodward Creek	2	1	1,500	1,500	0	0	0
Johnson Creek	2	1	1,500	1,500	0	0	0
Subtotal	19	14		57,000			4,550
South Fork Umatilla	11	9	3,500	31,500	4	500	2,000
Buck Creek	6	5	2,500	12,500	2	500	1,000
Thomas Creek	6	5	2,000	10,000	2	500	1,000
Spring Creek	5	4	2,000	8,000	1	50	50
Shimmiehorn Creek	5	4	2,000	8,000	1	50	50
Subtotal	33	27		70,000	10		4,100
TOTAL	769.90	233.15		724,773	64.25		52,770

* Estimated from empirical data

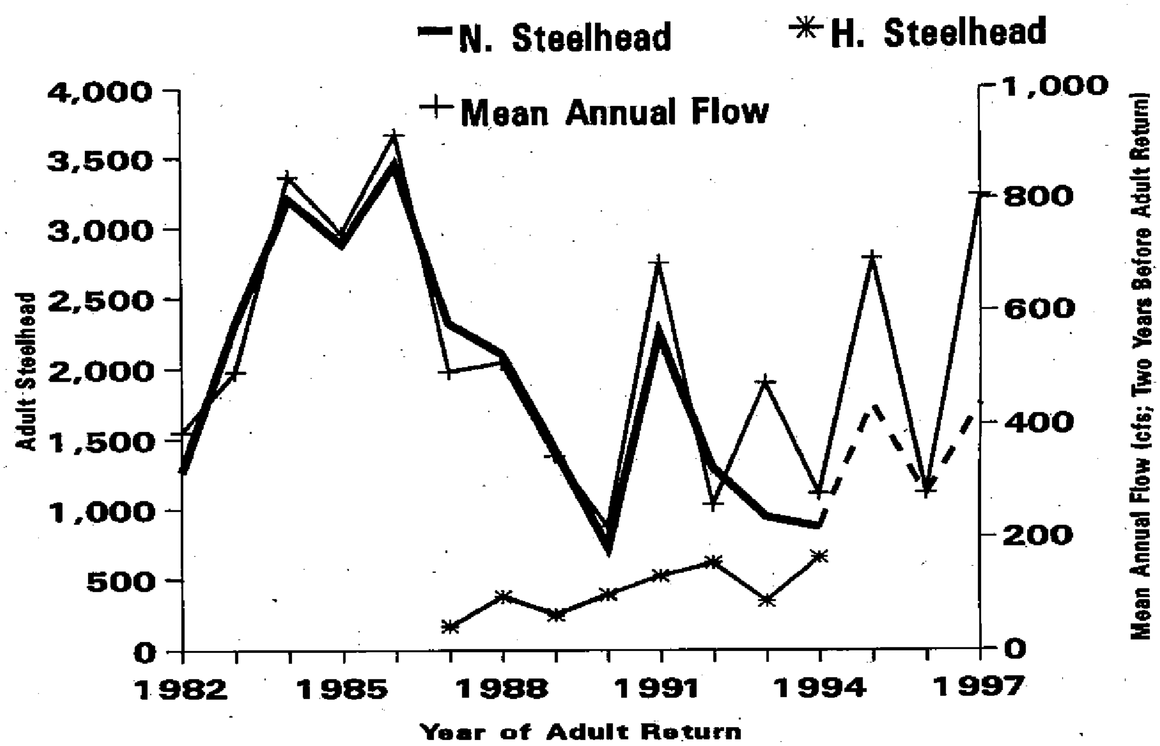


Figure B-1. Adult Steelhead Returns Compared to the Mean Annual Flows (cfs) at Umatilla Gage (RM 1.2) Two Years Prior to the Adult Return from 1982/3 to 1996/7, (1995/6 and 1996/7 adult returns approximated; STSFLWB1.CH3)

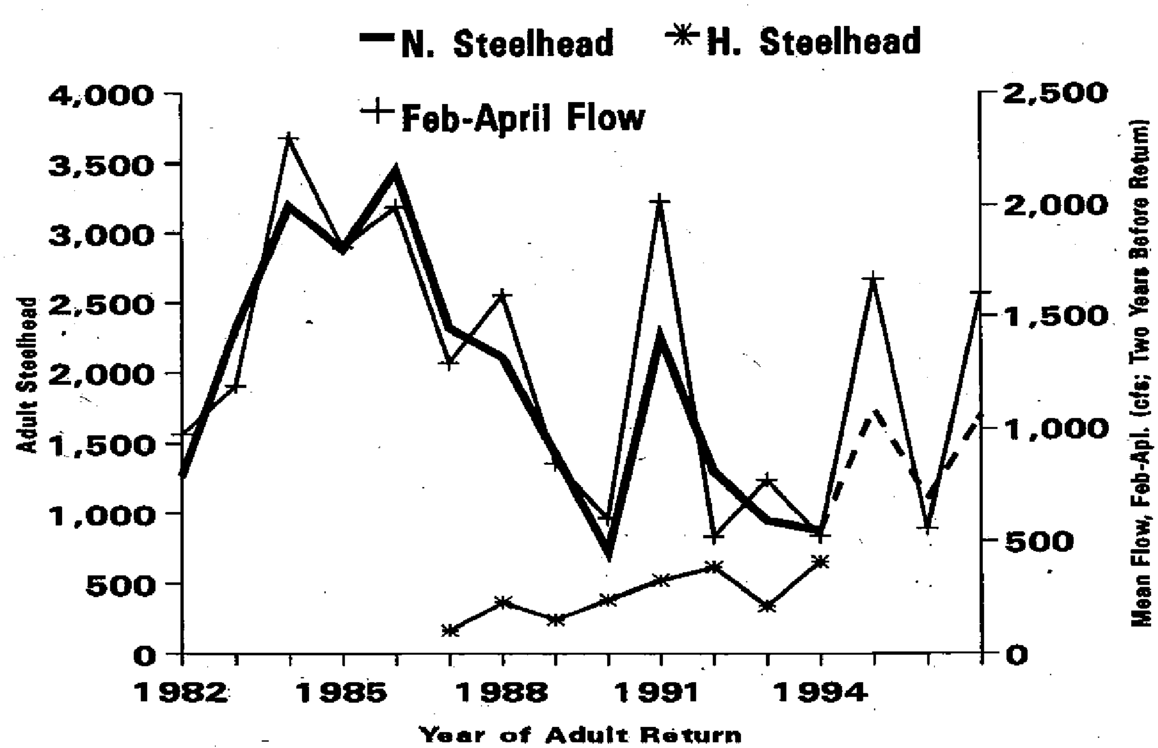


Figure B-2. Adult Steelhead Returns and the Average of February, March and April Mean Monthly Flows (cfs) at Umatilla Gage (RM 1.2) Two Years Prior to the Adult Return from 1982/3 to 1996/7 (1995/6 and 1996/7 adult returns approximated: STSFLWB2.CH3).

APPENDIX C
Thermograph Locations and Recorded Temperatures

Table C-1. Thermographs in the Umatilla River.

LOCATION	AGENCY	RIVER MILE	DEPLOYMENT PERIOD	THERMOGRAPH TYPE
Umatilla River (at Three Mile Falls Dam)	CTUIR	3.7	All Year	Temp-Mentor
Umatilla River (at Three Mile Falls Dam)	USBR	3.7	All Year	Hydromet
Umatilla River (at Maxwell Canal @ new gage)	USBR	15	All Year	Hydromet
Umatilla River (near Dillon Canal, at gage 0310)	USBR	24	All Year	Hydromet
Umatilla River (near Feed Canal, at gage 0290)	USBR	28	All Year	Hydromet
Umatilla River (near Yoakum, at gage 0260)	USBR	37	All Year	Hydromet
Umatilla River (Near Rieth)	CTUIR	49	Moved to 42.5	RTM2000
Umatilla River (Near Barnhart)	CTUIR	42.5	All Year	RTM2000
Umatilla River (Near Pendleton, at gage 0210)	USBR	55.2	All Year	Hydromet
Umatilla River (Near ODFW Office)	CTUIR	56	All Year	Temp-Mentor
Umatilla River	CTUIR	78.5	All Year	Temp-Mentor
Umatilla River	CTUIR	79	All Year	Temp-Mentor
Umatilla River (at USGS Gage)	CTUIR	81.7	All Year	Temp-Mentor
Umatilla River (Below mouth of N. and S. Forks)	USFS	89.5	Feb.-Dec.	Temp-Mentor
Minthorn Springs (Near Umatilla RM 65)	CTUIR	In Springs	All Year	Temp-Mentor
Mission Creek	CTUIR	3	All Year	RTM2000
Buckaroo Creek	CTUIR	2	All Year	Temp-Mentor
Squaw Creek	CTUIR	2	All Year	Temp-Mentor
Little Squaw Creek	CTUIR	0.1	All Year	Temp-Mentor
N.Fork Umatilla River	USFS	0.1	June-Oct.	Temp-Mentor
S.Fork Umatilla River	USFS	0.1	Feb.-Dec.	Temp-Mentor
S.Fork Umatilla River	USFS	6	June-Oct.	Temp-Mentor
Shimmiehorn	USFS	0.1	June-Oct.	Temp-Mentor

Table C-2. Thermographs in Meacham Creek Drainage.

LOCATION	AGENCY	RIVER MILE	DEPLOYMENT PERIOD	THERMOGRAPH TYPE
Meacham Creek	CTUIR	2	All Year	Temp-Mentor
Meacham Creek	CTUIR	5.25	All Year	Temp-Mentor
Meacham Creek	CTUIR	13	Discontinued (lost)	RTM2000
Meacham Creek	ODFW	31.5	All Year	Temp-Mentor
Meacham Creek	ODFW	32.5	All Year	Temp-Mentor
Bonifer Pond (near Meacham C. RM 2.5)	CTUIR	In Pond	All Year	Temp-Mentor
Camp Creek	CTUIR	0.6	All Year	RTM2000
N.F. Meacham	ODFW	0.1	April to October	Hobo
N.F. Meacham	USFS	2	June-Oct.	Temp-Mentor
East Meacham	CTUIR	0.1	All Year	RTM2000
Butcher Creek	CTUIR	1	All Year	RTM2000

Table C-3. Thermographs in Wildhorse Creek Drainage

LOCATION	AGENCY	RIVER MILE	DEPLOYMENT PERIOD	THERMOGRAPH TYPE
Wildhorse Creek (Mouth)	CTUIR	0	All Year	Temp-Mentor
Wildhorse Creek (Below new project)	CTUIR	9.5	All Year	Temp-Mentor
Wildhorse Creek (Above new project)	CTUIR	11	All Year	Temp-Mentor
Wildhorse Creek (Near Adams)	ODFW	13	All Year	Temp-Mentor
Wildhorse Creek (Headwaters)	CTUIR	26	All Year	Temp-Mentor

Table C-4. Thermographs in the Walla Walla River Basin

LOCATION	AGENCY	RIVER MILE	DEPLOYMENT PERIOD	THERMOGRAPH TYPE
Walla Walla River	CTUIR	8	All Year	Temp-Mentor
Walla Walla River	CTUIR	47	All Year	Temp-Mentor
S.F. Walla Walla	CTUIR	0.5	All Year	RTM2000
S.F. Walla Walla	CTUIR	7.	All Year	Temp-Mentor
S.F. Walla Walla	CTUIR	20	All Year	RTM2000
Elbow Creek (S.F. Walla Walla)	ODFW	0.1	April-Dec	HOBO
Burnt Cabin Creek (S.F. Walla Walla)	CTUIR	0.1	Discontinued	RTM2000
Reser Creek (S.F. Walla Walla)	CTUIR	0.1	All Year	RTM2000
N.F. Walla Walla	CTUIR	0.1	All Year	Temp-Mentor
N.F. Walla Walla	ODFW	6	April-Dec	HOBO
N.F. Walla Walla	ODFW	12	April-Dec	HOBO
Pine Creek	ODFW	20.5	All Year	Temp-Mentor
Pine Creek	ODFW	29	All Year	Temp-Mentor

Table C-5 Thermographs in Birch Creek, Butter Creek, and Willow Creek Drainages.

LOCATION	AGENCY	RIVER MILE	DEPLOYMENT PERIOD	THERMOGRAPH TYPE
Birch Creek	ODFW	3.5	All Year	Temp-Mentor
Birch Creek (near Sparks)	ODFW	6.5	All Year	Temp-Mentor
East Birch Creek	ODFW	8.5	All Year	Temp-Mentor
Westgate Canyon (East Birch Creek)	ODFW	0.75	All Year	Temp-Mentor
Pearson Creek	ODFW	4	April-Oct.	Hobo
West Birch Creek	ODFW	2	All Year	Hobo
West Birch Creek	ODFW	15	All Year	Hobo
Butter Creek	ODFW	51	April-Oct.	Hobo
Little Butter Creek (Near Gurdane)	ODFW	7	April-Oct.	Hobo
Little Butter Creek (Near Lena)	ODFW	19.5	April-Oct.	Hobo
Willow Creek	ODFW	61	April-Oct.	Hobo
Willow Creek	ODFW	77.5	April-Oct.	Hobo
Rhea Creek	ODFW	16.7	April-Oct.	Hobo
Rhea Creek	ODFW	35	April-Oct.	Hobo

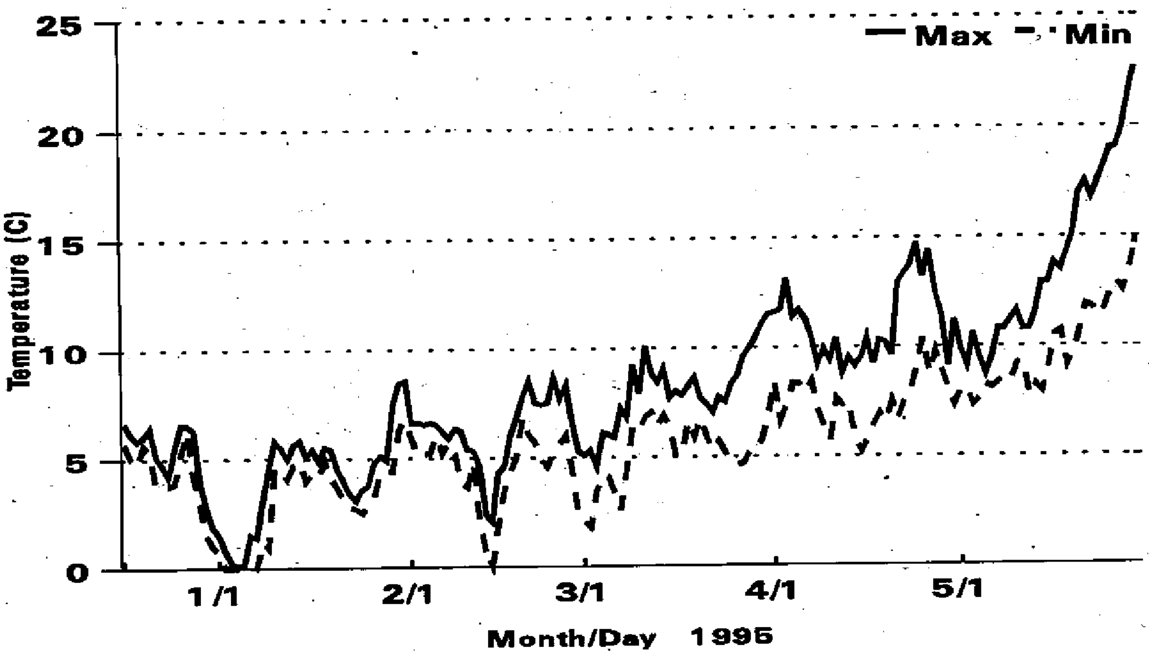


Figure C-1. Maximum and Minimum Temperatures Recorded in the Umatilla River, Near Rieth, RM 49.5, December 94 through May 1995 (TGUR9412.CH3).

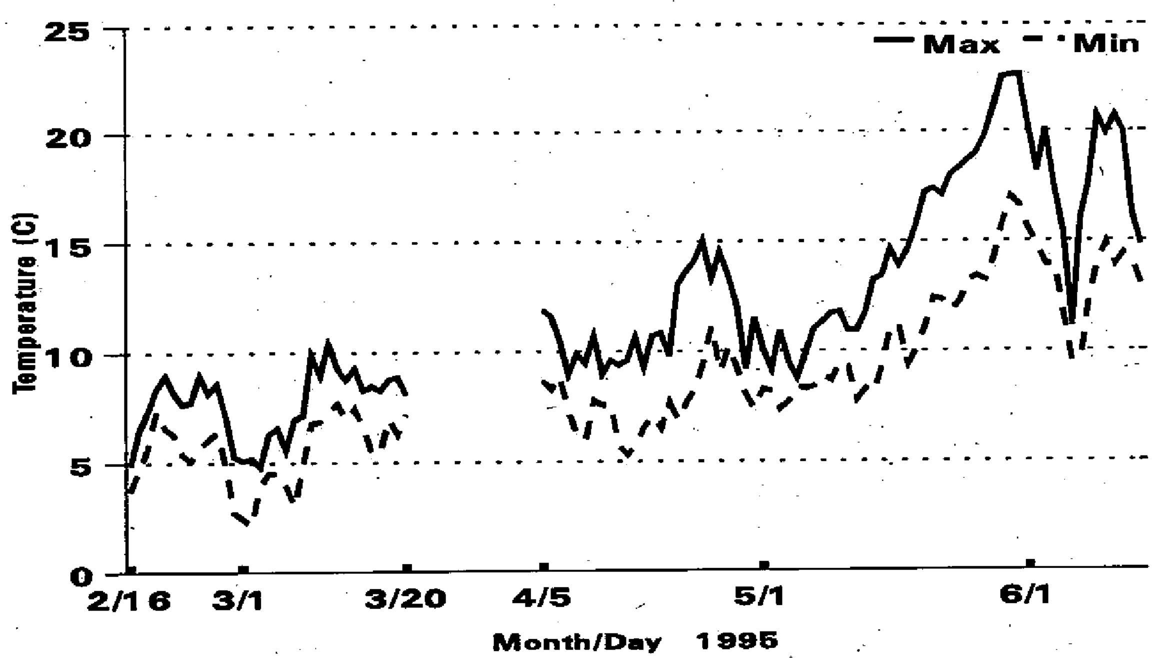


Figure C-2. Maximum and Minimum Temperatures Recorded in the Umatilla River, Barnhart, RM 42.5, February Through June, 1995 (TCUB9502.CH3).

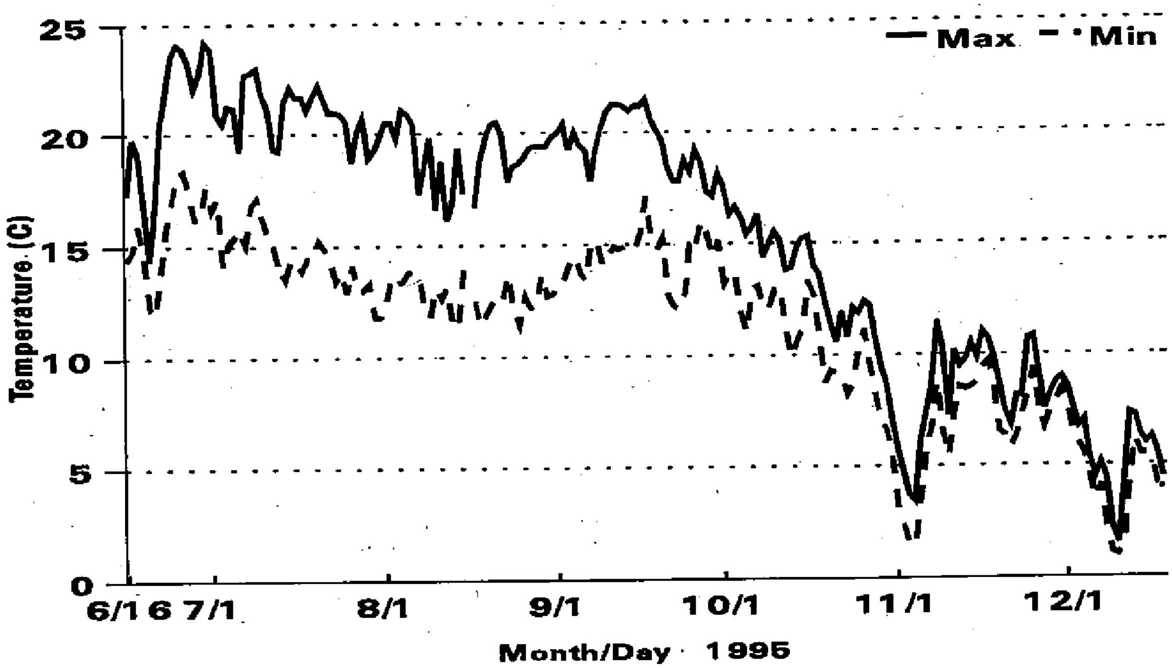


Figure C-3. The Maximum and Minimum Temperatures Recorded the Umatilla River, near Barnhart RM 42.5, June into December, 1995 (TCUB9506.CH3).

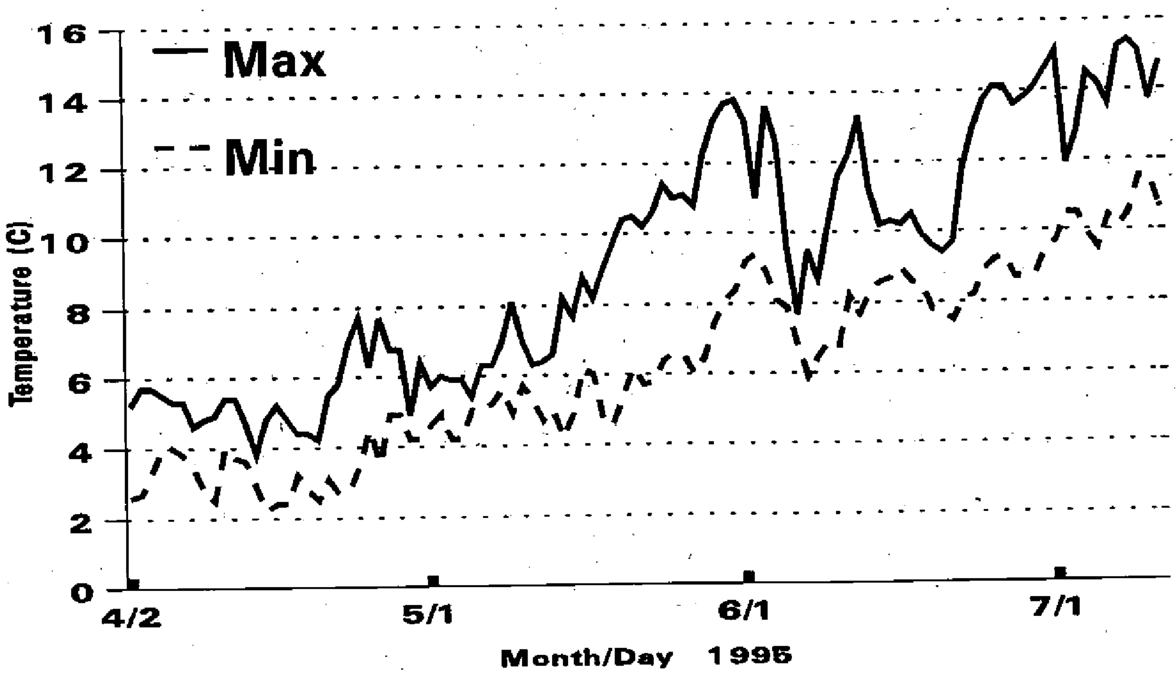


Figure C-4. Maximum and Minimum Temperatures Recorded in Butcher Creek, RM 1.5, May, 1995 to July, 1995 (TGBT9505.CH3).

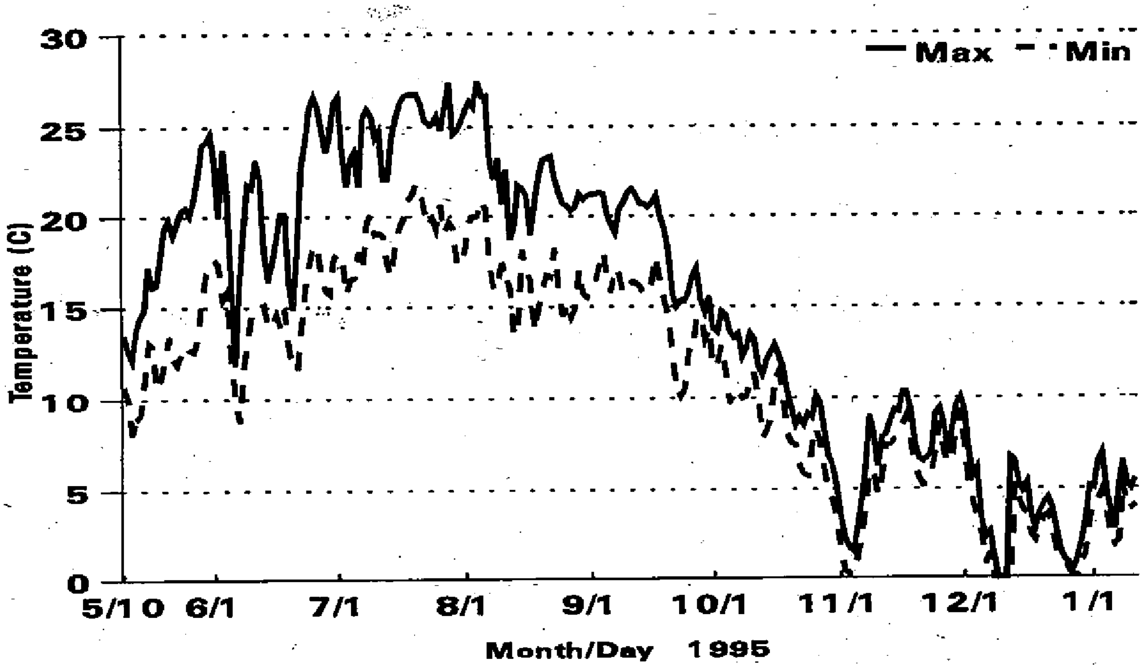


Figure C-5. Maximum and Minimum Temperatures Recorded in Wildhorse Creek, RM 1.5, May, 1995 to January, 1996 (TGWD9505.CH3).

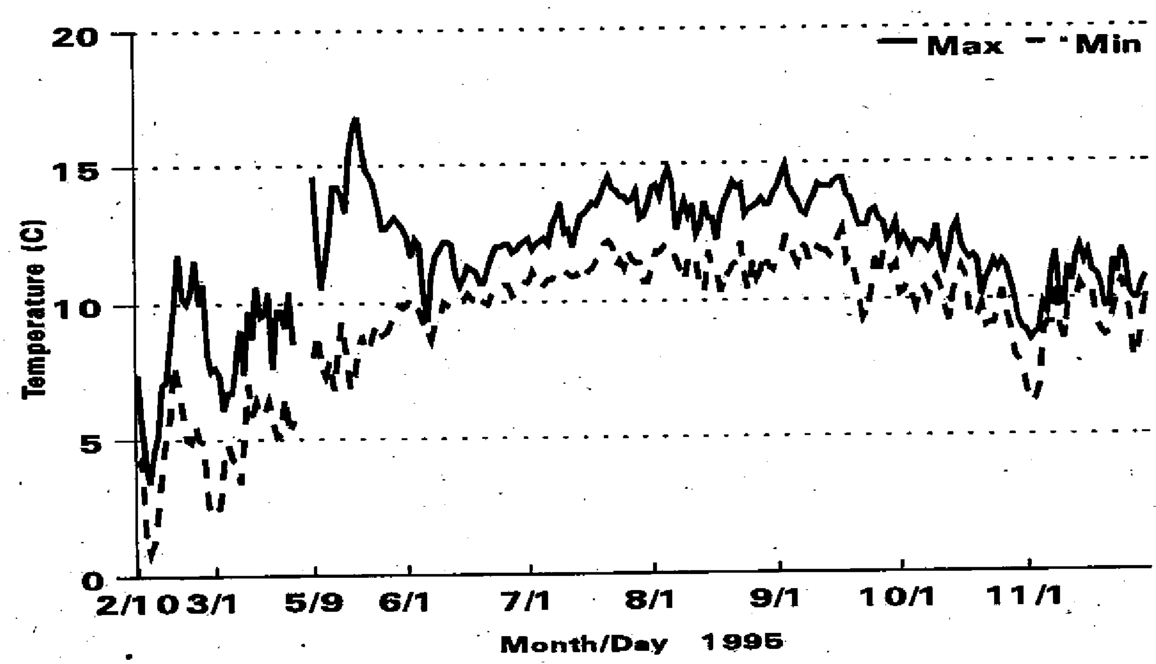


Figure C-6. Maximum and Minimum Temperatures Recorded in Mission Creek, RM 3, February through November, 1995 (TCMC9502.CH3).

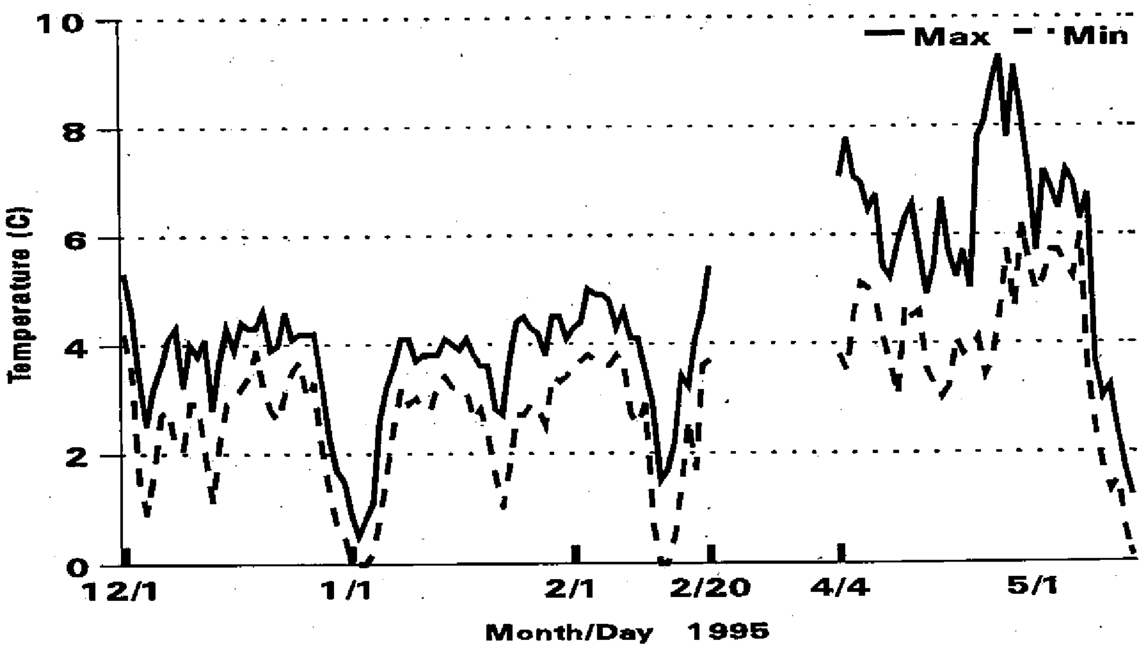


Figure C-7. Maximum and Minimum Temperatures Recorded in Camp Creek, RM 0.5, December, 1994 to May, 1995 (TCCP9412.CH3).

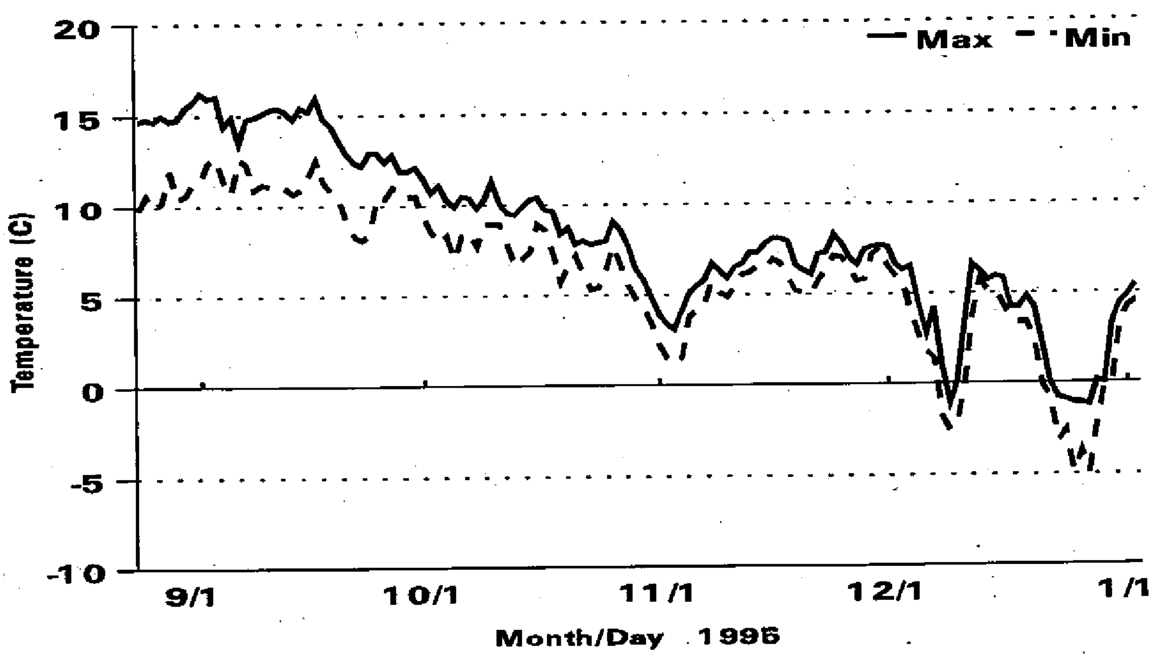


Figure C-8. Maximum and Minimum Temperatures Recorded in Camp Creek, RM 0.5, August, 1994 to January, 1996 (TGCP9508.CH3).

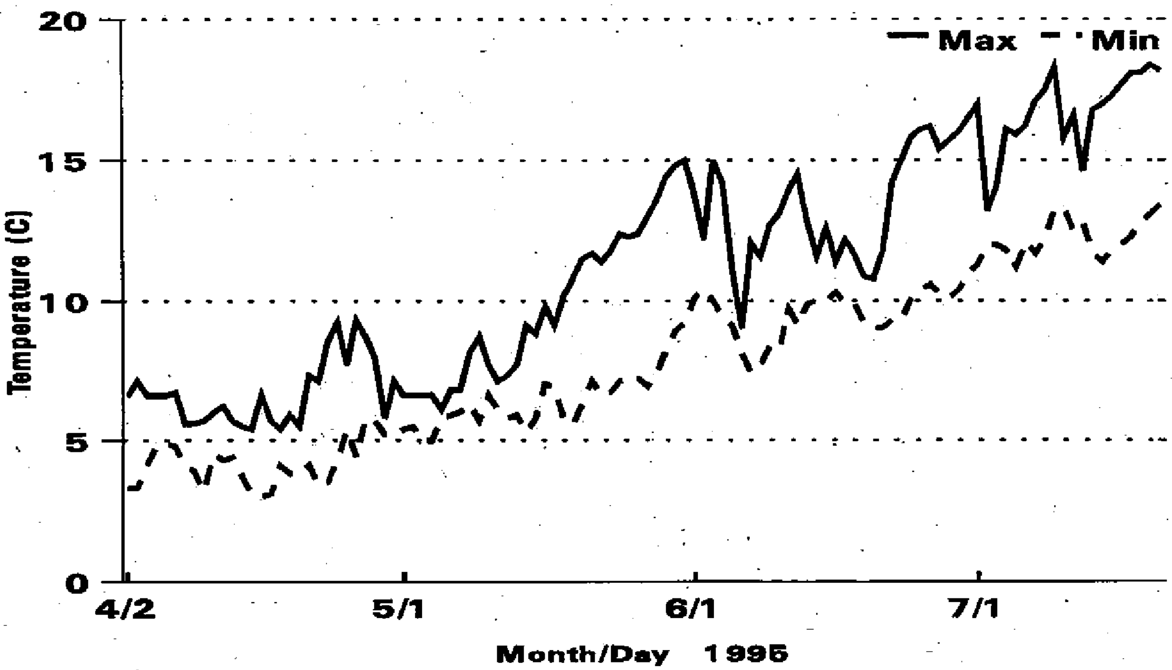


Figure C-9. Maximum and Minimum Temperatures Recorded in East Meacham Creek, RM 0.125, April Through July, 1995 (TGME9504.CH3).

APPENDIX D
Physical Habitat Survey Data Summary Tables.

Table D-1. The Stream, RM Range, RM Surveyed, Total Area, Range of Elevation, Number of Habitat Units and Date of Habitat Surveys.

STREAM	SECTION (RM)	RM SURVEYED	TOTAL AREA/m²	ELEVATION RANGE	# HABITAT UNITS	DATE (1995)
Umatilla River	81.8-89.6	7.8	151,949	1,880-2,320	639	7/18-8/7
Moonshine Creek	0.0-4.4	4.4	11,213	1,400-2,590	594	8/28-9/5
Mission Creek	0.0-4.3	4.3	9,994	1,270-2,200	872	8/15-9/11
Cottonwood Creek	0.0-4.1	4.1	15,431	1,330-2,200	912	6/20-8/1
Coonskin Creek	0.0-2.0	2.0	5,860	1,420-1,890	626	6/20-7/17
TOTAL	--	22.6	194,447	1,270-2,590	3,643	6/20-9/11

Table D-2. Summary of Habitat Quality Rankings from Habitat Survey Data, 1995 (AC = Active Channel).

HABITAT FEATURE	NUMERICAL VALUE OF HABITAT FEATURE				
	Umatilla River	Moonshine Creek	Mission Creek	Cottonwood Creek	Coonskin Creek
Min Stream Temperature (C)	10.0	10.0	6.0	10.5	11.0
Max Stream Temperature (C)	32.0	23.0	14.0	27.0	29.0
Pool Area (%)	29.4	18.5	10.0	24.9	29.5
Mean Depth (m)	0.45	0.15	0.09	0.12	0.18
AC Width:Depth-All Units	22.6	8.9	9.3	8.9	7.6
AC Width:Depth-Riffles	35.4	20.8	32.9	20.8	19.2
Dry Channel (%)	0.3	58.6	76.3	49.2	0.2
Undercut Bank (%)	8.6	6.0	8.2	10.9	11.2
Boulder Count	4,772	1,158	35	522	307
Wood Pieces (#/100m)	1.5	1.2	6.6	3.4	1.6
Wood Volume (m³/100m)	2.1	0.6	1.6	0.9	1.2
Mean Wood Complexity (#/unit)	1.3	1.2	1.6	1.5	1.5
Gravel (% of Wetted Area)	35	36	44	37	34
Silt-Sand-Organics (% Area)	16	21	24	32	31
# of Artificial Fish Passage Barriers	0	1	2	3	1
Mean Slope of all Habitat Units	1.4	2.7	2.8	3.3	3.1
Eroding Bank (%)	7.1	6.0	21.3	12.1	13.2
Mean Surface Slope of Riparian (%)	36	23	20	18	23
Mean Open Sky of All Units (%)	49	44	38	47	41
Mean Riparian Canopy Closure (%)	29	16	12	25	23
Valley Width Index (VWI)	5.0	10.0	31.1	19.6	11.5

Table D-3. Habitat Unit Summary for the Umatilla River, RM 81.8 to 89.6, July 18-August 7, 1995.

HABITAT DETAIL

Habitat Type	Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m^2)	Large Boulders (#>0.5m)	Substrate Percent Wetted Area S/O	Snd	Grvl	Cbbl	Bldr	Bdrk
DRY UNITS	1	6	4.4	0.00	24	0	0	10	40	40	10	0
GLIDE	63	1,321	7.6	0.47	13,871	558	10	13	33	28	13	3
POOL-BACKWATER	42	316	2.3	0.30	755	62	16	20	31	22	9	2
POOL-BEAVER DAM	1	67	7.8	2.00	519	0	30	20	20	10	10	10
POOL-DAMMED	5	92	6.7	0.56	680	22	12	18	32	26	12	0
POOL-ISOLATED	24	1,369	2.4	0.41	4,640	116	13	15	33	26	10	3
POOL-LATERAL SCOUR	108	2,204	8.7	0.88	23,629	493	6	12	33	29	13	7
POOL-PLUNGE	3	28	6.7	1.02	250	13	13	17	33	20	13	3
POOL-STRAIGHT SCOUR	63	1,271	9.1	0.70	14,201	459	5	9	34	34	16	2
PUDDLED CHANNEL	6	224	1.9	0.23	461	4	5	12	35	37	12	0
RAPID/BEDROCK	3	21	5.5	0.33	131	10	0	0	13	23	20	43
RAPID/BOULDERS	63	1,021	8.7	0.29	9,614	492	0	1	35	40	22	2
RIFFLE	206	5,525	8.9	0.26	60,403	1249	3	9	38	36	13	1
RIFFLE W/ POCKETS	47	1,849	10.9	0.35	22,653	1282	4	10	32	34	19	0
STEP/BOULDERS	1	2	11.1	0.30	24	10	10	10	20	40	20	0
STEP/LOG	1	0	2.8	0.15	1	0	10	20	40	20	10	0
STEP/STRUCTURE	2	6	11.1	0.15	95	2	10	10	35	25	15	5
Total:	639	15,322	8.1	0.45	151,949	4772	Avg: 6	10	35	32	14	3

HABITAT SUMMARY

Habitat Group	No. Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Wetted Area (m^2)	Wetted Area Percent	Large Boulders Number	Large Boulders #/100m^2	Wood Class
Dammed & BW Pools	72	1,843	2.7	0.38	6593	4.34	200	3.03	1.4
Scour Pools	174	3,503	8.8	0.82	38080	25.06	965	2.53	1.4
Glides	63	1,321	7.6	0.47	13871	9.13	558	4.02	1.3
Riffles	253	7,374	9.3	0.27	83056	54.66	2531	3.05	1.1
Rapids	66	1,043	8.6	0.29	9745	6.41	502	5.15	1.0
Cascades	0	0	.	.	0	0.00	0	0.00	.
Step/Falls	4	9	9.0	0.19	120	0.08	12	10.02	1.0
Small Streams (SS)	0	0	.	.	0	0.00	0	0.00	.
Dry	7	230	2.3	0.19	485	0.32	4	0.82	1.1

Table D-4. Stream Summary for the Umatilla River, RM 81.8 to 89.6, July 18-August 7, 1995.

STREAM SUMMARY UMATILLA RIVER

Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m^2)	Substrate Percent Wetted Area S/O	Sand	Grvl	Cbbl	Bldr	Bdrk	Total Large Boulder
639	15,322	8.1	0.45	151,949	6	10	35	32	14	3	4,772

Habitat Group	Wetted Area (m^2)	Percent
Scour Pool	38,080	25.1
Backwater Pools	6,593	4.3
Glide	13,871	9.1
Riffle	83,056	54.7
Rapid	9,745	6.4
Cascade	0	0.0
Step	120	0.1
Dry	485	0.3

Table D-5. Valley, Channel, Bank and Wood Summary for the Umatilla River, RM 81.8 to 89.6, July 18-August 7, 1995.

Valley and Channel Summary

Valley Characteristics (Percent Reach Length)

Narrow Valley Floor		Broad Valley Floor	
Steep V-shape	0	Constraining Terraces	100
Moderate V-shape	0	Multiple Terraces	0
Open V-shape	0	Wide Floodplain	0

Valley Width Index avg: 5.0 range: 5.0-5.0

Channel Morphology (Percent Reach Length)

Constrained		Unconstrained	
Hillslope	0	Single Channel	0
Bedrock	0	Multiple Channel	0
Terrace	0	Braided Channel	0
Alt. Terrace/Hill	100		
Landuse	0		

Channel Characteristics

Type	Length	Area	Dry Units
Primary	10,525	132,443	0
Secondary	4,797	19,505	7

Channel Dimensions

Wetted Surface		Active Channel		First Terrace	
Width	8.1	Width	16.3	Width	18.9
Depth	0.45	Height	0.4	Height	0.8
W:D	35.4				

Stream Flow Type: MF   Water Temp: 11.0-11.0
Avg. Unit Gradient: 1.4   Habitat Units/100m: 4.2

Riparian, Bank, and Wood Summary

Land Use: ST,TT   Riparian Veg.: C 30-50 D 1

Bank Stability

Bank Class	Percent Reach Length
Non-Erodible	7.8
Vegetation Stabilized	74.6
Boulder-cobble	10.4
Actively Eroding	7.1

Undercut Banks
Unit Average: 8.64%

Open Sky (% of 180)
Unit Average: 49
Range: 3-69

Large Woody Debris

Average Complexity Score: 1.3

Pieces	163	Volume(m^3)	221
Pieces/100m	1.5	Volume/100m	2.1

Table D-6. Riparian Summary for the Umatilla River, RM 81.8 to 89.6, July 18-August 7, 1995.

REACH 0

RIPARIAN ZONE VEGETATION SUMMARY

Reach 0 is represented by 22 transects

Predominant landform in each zone

	Zone 1 0-10 meters	Zone 2 10-20 meters	Zone 3 20-30 meters
Hillslope	9	18	30
High terrace	27	23	16
Low terrace	45	41	43
Floodplain	0	0	0
Wetland/meadow	0	0	0
Stream channel	11	14	9
Roadbed/Railroad	0	0	0
Riprap	0	0	0
Surface slope (%)	41	33	35

Canopy closure and ground cover

	Zone 1 0-10 meters (%)	Zone 2 10-20 meters (%)	Zone 3 20-30 meters (%)
Canopy closure	31	29	28
Shrub cover	39	37	42
Grass/forb cover	30	37	38

Average number of trees in a 5-meter wide band

	Zone 1 0-10 meters		Zone 2 10-20 meters		Zone 3 20-30 meters		Zones 1-3 0-30 meters	
Diameter class (cm)	Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood
3-15cm	0.6	4.4	0.4	1.8	0.3	1.6	1.3	7.8
15-30cm	0.1	0.5	0.5	0.1	0.3	0.3	0.9	1.0
30-50cm	0.2	0.5	0.7	0.3	0.6	0.2	1.6	1.0
50-90cm	**.*	0.2	0.1	0.1	0.0	**.*	0.1	0.4
>90cm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total/100m2	1.0	5.7	1.7	2.3	1.3	2.1	1.3	3.4

Table D-7. Water Diversions in the Umatilla River, RM 81.8-89.6, Habitat Survey 7/18-8/7, 1995.

UNIT NUMBER	RIVER MILE	DESIGNATED USE	TYPE	SIZE
5	81.9	Private Pond	Partially Screened Ditch	1m wide x .22m deep
24	82.0	Private	Screened PVC Pipe	2"
94	82.7	Private	Screened PVC Pipe	1.5"
95	82.7	Private	Screened Metal Pipe	2"
391	87.6	Private	Screened Metal Pipe	1.5"

Table D-8. Surface Springs identified in the Habitat Survey, Umatilla River, Survey Dates 7/18-8/7, 1995.

RIVER MILE	UNIT TYPE	BANK SIDE		AREA (m^2)
82.0	BW	LEFT		21
83.1	LP	RIGHT		108
83.3	RI	RIGHT		221
83.7	IP	RIGHT		195
83.7	IP	LEFT		60
84.2	IP	LEFT		10
84.5	IP	RIGHT		21
84.7	IP	RIGHT		150
84.8	IP	RIGHT		980
85.0	IP	LEFT		750
85.5	GL	LEFT		140
85.5	IP	LEFT		210
85.6	IP	LEFT		320
85.8	IP	RIGHT		1,050
86.0	GL	LEFT		90
86.0	IP	LEFT		45
86.3	IP	LEFT		400
86.3	IP	LEFT		24
86.4	GL	RIGHT		22
86.6	IP	RIGHT		35
87.8	IP	RIGHT		60
87.8	LP	RIGHT		132
89.1	BW	LEFT		70
89.1	IP	RIGHT		50
89.2	IP	RIGHT		15
89.2	IP	LEFT		130
89.4	IP	RIGHT		180
TOTAL 27	--	13 LEFT	14 RIGHT	5,489

Table D-9. Habitat Unit Summary for Moonshine Creek, RM 0.0 to 4.4, August 28-September 5, 1995.

REACH 0 REACH 0

HABITAT DETAIL

Habitat Type	Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m^2)	Large Boulders (#>0.5m)	Substrate Percent Wetted Area S/O	Snd	Grvl	Cbbl	Bldr	Bdrk
CASCADE/BEDROCK	3	19	1.2	0.20	25	3	7	13	20	17	7	37
CULVERT CROSSING	2	18	1.5	0.05	31	0	5	0	0	0	0	45
DRY CHANNEL	43	1,981	2.8	0.12	5,494	655	0	10	36	39	13	2
DRY UNITS	12	306	2.2	0.00	702	35	0	9	45	30	16	0
GLIDE	48	332	1.4	0.17	523	25	15	11	37	28	8	1
POOL-BACKWATER	11	9	1.2	0.21	11	3	11	11	35	25	5	14
POOL-BEAVER DAM	3	82	5.0	0.68	612	0	45	32	19	3	0	0
POOL-ISOLATED	10	145	0.8	0.22	170	0	23	31	29	17	0	0
POOL-LATERAL SCOUR	110	487	1.4	0.26	729	53	10	11	37	31	9	2
POOL-PLUNGE	9	22	3.0	0.49	75	5	13	13	34	26	11	2
POOL-STRAIGHT SCOUR	68	273	1.5	0.22	467	51	11	8	36	30	10	5
POOL-TRENCH	2	7	1.0	0.45	8	1	10	10	35	25	10	10
PUDDLED CHANNEL	13	298	1.1	0.18	376	100	10	10	32	31	15	2
RAPID/BEDROCK	9	45	1.2	0.05	58	2	15	7	13	10	4	50
RAPID/BOULDERS	48	220	1.4	0.05	306	65	10	7	35	33	15	1
RIFFLE	158	977	1.2	0.06	1,172	78	11	8	40	31	8	1
RIFFLE W/ POCKETS	34	341	1.3	0.10	438	80	11	9	32	32	15	1
STEP/BEDROCK	1	1	2.0	0.05	2	1	10	10	30	30	10	10
STEP/BOULDERS	1	1	1.5	0.05	2	1	10	10	40	30	10	0
STEP/COBBLE	2	1	1.3	0.05	1	0	15	10	40	25	10	0
STEP/LOG	4	2	1.5	0.05	4	0	18	18	33	18	13	0
STEP/STRUCTURE	3	4	2.7	0.02	9	0	40	23	7	0	0	30
Total:	594	5,571	1.5	0.15	11,213	1158	Avg: 11	10	36	30	10	3

HABITAT SUMMARY

Habitat Group	No. Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Wetted Area (m^2)	Wetted Area Percent	Large Boulders Number	Large Boulders #/100m^2	Wood Class
Dammed & BW Pools	24	236	1.5	0.27	792	7.07	3	0.38	1.2
Scour Pools	189	789	1.5	0.26	1280	11.41	110	8.60	1.5
Glides	48	332	1.4	0.17	523	4.66	25	4.78	1.1
Riffles	192	1,318	1.2	0.07	1610	14.36	158	9.81	1.1
Rapids	57	265	1.4	0.05	363	3.24	67	18.44	1.2
Cascades	3	19	1.2	0.20	25	0.22	3	12.10	1.3
Step/Falls	11	9	1.8	0.04	18	0.16	2	11.17	1.2
Small Streams (SS)	0	0	.	.	0	0.00	0	0.00	.
Dry	68	2,585	2.4	0.11	6572	58.61	790	12.02	1.1

Table D-10. Stream Summary for Moonshine Creek, RM 0.0 to 4.4, August 28-September 5, 1995.

STREAM SUMMARY MOONSHINE CREEK

Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m^2)	Substrate Percent Wetted Area S/O	Sand	Grvl	Cbbl	Bldr	Bdrk	Total Large Boulder
594	5,571	1.5	0.15	11,213	11	10	36	30	10	3	1,158

Habitat Group	Wetted Area (m^2)	Percent
Scour Pool	1,280	11.4
Backwater Pools	792	7.1
Glide	523	4.7
Riffle	1,610	14.4
Rapid	363	3.2
Cascade	25	0.2
Step	18	0.2
Dry	6,572	58.6

Table D-11. Valley, Channel, Bank and Wood Summary for Moonshine Creek, RM 0.0 to 4.4, August 28-September 5, 1995.

Valley and Channel Summary

Valley Characteristics (Percent Reach Length)

Narrow Valley Floor		Broad Valley Floor	
Steep V-shape	0	Constraining Terraces	94
Moderate V-shape	0	Multiple Terraces	0
Open V-shape	0	Wide Floodplain	6

Valley Width Index avg: 10.0 range: 10.0-10.0

Channel Morphology (Percent Reach Length)

Constrained		Unconstrained	
Hillslope	0	Single Channel	48
Bedrock	0	Multiple Channel	0
Terrace	0	Braided Channel	0
Alt. Terrace/Hill	52		
Landuse	0		

Channel Characteristics

Type	Length	Area	Dry Units
Primary	5,351	10,980	68
Secondary	220	233	0

Channel Dimensions

Wetted Surface		Active Channel		First Terrace	
Width	1.5	Width	5.1	Width	5.9
Depth	0.15	Height	0.5	Height	0.8
W:D	20.8				

Stream Flow Type: LF Water Temp: 0.0-19.5
Avg. Unit Gradient: 2.7 Habitat Units/100m: 10.7

Riparian, Bank, and Wood Summary

Land Use: AG,RR Riparian Veg.: D,S

Bank Stability

Bank Class	Percent Reach Length
Non-Erodible	2.1
Vegetation Stabilized	91.5
Boulder-cobble	0.3
Actively Eroding	6.0

Undercut Banks
Unit Average: 6.02%

Open Sky (% of 180)
Unit Average: 44
Range: 0-94

Large Woody Debris

Average Complexity Score: 1.2

Pieces	63	Volume(m^3)	34
Pieces/100m	1.2	Volume/100m	0.6

Table D-12. Riparian Summary for Moonshine Creek, RM 0.0 to 4.4, August 28-September 5, 1995.

REACH 0 REACH 0

RIPARIAN ZONE VEGETATION SUMMARY

Reach 0 is represented by 20 transects

Predominant landform in each zone

	Zone 1 0-10 meters	Zone 2 10-20 meters	Zone 3 20-30 meters
Hillslope	10	15	18
High terrace	53	50	60
Low terrace	38	35	23
Floodplain	0	0	0
Wetland/meadow	0	0	0
Stream channel	0	0	0
Roadbed/Railroad	0	0	0
Riprap	0	0	0
Surface slope (%)	34	17	19

Canopy closure and ground cover

	Zone 1 0-10 meters (%)	Zone 2 10-20 meters (%)	Zone 3 20-30 meters (%)
Canopy closure	27	14	6
Shrub cover	48	43	40
Grass/forb cover	46	52	55

Average number of trees in a 5-meter wide band

	Zone 1 0-10 meters		Zone 2 10-20 meters		Zone 3 20-30 meters		Zones 1-3 0-30 meters	
Diameter class (cm)	Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood
3-15cm	0.0	4.0	0.1	2.1	0.0	0.6	0.1	6.7
15-30cm	0.0	0.9	0.0	0.4	0.0	0.2	0.0	1.4
30-50cm	0.0	1.2	0.0	0.2	0.0	0.1	0.0	1.4
50-90cm	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
>90cm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total/100m^2	0.0	6.1	0.1	2.7	0.0	0.8	***.*	3.2

Table D-13. Surface Springs identified in the Habitat Survey, Moonshine Creek, RM 0.0-4.4, 8/28-9/5, 1995.

UNIT NUMBER	UNIT TYPE	BANK SIDE		UNIT AREA (m^2)
1	GL	LEFT		60
5	SP	RIGHT		14
11	GL	LEFT		40
13	IP	RIGHT		70
69	LP	RIGHT		3
100	IP	RIGHT		1
140	LP	LEFT		6
149	SP	RIGHT		3
159	RI	RIGHT		6
188	IP	LEFT		1
211	LP	RIGHT		7
214	RI	RIGHT		6
220	RI	LEFT		11
231	IP	LEFT		1
255	RI	LEFT		6
269	LP	RIGHT		11
277	LP	RIGHT		9
439	IP	RIGHT		70
449	RB	RIGHT		6
460	PP	RIGHT		7
476	RP	LEFT		8
510	RP	RIGHT		7
520	RR	LEFT		10
530	GL	RIGHT		4
553	PD	LEFT		30
580	PD	RIGHT		18
584	PD	LEFT		25
TOTAL 27	–	11 LEFT	16 RIGHT	440

Table D-14. Habitat Unit Summary for Mission Creek, RM 0.0 to 4.3, August 15-September 11, 1995.

REACH 0 REACH 0

HABITAT DETAIL

Habitat Type	Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m^2)	Large Boulders (#>0.5m)	Substrate Percent Wetted Area S/O	Snd	Grvl	Cbbl	Bldr	Bdrk
CULVERT CROSSING	3	53	1.2	0.14	59	0	7	27	3	3	0	60
DRY CHANNEL	166	2,745	2.3	0.00	6,243	5	0	19	30	40	11	0
DRY UNITS	44	486	2.4	0.00	1,209	4	0	11	44	34	10	1
GLIDE	35	150	1.1	0.10	176	0	8	20	49	21	2	0
POOL-BACKWATER	20	29	0.4	0.08	16	0	14	49	31	4	0	2
POOL-DAMMED	6	22	0.8	0.17	19	0	10	35	43	12	0	0
POOL-ISOLATED	14	40	0.8	0.12	40	1	17	27	31	16	4	4
POOL-LATERAL SCOUR	148	515	1.0	0.19	552	3	8	22	47	21	2	1
POOL-PLUNGE	9	25	2.2	0.42	52	6	6	14	39	31	8	2
POOL-STRAIGHT SCOUR	78	248	1.0	0.18	260	7	8	22	47	19	4	1
POOL-TRENCH	10	51	1.0	0.40	54	0	7	20	33	18	3	20
PUDDLED CHANNEL	18	253	0.7	0.06	167	1	14	20	34	21	7	4
RAPID/BEDROCK	9	28	0.7	0.05	21	0	8	14	10	1	0	67
RAPID/BOULDERS	49	190	0.7	0.06	139	7	1	10	35	40	13	0
RIFFLE	232	945	1.2	0.05	852	1	3	16	57	21	2	0
RIFFLE W/ POCKETS	13	110	0.9	0.07	101	0	5	12	41	31	11	0
STEP/BEDROCK	1	2	0.4	0.03	1	0	0	0	0	0	0	100
STEP/BOULDERS	1	0	0.7	0.05	0	0	0	0	30	20	50	0
STEP/COBBLE	3	1	0.6	0.02	1	0	0	13	50	37	0	0
STEP/LOG	3	5	1.3	0.01	4	0	0	17	63	10	10	0
STEP/STRUCTURE	10	40	0.8	0.02	20	0	10	27	39	6	0	18
Total:	872	5,937	1.3	0.09	9,986	35	Avg: 5	19	44	25	5	2

HABITAT SUMMARY

Habitat Group	No. Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Wetted Area (m^2)	Wetted Area Percent	Large Boulders Number	Large Boulders #/100m^2	Wood Class
Dammed & BW Pools	40	90	0.6	0.11	75	0.75	1	1.33	1.7
Scour Pools	245	839	1.1	0.20	918	9.19	16	1.74	1.8
Glides	35	150	1.1	0.10	176	1.76	0	0.00	1.7
Riffles	245	1,055	1.2	0.05	953	9.55	1	0.10	1.3
Rapids	58	218	0.7	0.06	160	1.61	7	4.37	1.3
Cascades	0	0	.	.	0	0.00	0	0.00	.
Step/Falls	18	48	0.8	0.02	25	0.25	0	0.00	2.1
Small Streams (SS)	0	0	.	.	0	0.00	0	0.00	.
Dry	228	3,484	2.2	*.**	7619	76.29	10	0.13	1.6

Table D-15. Stream Summary for Mission Creek, RM 0.0 to 4.3, August 15-September 11, 1995.

STREAM SUMMARY MISSION CREEK

Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m^2)	Substrate Percent Wetted Area S/O	Sand	Grvl	Cbbl	Bldr	Bdrk	Total Large Boulder
872	5,937	1.3	0.09	9,986	5	19	44	25	5	2	35

Habitat Group	Wetted Area (m^2)	Percent
Scour Pool	918	9.2
Backwater Pools	75	0.8
Glide	176	1.8
Riffle	953	9.5
Rapid	160	1.6
Cascade	0	0.0
Step	25	0.3
Dry	7,619	76.3

Table D-16. Valley, Channel, Bank and Wood Summary for Mission Creek, RM 0.0 to 4.3, August 15-September 11, 1995.

Valley and Channel Summary

Valley Characteristics (Percent Reach Length)

Narrow Valley Floor		Broad Valley Floor	
Steep V-shape	0	Constraining Terraces	100
Moderate V-shape	0	Multiple Terraces	0
Open V-shape	0	Wide Floodplain	0

Valley Width Index avg: 31.1 range: 1.0-100.0

Channel Morphology (Percent Reach Length)

Constrained		Unconstrained	
Hillslope	0	Single Channel	0
Bedrock	0	Multiple Channel	0
Terrace	89	Braided Channel	0
Alt. Terrace/Hill	11		
Landuse	0		

Channel Characteristics

Type	Length	Area	Dry Units
Primary	5,757	9,759	228
Secondary	181	227	0

Channel Dimensions

Wetted Surface		Active Channel		First Terrace	
Width	1.3	Width	3.2	Width	5.3
Depth	0.09	Height	0.4	Height	1.1
W:D	32.9				

Stream Flow Type: LF Water Temp: 0.0-54.0
Avg. Unit Gradient: 2.8 Habitat Units/100m: 14.7

Riparian, Bank, and Wood Summary

Land Use: HG/RR Riparian Veg.: D 30-50/S

Bank Stability

Bank Class	Percent Reach Length
Non-Erodible	1.7
Vegetation Stabilized	72.4
Boulder-cobble	4.6
Actively Eroding	21.3

Undercut Banks

Unit Average: 8.17%

Open Sky (% of 180)

Unit Average: 38
Range: 0-98

Large Woody Debris

Average Complexity Score: 1.6

Pieces	378	Volume(m^3)	93
Pieces/100m	6.6	Volume/100m	1.6

Table D-17. Riparian Summary for Mission Creek, RM 0.0 to 4.3, August 15-September 11, 1995.

REACH 0 | REACH 0

RIPARIAN ZONE VEGETATION SUMMARY

Reach 0 is represented by 36 transects

Predominant landform in each zone

	Zone 1 0-10 meters	Zone 2 10-20 meters	Zone 3 20-30 meters
Hillslope	11	15	19
High terrace	89	85	81
Low terrace	0	0	0
Floodplain	0	0	0
Wetland/meadow	0	0	0
Stream channel	0	0	0
Roadbed/Railroad	0	0	0
Riprap	0	0	0
Surface slope (%)	39	12	9

Canopy closure and ground cover

	Zone 1 0-10 meters (%)	Zone 2 10-20 meters (%)	Zone 3 20-30 meters (%)
Canopy closure	23	8	4
Shrub cover	33	15	7
Grass/forb cover	44	60	69

Average number of trees in a 5-meter wide band

	Zone 1 0-10 meters		Zone 2 10-20 meters		Zone 3 20-30 meters		Zones 1-3 0-30 meters	
Diameter class (cm)	Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood
3-15cm	0.1	6.7	0.1	0.1	0.0	0.0	0.2	6.8
15-30cm	0.1	0.9	0.2	0.1	0.0	**.*	0.2	1.0
30-50cm	0.0	0.5	0.0	0.1	0.0	0.1	0.0	0.7
50-90cm	0.0	0.2	0.0	0.0	0.0	**.*	0.0	0.2
>90cm	0.0	**.*	0.0	0.0	0.0	0.0	0.0	**.*
Total/100m^2	0.2	8.3	0.3	0.3	0.0	0.2	0.1	2.9

Table D-18. Surface Springs identified in the Habitat Survey, Mission Creek, RM 0.0-4.3, 8/15-9/11, 1995

UNIT NUMBER	UNIT TYPE	BANK SIDE		UNIT AREA (m^2)
29	DP	RIGHT		5
87	IP	RIGHT		1
247	LP	RIGHT		4
251	BW	LEFT		1
392	PD	LEFT		8
497	LP	RIGHT		9
559	RB	LEFT		6
578	CC	RIGHT		7
611	LP	LEFT		3
711	RB	LEFT		5
714	LP	RIGHT		4
742	LP	LEFT		6
748	LP	RIGHT		7
766	LP	RIGHT		4
774	PP	RIGHT		7
786	LP	RIGHT		5
796	LP	RIGHT		7
826	SP	RIGHT		1
849	RP	RIGHT		14
859	SP	LEFT		5
862	PP	RIGHT		10
TOTAL 21	—	7 LEFT	14 RIGHT	119

Table D-19. Habitat Unit Summary for Cottonwood Creek, RM 0.0 to 4.1, June 20-August 1, 1995.

HABITAT DETAIL

Habitat Type	Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m^2)	Large Boulders (#>0.5m)	Substrate Percent Wetted Area S/O	Snd	Grvl	Cbbl	Bldr	Bdrk
CULVERT CROSSING	4	26	1.0	0.24	26	100	18	38	5	0	0	15
DRY UNITS	113	2,205	3.1	0.00	6,759	282	1	10	26	38	23	2
GLIDE	61	398	1.3	0.17	620	2	21	32	34	12	1	0
POOL-BACKWATER	27	44	0.6	0.13	35	1	23	40	30	7	0	0
POOL-BEAVER DAM	12	186	3.0	0.44	1,011	0	33	54	13	0	0	0
POOL-DAMMED	16	100	1.7	0.25	198	0	17	49	29	4	0	0
POOL-ISOLATED	23	357	1.6	0.20	1,346	5	26	27	30	13	2	3
POOL-LATERAL SCOUR	145	630	1.3	0.23	908	15	13	23	41	16	3	4
POOL-PLUNGE	11	31	1.6	0.45	58	5	14	22	40	20	5	1
POOL-STRAIGHT SCOUR	65	222	1.2	0.19	274	15	12	22	41	20	3	2
POOL-TRENCH	4	10	1.3	0.29	12	0	13	13	5	0	0	70
PUDDLED CHANNEL	36	537	1.1	0.06	826	19	21	16	31	21	10	1
RAPID/BEDROCK	15	81	0.7	0.07	53	3	9	5	8	5	0	72
RAPID/BOULDERS	34	176	1.0	0.07	198	32	1	9	26	42	20	1
RIFFLE	304	2,344	1.1	0.08	2,846	30	7	21	49	19	4	1
RIFFLE W/ POCKETS	16	189	1.2	0.10	232	13	10	16	38	25	10	1
STEP/BEDROCK	2	2	0.9	0.06	2	0	10	0	0	0	0	90
STEP/BOULDERS	3	1	0.8	0.04	1	0	7	13	10	23	47	0
STEP/COBBLE	3	1	0.5	0.05	1	0	0	3	27	63	7	0
STEP/LOG	3	1	1.1	0.03	1	0	27	40	33	0	0	0
STEP/STRUCTURE	15	9	2.7	0.03	24	0	63	17	8	4	1	8
Total:	912	7,547	1.4	0.12	15,431	522	Avg:11	21	37	20	7	3

HABITAT SUMMARY

Habitat Group	No. Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Wetted Area (m^2)	Wetted Area Percent	Large Boulders Number	Large Boulders #/100m^2	Wood Class
Dammed & BW Pools	78	686	1.5	0.23	2590	16.79	6	0.23	1.9
Scour Pools	225	892	1.3	0.23	1252	8.11	35	2.80	1.9
Glides	61	398	1.3	0.17	620	4.02	2	0.32	1.5
Riffles	320	2,534	1.1	0.08	3078	19.95	43	1.40	1.4
Rapids	49	256	0.9	0.07	251	1.62	35	13.97	1.2
Cascades	0	0	.	.	0	0.00	0	0.00	.
Step/Falls	26	14	1.9	0.03	29	0.19	0	0.00	1.7
Small Streams (SS)	0	0	.	.	0	0.00	0	0.00	.
Dry	149	2,742	2.6	0.01	7585	49.16	301	3.97	1.1

Table D-20. Stream Summary for Cottonwood Creek, RM 0.0 to 4.1, June 20-August 1, 1995.

STREAM SUMMARY — COTTONWOOD CREEK

Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m^2)	Substrate Percent Wetted Area S/O	Sand	Grvl	Cbbl	Bldr	Bdrk	Total Large Boulder
912	7,547	1.4	0.12	15,431	11	21	37	20	7	3	522

Habitat Group	Wetted Area (m^2)	Percent
Scour Pool	1,252	8.1
Backwater Pools	2,590	16.8
Glide	620	4.0
Riffle	3,078	19.9
Rapid	251	1.6
Cascade	0	0.0
Step	29	0.2
Dry	7,585	49.2

Table D-21. Valley, Channel, Bank and Wood Summary for Cottonwood Creek, RM 0.0 to 4.1, June 20-August 1, 1995.

Valley and Channel Summary

Valley Characteristics (Percent Reach Length)

Narrow Valley Floor		Broad Valley Floor	
Steep V-shape	0	Constraining Terraces	75
Moderate V-shape	0	Multiple Terraces	25
Open V-shape	0	Wide Floodplain	0

Valley Width Index avg: 19.6 range: 2.0-50.0

Channel Morphology (Percent Reach Length)

Constrained		Unconstrained	
Hillslope	0	Single Channel	0
Bedrock	0	Multiple Channel	0
Terrace	75	Braided Channel	0
Alt. Terrace/Hill	25		
Landuse	0		

Channel Characteristics

Type	Length	Area	Dry Units
Primary	7,018	13,999	149
Secondary	529	1,432	0

Channel Dimensions

Wetted Surface		Active Channel		First Terrace	
Width	1.4	Width	3.6	Width	6.3
Depth	0.12	Height	0.3	Height	0.7
W:D	***.*				

Stream Flow Type: LF Water Temp: 12.0-21.0
Avg. Unit Gradient: 3.3 Habitat Units/100m: 12.1

Riparian, Bank, and Wood Summary

Land Use: HG,HG Riparian Veg.: D 30-50,D 1

Bank Stability

Bank Class	Percent Reach Length
Non-Erodible	4.0
Vegetation Stabilized	76.4
Boulder-cobble	7.5
Actively Eroding	12.1

Undercut Banks
Unit Average: 10.94%

Open Sky (% of 180)
Unit Average: 47
Range: **-96

Large Woody Debris

Average Complexity Score: 1.5

Pieces	236	Volume(m^3)	61
Pieces/100m	3.4	Volume/100m	0.9

Table D-22. Riparian Summary for Cottonwood Creek, RM 0.0 to 4.1, June 20-August 1, 1995.

REACH 0

RIPARIAN ZONE VEGETATION SUMMARY

REACH 0

Reach 0 is represented by 32 transects

Predominant landform in each zone

	Zone 1 0-10 meters	Zone 2 10-20 meters	Zone 3 20-30 meters
Hillslope	13	25	31
High terrace	72	70	66
Low terrace	14	3	3
Floodplain	0	0	0
Wetland/meadow	0	0	0
Stream channel	0	0	0
Roadbed/Railroad	0	0	0
Riprap	0	0	0
Surface slope (%)	28	12	14

Canopy closure and ground cover

	Zone 1 0-10 meters (%)	Zone 2 10-20 meters (%)	Zone 3 20-30 meters (%)
Canopy closure	41	21	14
Shrub cover	33	29	21
Grass/forb cover	47	53	60

Average number of trees in a 5-meter wide band

	Zone 1 0-10 meters		Zone 2 10-20 meters		Zone 3 20-30 meters		Zones 1-3 0-30 meters	
Diameter class (cm)	Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood
3-15cm	3.0	13.1	0.4	4.3	0.3	1.6	3.7	19.0
15-30cm	0.1	1.1	**.*	0.6	0.1	0.2	0.2	1.8
30-50cm	0.0	0.3	0.0	0.2	0.0	0.2	0.0	0.6
50-90cm	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.3
>90cm	0.0	0.1	0.0	**.*	0.0	0.0	0.0	0.1
Total/100m^2	3.0	14.7	0.5	5.2	0.4	2.0	1.3	7.3

Table D-23. Surface Springs identified in the Habitat Survey, Cottonwood Creek, RM 0.0-4.1, 6/20-8/1, 1995

UNIT NUMBER	UNIT TYPE	BANK SIDE		UNIT AREA (m^2)
1	GL	LEFT		14
7	BP	LEFT		825
8	IP	LEFT		1,200
9	IP	LEFT		150
204	RI	LEFT		129
246	LP	LEFT		13
299	LP	RIGHT		4
311	RR	LEFT		4
316	LP	LEFT		16
322	RI	RIGHT		15
337	PD	RIGHT		1
649	LP	LEFT		2
662	IP	LEFT		5
694	LP	LEFT		1
724	RI	LEFT		4
741	PD	LEFT		17
773	RB	RIGHT		2
776	RI	LEFT		41
783	RB	RIGHT		7
795	PD	RIGHT		13
810	IP	LEFT		3
843	IP	RIGHT		1
886	TP	LEFT		5
TOTAL 23	–	16 LEFT	7 RIGHT	2,472

Table D-24. Habitat Unit Summary for Coonskin Creek, RM 0.0 to 2.0, June 20-July 17, 1995.

REACH 0 REACH 0

HABITAT DETAIL

Habitat Type	Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m2)	Large Boulders (#>0.5m)	Substrate Percent Wetted Area S/O	Snd	Grvl	Cbbl	Bldr	Bdrk
CULVERT CROSSING	1	23	0.6	0.05	14	0	10	10	30	30	20	0
DRY UNITS	2	8	1.7	0.00	11	0	20	30	30	15	5	0
GLIDE	14	133	2.3	0.23	385	14	21	26	34	14	3	1
POOL-ALCOVE	1	76	1.7	0.35	130	0	30	60	10	0	0	0
POOL-BACKWATER	14	30	0.9	0.15	33	3	20	39	29	9	2	0
POOL-DAMMED	4	16	1.3	0.20	19	0	18	38	33	13	0	0
POOL-ISOLATED	2	19	1.4	0.38	22	0	20	45	25	10	0	0
POOL-LATERAL SCOUR	126	531	1.3	0.26	776	19	12	21	34	24	7	1
POOL-PLUNGE	27	65	2.0	0.39	134	14	14	23	27	20	10	4
POOL-STRAIGHT SCOUR	109	393	1.4	0.25	587	47	13	21	33	23	8	1
POOL-TRENCH	7	23	1.2	0.55	29	1	10	23	16	11	6	34
RAPID/BEDROCK	7	47	1.3	0.09	57	1	10	13	13	6	1	57
RAPID/BOULDERS	48	264	1.5	0.08	422	55	11	13	33	27	16	0
RIFFLE	171	1,629	1.4	0.08	2,240	55	11	16	41	24	8	1
RIFFLE W/ POCKETS	62	726	1.3	0.13	977	87	11	16	31	28	13	1
STEP/BEDROCK	11	9	1.4	0.05	12	1	19	13	8	6	8	45
STEP/BOULDERS	6	2	1.2	0.05	2	10	10	17	32	25	17	0
STEP/COBBLE	1	0	0.5	0.05	0	0	20	20	10	20	10	20
STEP/LOG	8	4	0.9	0.09	3	0	18	24	36	21	1	0
STEP/STRUCTURE	5	3	2.1	0.06	7	0	26	24	28	16	4	2
Total:	626	4,001	1.4	0.18	5,860	307	Avg:12	19	34	23	9	3

HABITAT SUMMARY

Habitat Group	No. Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Wetted Area (m2)	Wetted Area Percent	Large Boulders Number	Large Boulders #/100m2	Wood Class
Dammed & BW Pools	21	141	1.0	0.19	204	3.47	3	1.47	1.7
Scour Pools	269	1,012	1.4	0.28	1526	26.04	81	5.31	1.7
Glides	14	133	2.3	0.23	385	6.57	14	3.64	1.5
Riffles	233	2,354	1.4	0.10	3217	54.89	142	4.41	1.4
Rapids	55	311	1.5	0.08	480	8.18	56	11.68	1.3
Cascades	0	0	.	.	0	0.00	0	0.00	.
Step/Falls	31	19	1.3	0.06	25	0.43	11	43.65	1.2
Small Streams (SS)	0	0	.	.	0	0.00	0	0.00	.
Dry	2	8	1.7	0.00	11	0.19	0	0.00	1.0

Table D-25. Stream Summary for Coonskin Creek, RM 0.0 to 2.0, June 20-July 17, 1995.

STREAM SUMMARY — COONSKIN CREEK

Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m2)	Substrate Percent Wetted Area S/O	Sand	Grvl	Cbbl	Bldr	Bdrk	Total Large Boulder
626	4,001	1.4	0.18	5,860	12	19	34	23	9	3	307

Habitat Group	Wetted Area (m2)	Percent
Scour Pool	1,526	26.0
Backwater Pools	204	3.5
Glide	385	6.6
Riffle	3,217	54.9
Rapid	480	8.2
Cascade	0	0.0
Step	25	0.4
Dry	11	0.2

Table D-26. Valley, Channel, Bank and Wood Summary for Coonskin Creek, RM 0.0 to 2.0, June 20-July 17, 1995.

Valley and Channel Summary

Valley Characteristics (Percent Reach Length)

Narrow Valley Floor		Broad Valley Floor	
Steep V-shape	0	Constraining Terraces	100
Moderate V-shape	0	Multiple Terraces	0
Open V-shape	0	Wide Floodplain	0

Valley Width Index avg: 11.5 range: 10.0-50.0

Channel Morphology (Percent Reach Length)

Constrained		Unconstrained	
Hillslope	0	Single Channel	0
Bedrock	0	Multiple Channel	0
Terrace	100	Braided Channel	0
Alt. Terrace/Hill	0		
Landuse	0		

Channel Characteristics

Type	Length	Area	Dry Units
Primary	3,496	5,299	1
Secondary	505	561	1

Channel Dimensions

Wetted Surface		Active Channel		First Terrace	
Width	1.4	Width	3.5	Width	5.7
Depth	0.18	Height	0.4	Height	0.8
W:D	19.2				

Stream Flow Type: MF Water Temp: 12.5-21.0
Avg. Unit Gradient: 3.1 Habitat Units/100m: 15.6

Riparian, Bank, and Wood Summary

Land Use: AG,LG Riparian Veg.: S,G

Bank Stability

Bank Class	Percent Reach Length
Non-Erodible	2.0
Vegetation Stabilized	83.8
Boulder-cobble	0.5
Actively Eroding	13.2

Undercut Banks
Unit Average: 11.23%

Open Sky (% of 180)
Unit Average: 41
Range: 0-92

Large Woody Debris

Average Complexity Score: 1.5

Pieces	55	Volume(m3)	43
Pieces/100m	1.6	Volume/100m	1.2

Table D-27. Riparian Summary for Coonskin Creek, RM 0.0 to 2.0, June 20-July 17, 1995.

REACH 0 REACH 0

RIPARIAN ZONE VEGETATION SUMMARY

Reach 0 is represented by 23 transects

Predominant landform in each zone

	Zone 1 0-10 meters	Zone 2 10-20 meters	Zone 3 20-30 meters
Hillslope	2	4	9
High terrace	43	44	50
Low terrace	55	49	39
Floodplain	0	0	0
Wetland/meadow	0	0	0
Stream channel	0	2	2
Roadbed/Railroad	0	0	0
Riprap	0	0	0
Surface slope (%)	32	17	19

Canopy closure and ground cover

	Zone 1 0-10 meters (%)	Zone 2 10-20 meters (%)	Zone 3 20-30 meters (%)
Canopy closure	31	22	15
Shrub cover	51	42	35
Grass/forb cover	44	51	53

Average number of trees in a 5-meter wide band

	Zone 1 0-10 meters		Zone 2 10-20 meters		Zone 3 20-30 meters		Zones 1-3 0-30 meters	
Diameter class (cm)	Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood
3-15cm	0.0	3.3	**.*	1.8	0.0	1.0	**.*	6.2
15-30cm	0.0	0.7	**.*	**.*	**.*	0.2	0.1	0.9
30-50cm	0.0	0.6	**.*	0.5	0.0	0.1	**.*	1.2
50-90cm	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
>90cm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total/100m2	0.0	4.7	0.1	2.3	***.*	1.3	0.1	2.8

Table D-28. Surface Springs identified in the Habitat Survey, Coonskin Creek, RM 0.0-2.0, 6/20-7/17, 1995.

UNIT NUMBER	UNIT TYPE	BANK SIDE		UNIT AREA (m^2)
11	IP	LEFT		15
87	LP	RIGHT		3
92	RI	LEFT		4
137	RI	LEFT		15
179	LP	LEFT		3
216	LP	LEFT		4
221	LP	RIGHT		5
263	RP	LEFT		13
268	SP	RIGHT		11
405	LP	LEFT		5
487	LP	RIGHT		3
498	LP	RIGHT		2
531	RI	RIGHT		2
548	TP	LEFT		5
602	SP	LEFT		5
621	RP	RIGHT		19
625	RB	LEFT		24
TOTAL 17	—	10 LEFT	7 RIGHT	138

APPENDIX E
Biological Survey Data Summary Tables and Figures

Table E-1. Mean Density and Population Estimate of Rainbow/Steelhead and Bull Trout, Chinook Salmon, and Mountain Whitefish, Umatilla River, RM 81.8-89.6, 8/8-8/25, 1995.

HABITAT TYPE	# OF UNITS	# UNITS SAMPLED	% OF TOTAL SAMPLED	AREA-M²	AREA-M² SAMPLED	% OF AREA SAMPLED	MEAN SALMONID DENSITY	EST. # SALMONIDS
POOLS								
Plunge Pool	3	1	33.3	250	165	66.0	0.9515	238
Scour Pool	63	8	12.7	14,201	1,057	7.4	0.4541	6,449
Lateral Pool	108	11	10.2	23,629	364	1.5	0.8709	20,578
Dammed Pool	5	1	20.0	680	26	3.8	1.7692	1,203
Beaver Dam Pool	1	0'	0.0	519	0	0.0	-	-
SUBUNIT POOLS								
Back Water Pool	42	5	11.9	755	87	11.5	0.9080	686
Isolated Pool	14	1	7.1	1,657	43	2.6	0.0930	154
Isolated Pool w/ss	10	7	70.0	2,983	2,604	87.3	0.0545	163
Unclass. Isolated Pool w/ss	9*	9	100.0	2,053	2,053	100.0	0.1495	307
Puddled	6	2	33.3	461	63	13.7	0.1111	51
GLIDES								
Glide	63	8	12.7	13,871	1,178	8.5	0.1469	2,037
Subtotal	324	53	16.4	61,059	7,640	12.5	0.5219	31,866
RIFFLES								
Riffle	206	9	4.4	60,403	1,228	2.0	0.3461	20,905
Riffle With Pockets	47	4	8.5	22,653	732	3.2	0.5137	11,636
RAPIDS								
Rapid-Boulder	63	6	9.5	9,614	635	6.6	0.4898	4,709
Rapid-Bedrock	3	0'	0.0	131	0	0.0	-	-
Subtotal	319	19	6.0	92,801	2,595	2.8	0.4014	37,250
SPECIAL CASES								
Steps	4	0^	0.0	120	0	0.0	-	-
Dry	1	0^	0.0	24	0	0.0	0	0
Subtotal	5	0	0.0	144	0	0.0	0	0
TOTALS	648*	72	11.1	154,004	10,235	6.7	0.4486	69,116

^ The physical properties of Steps, and Dry Units prevented sampling.
* Includes 9 units unclassified during the habitat survey, but identified during the biological survey.
' Was not sampled because the habitat type could not be sampled effectively or accurately.

Table E-2. Mean Density and Population Estimate of Natural Rainbow/Steelhead Trout, Chinook and Coho Salmon, Moonshine Creek, RM 0.0-4.4, 9/18-9/21, 1995.

HABITAT TYPE	# OF UNITS	# UNITS SAMPLED	% OF TOTAL SAMPLED	AREA-M²	AREA-M² SAMPLED	% OF AREA SAMPLED	MEAN SALMONID DENSITY	EST. # SALMONIDS
POOLS								
Plunge Pool	9	6	66.7	75	64	80.0	2.2188	166
Scour Pool	68	13	19.1	467	171	36.6	0.4795	224
Lateral Pool	110	18	16.4	729	135	18.5	0.4667	340
Trench Pool	2	1	50.0	8	7	87.5	1.8571	15
Beaver Dam Pool	3	1	33.3	612	31	5.1	0.1290	79
SUBUNIT POOLS								
Back Water Pool	11	2	18.2	11	9	81.8	0.1111	1
Isolated Pool	10	1	10.0	170	2	1.2	0.0000	0
Puddled	13	2	15.4	376	167	44.4	0.0599	23
GLIDES								
Glide	48	10	20.8	528	157	29.7	0.0764	40
Subtotal	274	54	19.7	2,976	743	25.0	0.2984	888
RIFFLES								
Riffle	158	13	8.2	1,172	156	13.3	0.0385	45
Riffle With Pockets	34	8	23.5	438	100	22.8	0.4800	210
RAPIDS								
Rapid-Boulder	48	7	14.6	306	46	15.0	0.0435	13
Rapid-Bedrock	9	4	44.4	58	36	62.1	0.0556	3
CACADES								
Cascade-Bedrock	3	3	100.0	25	23	92.0	0.3913	10
Subtotal	252	35	13.9	1,999	361	18.1	0.1406	281
SPECIAL CASES								
Steps	11	0^	0.0	18	0	0.0	-	-
Culvert Crossing	2	0^	0.0	31	0	0.0	-	-
Dry	55	0^	0.0	6,196	0	0.0	0	0
Subtotal	68	0	0.0	6,245	0	0.0	0	0
TOTALS	594	89	15.0	11,213	1,104	9.9	0.1042	1,169

^ The physical properties of Steps, Dry Units, and Culvert Crossings prevented sampling.

Table E-3. Mean Density and Population Estimate of Rainbow/Steelhead Trout and Coho Salmon, Mission Creek, RM 0.0-4.3, 9/5-9/13, 1995.

HABITAT TYPE	# OF UNITS	# UNITS SAMPLED	% OF TOTAL SAMPLED	AREA-M²	AREA-M² SAMPLED	% OF AREA SAMPLED	MEAN SALMONID DENSITY	EST. # SALMONIDS
POOLS								
Plunge Pool	9	6	66.7	52	47	90.4	1.6170	84
Scour Pool	78	7	9.0	260	42	16.2	0.7857	204
Lateral Pool	148	18	12.2	552	73	13.2	0.8356	461
Trench Pool	10	4	40.0	54	27	50.0	1.0370	56
Dammed Pool	6	2	33.3	19	12	63.2	0.3333	6
SUBUNIT POOLS								
Back Water Pool	20	3	15.0	16	4	25.0	0.2500	4
Isolated Pool	14	2	14.3	40	9	22.5	0.0000	0
Puddled	18	0"	0.0	167	0	0.0	-	-
GLIDES								
Glide	35	4	11.4	176	41	23.3	0.3659	64
Subtotal	338	46	13.6	1,336	255	19.1	0.6579	879
RIFFLES								
Riffle	232	10	4.3	852	114	13.4	0.0351	30
Riffle With Pockets	13	4	30.8	101	48	47.5	0.2083	21
RAPIDS								
Rapid-Boulder	49	5	10.2	139	22	15.8	0.0000	0
Rapid-Bedrock	9	0'	0.0	21	0	0.0	-	-
Subtotal	303	19	6.3	1,113	184	16.5	0.0458	51
SPECIAL CASES								
Steps	18	0^	0.0	26	0	0.0	-	-
Culvert Crossing	3	0^	0.0	59	0	0.0	-	-
Dry	210	0^	0.0	7,452	0	0.0	.0000	0
Subtotal	231	0	0.0	7,537	0	0.0	.0000	0
TOTALS	872	65	7.5	9,986	440	4.4	0.0931	930

^ The physical properties of Steps, Dry Units, and Culvert Crossings prevented sampling.
" Was not sampled because habitat was not suitable for salmonids.
' Was not sampled because habitat type could not be sampled effectively or accurately.

Table E-4. Mean Density and Population Estimate of Natural Rainbow/Steelhead Trout, Chinook and Coho Salmon, Cottonwood Creek, RM 0.0-4.1, 7/5-8/1, 1995.

HABITAT TYPE	# OF UNITS	# UNITS SAMPLED	% OF TOTAL SAMPLED	AREA-M²	AREA-M² SAMPLED	% OF AREA SAMPLED	MEAN SALMONID DENSITY	EST. # SALMONIDS
POOLS								
Plunge Pool	11	6	54.5	58	48	82.8	2.5000	145
Scour Pool	65	13	20.0	274	69	25.2	0.2319	64
Lateral Pool	145	14	9.7	908	118	13.0	0.1949	177
Trench Pool	4	1	25.0	12	4	33.4	1.0000	12
Dammed Pool	16	3	18.8	198	48	24.2	0.1250	15
Beaver Dam Pool	12	2	16.7	1,011	796	78.7	0.0000	0
SUBUNIT POOLS								
Back Water Pool	27	1	3.7	35	1	2.9	0.0000	0
Isolated Pool	23	3	13.0	1,346	1,143	84.9	0.0367	49
Puddled	36	1	2.8	826	7	0.8	0.0000	0
GLIDES								
Glide	61	8	13.1	620	141	22.7	0.0355	22
Subtotal	400	52	13.0	5,288	2,375	44.9	0.0915	484
RIFFLES								
Riffle	304	12	3.9	2,846	417	14.7	0.0312	89
Riffle With Pockets	16	2	12.5	232	23	9.9	0.1304	30
RAPIDS								
Rapid-Boulder	34	3	8.8	198	26	13.1	0.1154	23
Rapid-Bedrock	15	1	6.7	53	5	9.4	0.0000	0
Subtotal	369	18	4.9	3,329	471	14.1	0.0427	142
SPECIAL CASES								
Steps	26	0^	0.0	29	0	0.0	-	-
Culvert Crossing	4	0^	0.0	26	0	0.0	-	-
Dry	113	0^	0.0	6,759	0	0.0	0.0000	0
Subtotal	143	0	0.0	6,814	0	0.0	0.0000	0
TOTALS	912	70	7.7	15,431	2,824	18.3	0.0406	626

^ The physical properties of Steps, Dry Units, and Culvert Crossings prevented sampling.

Table E-5. Population Density Estimate of Rainbow/Steelhead Trout, Chinook and Coho Salmon, Coonskin Creek, RM 0.0-2.0, 6/29-7/18, 1995.

HABITAT TYPE	# OF UNITS	# UNITS SAMPLED	% OF TOTAL SAMPLED	AREA-M²	AREA-M² SAMPLED	% OF AREA SAMPLED	MEAN SALMONID DENSITY	EST. # SALMONIDS
POOLS								
Plunge Pool	27	9	33.3	134	56	41.8	1.6964	227
Scour Pool	109	16	14.7	587	94	16.0	1.1277	662
Lateral Pool	126	19	15.1	776	144	18.6	0.5000	388
Trench Pool	7	5	71.4	29	20	69.0	4.8000	139
Dammed Pool	4	2	50.0	19	8	42.1	0.0000	0
SUBUNIT POOLS								
Alcove	1	0"	0.0	130	0	0.0	-	-
Back Water Pool	14	1	7.1	33	1	0.1	0.0000	0
Isolated Pool (IP)	2	2	100.0	22	20	0.9	0.0000	0
GLIDES								
Glide	14	5	35.7	385	171	44.4	0.0877	34
Subtotal	304	57	18.8	2,115	514	24.3	0.6856	1,450
RIFFLES								
Riffle	171	12	7.0	2,240	130	0.1	0.0846	190
Riffle With Pockets	62	6	9.7	977	135	13.8	0.1555	152
RAPIDS								
Rapid-Boulder	48	9	9.7	422	104	24.6	0.1731	73
Rapid-Bedrock	7	2	28.6	57	22	38.6	0.1818	10
Subtotal	288	29	10.1	3,696	391	10.6	0.1150	425
SPECIAL CASES								
Steps	31	0^	0.0	24	0	0.0	-	-
Culvert Crossing	1	0^	0.0	14	0	0.0	-	-
Dry	2	0^	0.0	11	0	0.0	0.0000	0
Subtotal	34	0	0.0	49	0	0.0	0.0000	0
TOTALS	626	88	14.1	5,860	905	15.4	0.3200	1,875

^ The physical properties of Steps, Dry Units, and Culvert Crossings prevented sampling.
" Was not sampled because the habitat was not suitable for salmonids.

Table E-6. Mean Density and Population Estimate of Rainbow/Steelhead and Bull Trout, Umatilla River, RM 81.8-89.6, 8/8-8/25, 1995.

HABITAT TYPE	TOTAL AREA SAMPLED/M²	AREA/M² W/SPP. PRESENT	MEAN DENSITY IN TOTAL AREA	EST# IN UNIT
Natural Rainbow/Steelhead Trout				
Plunge Pool	165	165	.9515	157
Lateral Pool	364	364	.7967	290
Backwater Pool	87	78	.7126	62
Riffle With Pockets	732	732	.4481	328
Rapid Over Boulders	635	635	.4000	254
Dammed Pool	26	26	.3846	10
Scour Pool	1,057	1,057	.3349	354
Riffle	1,228	1,215	.3119	383
Puddled	63	44	.1111	7
Unclass. IP w/ss	2,053	1,988	.0974	200
Isolated Pool	43	43	.0930	4
Glide	1,178	1,178	.0925	109
Isolated Pool w/ss	2,604	2,604	.0445	116
Bull Trout				
Plunge Pool	165	165	.0121	2
Riffle With Pockets	732	330	.0027	2
Scour Pool	1,057	66	.0009	1
Natural Juvenile Chinook Salmon				
Dammed Pool	26	26	1.3461	35
Backwater Pool	87	34	0.2759	24
Plunge Pool	165	165	0.1333	22
Glide	1,178	890	0.0993	117
Lateral Pool	364	265	0.0522	19
Unclass. IP w/ss	2,053	1,757	0.0502	103
Scour Pool	1,057	1,057	0.0435	46
Riffle	1,228	1,140	0.0269	33
Isolated Pool w/ss	2,604	1,242	0.0092	24
Riffle With Pockets	732	402	0.0068	5
Rapid Over Boulders	635	169	0.0063	4
Adult Chinook Salmon				
Plunge Pool	165	165	0.0060	1
Lateral Pool	364	53	0.0027	1
Rapid Over Boulders	635	169	0.0016	1
Mountain Whitefish				
Plunge Pool	165	165	0.1273	21
Rapid Over Boulders	635	528	0.0760	48
Scour Pool	1,057	622	0.0757	80
Riffle With Pockets	732	557	0.0533	39
Lateral Pool	364	150	0.0247	9
Riffle	1,228	534	0.0060	7

Table E-7. Mean Density and Population Estimate per Habitat Type of Rainbow/Steelhead Trout, Coho, and Chinook Salmon, Moonshine Creek, RM 0.0-4.4, 9/18-9/21, 1995.

HABITAT TYPE	TOTAL AREA SAMPLED/M²	AREA/M² W/ SPP. PRESENT	MEAN DENSITY AND TOTAL AREA	EST. # IN UNIT
Natural Rainbow/Steelhead Trout				
Plunge Pool	64	64	2.2186	142
Trench Pool	7	7	1.8571	13
Riffle With Pockets	100	87	0.4900	49
Lateral Pool	135	90	0.4667	63
Scour Pool	171	165	0.4269	73
Cascade Over Bedrock	23	15	0.3913	9
Backwater Pool	9	8	0.2222	2
Beaver Dam Pool	31	31	0.1290	4
Glide	157	111	0.0764	12
Puddled	167	26	0.0599	10
Rapid Over Bedrock	36	17	0.0556	2
Rapid Over Boulder	46	15	0.0435	2
Riffle	156	55	0.0385	6
Natural Juvenile Coho Salmon				
Scour Pool	171	73	0.0526	9
Natural Juvenile Chinook Salmon				
Scour Pool	171	73	0.0058	1

Table E-8. Mean Density and Population Estimate per Habitat Type of Rainbow/Steelhead Trout, and Coho Salmon, Mission Creek, RM 0.0-4.3, 9/5-9/13, 1995.

HABITAT TYPE	TOTAL AREA SAMPLED/M²	AREA/M² W/ SPP. PRESENT	MEAN DENSITY IN TOTAL AREA	EST. # IN UNIT
Natural Rainbow/Steelhead Trout				
Plunge Pool	47	39	1.2766	60
Trench Pool	27	22	1.0370	28
Lateral Pool	73	60	0.7945	58
Scour Pool	42	30	0.6905	29
Glide	41	32	0.3659	15
Dammed Pool	12	7	0.3333	4
Backwater Pool	4	2	0.2500	1
Riffle With Pockets	48	12	0.2083	10
Riffle	114	66	0.0351	4
Hatchery Rainbow/Steelhead Trout				
Plunge Pool	47	7	0.0213	1
Natural Juvenile Coho Salmon				
Plunge Pool	47	7	0.3191	15
Scour Pool	42	10	0.0952	4
Lateral Pool	73	5	0.0274	2

Table E-9. Mean Density and Population Estimate per Habitat Type of Rainbow/Steelhead Trout, Coho and Chinook Salmon, Cottonwood Creek, RM 0.0-4.1, 7/5-8/1, 1995.

HABITAT TYPE	TOTAL AREA SAMPLED/M²	AREA/M² W/SPP. PRESENT	MEAN DENSITY IN TOTAL AREA	EST. # IN UNIT
Natural Rainbow/Steelhead Trout				
Plunge Pool	48	30	1.9167	92
Trench Pool	4	4	1.0000	4
Scour Pool	69	29	0.2319	16
Lateral Pool	118	63	0.1441	17
Riffle With Pockets	23	10	0.1304	3
Rapid Over Boulders	26	15	0.1154	3
Dammed Pool	48	45	0.1042	5
Glide	141	44	0.0355	5
Riffle	417	87	0.0288	12
Isolated Pool	1,143	7	0.0201	23
Natural Juvenile Coho Salmon				
Plunge Pool	48	43	0.5625	27
Lateral Pool	118	40	0.0424	5
Isolated Pool	1,143	1,076	0.0149	17
Riffle	417	23	0.0024	1
Natural Juvenile Chinook Salmon				
Isolated Pool	1,143	1,076	0.0009	1

Table E-10. Mean Density and Population Estimate per Habitat Type of Rainbow/Steelhead Trout, Coho and Chinook Salmon, Coonskin Creek, RM 0.0-2.0, 6/29-7/18, 1995.

HABITAT TYPE	TOTAL AREA SAMPLED/M²	AREA/M² W/SPP. PRESENT	MEAN DENSITY IN TOTAL AREA	EST # IN UNIT
Natural Rainbow/Steelhead Trout				
Trench Pool	20	20	4.0000	80
Plunge Pool	56	37	0.7090	95
Scour Pool	94	61	0.6596	62
Lateral Pool	144	83	0.2430	35
Riffle With Pockets	135	53	0.1556	21
Rapid Over Boulders	104	42	0.1154	12
Glide	171	147	0.0877	15
Riffle	130	33	0.0462	6
Natural Juvenile Coho Salmon				
Trench Pool	20	3	0.7000	14
Scour Pool	94	17	0.3617	34
Lateral Pool	144	56	0.2431	35
Rapid Over Boulders	104	20	0.0673	7
Rapid Over Bedrock	22	12	0.0454	1
Riffle	130	13	0.0385	5
Natural Juvenile Chinook Salmon				
Rapid Over Bedrock	22	12	0.1364	3
Scour Pool	94	17	0.0851	8
Trench Pool	20	2	0.0500	1

Table E-11. Habitat of Mountain Whitefish, Umatilla River, RM 81.8-89.6, 8/8-8/25, 1995.

HABITAT TYPE	TOTAL AREA /m²	AREA SAMPLED /m²	# CAPTURED	% OF TOTAL CATCH	DENSITY*	EXPANDED POPULATION ESTIMATE*	RM RANGE	MEAN RM
FAST WATER HABITAT TYPE								
Rapid Over Boulders	9,614	635	40	21.6	0.0630*	606	88.3-88.7	88.3
Riffle With Pockets	22,653	732	35	18.9	0.0478*	1,083	82.2-88.4	87.0
Riffle	60,403	1,228	7	3.8	0.0060*	344	82.4-83.6	83.0
Subtotal	92,670	2,595	82	44.3	0.0220*	2,033	82.2-88.7	87.3
SLOW WATER HABITAT TYPE								
Straight Scour Pool	14,201	1,057	73	39.5	0.0691*	981	82.3-88.5	87.8
Plunge Pool	250	165	21	11.4	0.1273*	32	89.2	89.2
Lateral Scour Pool	23,629	364	9	4.9	0.0247*	584	83.3-88.6	87.9
Subtotal	38,080	1,586	103	55.7	0.0649*	1,597	82.3-88.6	88.1
TOTAL	130,750	4,181	185	100.00	0.0442*	3,630*	82.2-88.7	87.7

* Density was only estimated for units where mountain whitefish were captured.
- Mountian whitefish were not captured in other habitat types.

Table E-12. Actual, Estimated Number and Percentage with Minimum, Maximum and Mean Lengths, and RM Range of Salmonids captured in the Umatilla River, RM 81.8-89.6, 8/8-8/25, 1995.

SPECIES	% SPECIES COMPOSITION	TOTAL # CAPTURED	EXPANDED ESTIMATED # OF EACH SPECIES	MIN,MEAN,MAX LENGTHS (mm)	RM RANGE
Rainbow/Steelhead Trout - Natural	78.50	1,899	54,258	29,84,258	81.9-89.4
Juvenile Chinook Salmon - Natural	13.52	327	9,343	65,89,127	81.9-89.3
Mountain Whitefish - Natural	7.65	185	5,286	116,258,440	82.2-88.7
Bull Trout - Natural	0.21	5	152	170,223,265	87.7-89.2
Adult Spring Chinook	0.12	3	96	540,655,850	88.0-89.2
TOTAL	100.00%	2,419	69,116	29,99,850	81.9-89.4

Table E-13. Actual, Estimated Number and Percentage with Minimum, Maximum and Mean Lengths, and RM Range of Salmonids captured in Moonshine Creek, RM 0-4.4, 9/18-9/21, 1995.

SPECIES	% SPECIES COMPOSITION	TOTAL # CAPTURED	EXPANDED ESTIMATED # OF EACH SPECIES	MIN,MEAN,MAX LENGTHS (mm)	RM RANGE
Rainbow/Steelhead Trout - Natural	97.36	369	1,138	48,107,240	0.0-4.2
Coho Salmon - Natural	2.38	9	28	88,91,95	0.2
Chinook Salmon - Natural	0.26	1	3	88	0.2
TOTAL	100.00%	379	1,169	48,107,240	0.0-4.2

Table E-14. Actual, Estimated Number and Percentage with Minimum, Maximum and Mean Lengths, and RM Range of Salmonids captured in Mission Creek, RM 0-4.3, 9/5-9/13, 1995.

SPECIES	% SPECIES COMPOSITION	TOTAL # CAPTURED	EXPANDED ESTIMATED # OF EACH SPECIES	MIN,MEAN,MAX LENGTHS (mm)	RM RANGE
Rainbow/Steelhead Trout - Natural	90.18	202	839	56,122,290	0.5-4.2
Coho Salmon - Natural	9.38	21	87	75,90,100	0.5
Rainbow/Steelhead Trout - Hatchery	0.44	1	4	230	0.5
TOTAL	100.00%	224	930	56,120,290	0.5-4.2

Table E-15. Actual, Estimated Number and Percentage with Minimum, Maximum and Mean Lengths, and RM range of Salmonids captured in Cottonwood Creek, RM 0-4.1, 7/5-8/1, 1995.

SPECIES	% SPECIES COMPOSITION	TOTAL # CAPTURED	EXPANDED ESTIMATED # OF EACH SPECIES	MIN,MEAN,MAX LENGTHS (mm)	RM RANGE
Rainbow/Steelhead Trout - Natural	78.18	172	489	37,111,340	0.0-3.1
Coho Salmon - Natural	21.36	47	134	69,84,103	0.1-1.1
Chinook Salmon - Natural	0.46	1	3	63	0.0-0.1
TOTAL	100.00%	220	626	37,105,340	0.0-3.1

Table E-16. Actual, Estimated Number and Percentage with Minimum, Maximum and Mean Lengths, and RM Range of Salmonids captured in Coonskin Creek, RM 0-2.0, 6/29-7/18, 1995.

SPECIES	% SPECIES COMPOSITION	TOTAL # CAPTURED	EXPANDED ESTIMATED # OF EACH SPECIES	MIN,MEAN,MAX LENGTHS (mm)	RM RANGE
Rainbow/Steelhead Trout - Natural	76.04	311	1,426	42,108,327	0.0-2.0
Coho Salmon - Natural	21.03	86	394	64,79,90	0.1-0.2
Chinook Salmon - Natural	2.93	12	55	74,83,90	0.1-0.2
TOTAL	100.00	409	1,875	42,101,327	0.0-2.0

Table E-17. Number of Non-Salmonids visually estimated or captured^ from 74 of 648 units, Umatilla River, RM 81.8-89.6, 8/8-8/25, 1995.

SPECIES	NUMBER VISUALLY ESTIMATED	% OF NUMBER VISUALLY ESTIMATED	DENSITY OF NON-SALMONIDS	EXPANDED NON-SALMONID ESTIMATE	NON-SALMONID TO SALMONID RATIO
Speckled Dace (Rhinichthys osculus)	5,411	53.71	0.5287	81,418	1.180:1
Sculpin (Cottus spp.)	4,550	45.16	0.4446	68,463	0.991:1
Redside Shiner (Richardsonius balteatus)	91	0.90	0.0089	1,369	0.020:1
Sucker (Catostomus spp.)	17	0.17	0.0017	256	0.004:1
Northern Squawfish^ (Ptychocheilus oregonesis)	6	0.06	0.0006	6	0.001:1
TOTAL	10,075	100.00	0.9844	151,511	2.193:1

* Conservative estimate, see methods section for expansion methodology.
^ Northern Squawfish were the only non-salmonid captured.

Table E-18. Number of Non-Salmonids visually estimated from 90 of 594 units, Moonshine Creek, RM 0-4.4, 9/18-9/21, 1995.

SPECIES	NUMBER VISUALLY ESTIMATED	% OF NUMBER VISUALLY ESTIMATED	DENSITY OF NON-SALMONIDS	EXPANDED NON-SALMONID ESTIMATED	NON-SALMONID TO SALMONID RATIO
Sucker (Catostomus spp.)	455	44.70	0.4121	4,621	3.953:1
Sculpin (Cottus spp.)	368	36.15	0.3334	3,738	3.198:1
Speckled Dace (Rhinichthys osculus)	195	19.15	0.1767	1,981	1.695:1
TOTAL	1,018	100.00	0.9221	10,340	8.845:1

Table E-19. Number of Non-Salmonids visually estimated from 65 of 872 units, Mission Creek, RM 0-4.3, 9/5-9/13, 1995.

SPECIES	NUMBER VISUALLY ESTIMATED	% OF NUMBER VISUALLY ESTIMATED	DENSITY OF NON-SALMONIDS	EXPANDED NON-SALMONID ESTIMATE	NON-SALMONID TO SALMONID RATIO
Speckled Dace (Rhinichthys osculus)	350	76.92	0.7954	7,943	8.541:1
Sculpin (Cottus spp.)	85	18.68	0.1932	1,929	2.074:1
Redside Shiner (Richardsonius blateatus)	20	4.40	0.0455	454	0.488:1
TOTAL	455	100.00	1.0340	10,326	11.103:1

Table E-20. Number of Non-Salmonids visually estimated from 70 of 912 units, Cottonwood Creek, RM 0-4.1, 7/5-8/1, 1995.

SPECIES	NUMBER VISUALLY ESTIMATED	% OF NUMBER VISUALLY ESTIMATED	DENSITY OF NON-SALMONIDS	EXPANDED NON-SALMONID ESTIMATE	NON-SALMONID TO SALMONID RATIO
Speckled Dace (Rhinichthys osculus)	1,401	85.06	0.4926	7,602	10.150:1
Sculpin (Cottus spp.)	106	6.44	0.0373	575	0.768:1
Redside Shiner (Richardsonius blateatus)	80	4.86	0.0281	434	0.579:1
Sucker (Catostomus spp.)	60	3.64	0.0211	326	0.435:1
TOTAL	1,647	100.00	0.5792	8,937	11.932:1

Table E-21. Number of Non-Salmonids visually estimated from 87 of 626 units, Coonskin Creek, RM 0-2.0, 6/29-7/18, 1995.

SPECIES	NUMBER VISUALLY ESTIMATED	% OF NUMBER VISUALLY ESTIMATED	DENSITY OF NON-SALMONIDS	EXPANDED NON-SALMONID ESTIMATE	NON-SALMONID TO SALMONID RATIO
Speckled Dace (Rhinichthys osculus)	215	71.19	0.2375	1,392	0.742:1
Sculpin (Cottus spp.)	87	21.81	0.0961	563	0.300:1
TOTAL	302	100.00	0.3336	1,955	1.043:1

Table E-22. Index Site Summary; Site, Date Sampled, Site Composition, Discharge, Salmonid Catch Per Unit Effort (Fish Per Minute), and Mean Catch, 1995. (^ Juvenile Hatchery Coho).

SITE #	STREAM	RM	DATE 1995	SITE L(m)*	SLOW Water L(m)*	%	FAST Water L(m)*	%	DISCHG*	CPUE* (FPM)	MEAN CPUE
01	Umatilla River	1.5	4/10	213	110	52	103	48	MF/HF	0.8	
01	Umatilla River	1.5	9/13	213	147	69	66	31	LF	0	0.4
01	Umatilla River	1.5	11/28	213	133	62	80	38	HF	0.5	
02	Umatilla River	9.0	4/10	152	95	63	57	37	MF/HF	1.9^	
02	Umatilla River	9.0	9/18	152	100	66	52	34	LF	0	0.6^
02	Umatilla River	9.0	11/28	152	97	64	55	36	MF/HF	0	
03	Umatilla River	25.0	4/10	138	91	66	47	34	MF/HF	0.4	
03	Umatilla River	25.0	9/13	138	85	62	63	38	LF	0	0.2
03	Umatilla River	25.0	11/28	138	46	33	91	67	MF/HF	0.1	
04	Umatilla River	38.0	4/17	402	314	78	88	22	MF/HF	0	
04	Umatilla River	38.0	9/20	402	324	81	78	19	LF/MF	0.1	0
04	Umatilla River	38.0	11/21	402	337	84	65	16	MF	0	
05	Umatilla River	50.0	4/17	148	43	29	105	71	MF/HF	0	
05	Umatilla River	50.0	9/14	148	95	64	53	36	LF	0.1	0.1
05	Umatilla River	50.0	11/21	148	43	29	105	71	MF	0.1	
06	Umatilla River	60.0	4/6	127	29	23	98	77	MF	0.1	
06	Umatilla River	60.0	9/14	127	28	22	99	78	LF	0.5	0.2
06	Umatilla River	60.0	11/16	127	27	21	100	79	MF	0	
07	Umatilla River	67.5	4/5	234	70	30	164	70	MF	0	
07	Umatilla River	67.5	9/19	234	106	45	128	55	LF	0.9	0.4
07	Umatilla River	67.5	11/16	234	60	26	174	74	MF	0.4	
08	Umatilla River	74.0	4/5	168	78	46	129	54	MF	0.2	
08	Umatilla River	74.0	9/20	168	63	38	105	62	LF	0.2	0.2
08	Umatilla River	74.0	11/27	168	78	46	90	54	MF/HF	0.1	
09	Umatilla River	81.0	4/5	70	24	34	46	66	MF	0.8	
09	Umatilla River	81.0	9/12	70	20	29	50	71	LF	1.0	0.7
09	Umatilla River	81.0	11/27	70	25	36	45	64	MF/HF	0.3	
10	Umatilla River	88.0	4/5	92	53	58	39	42	MF	0.5	
10	Umatilla River	88.0	9/12	92	54	59	38	41	LF/MF	1.6	1.5
10	Umatilla River	88.0	11/30	92	56	61	36	39	HF	2.3	
11	NF Umatilla R.	1	3/24	37	13	35	24	65	MF/HF	0.5	
11	NF Umatilla R.	1	9/27	37	16	43	26	57	MF	1.2	1.8
11	NF Umatilla R.	1	11/20	37	13	35	24	65	MF	3.7	
12	NF Umatilla R.	3.0	3/24	41	9	22	32	78	MF/HF	0.4	
12	NF Umatilla R.	3.0	9/27	41	16	39	25	61	MF	1.6	1.0
12	NF Umatilla R.	3.0	11/20	41	13	32	28	68	MF	1.1	
13	SF Umatilla R.	1.0	3/27	76	33	43	43	57	MF	0.3	
13	SF Umatilla R.	1.0	9/12	76	38	50	38	50	LF	3.9	2.1
13	SF Umatilla R.	1.0	—	—	—	—	—	—	—	—	
14	SF Umatilla R	4.0	3/27	47	13	28	34	72	MF	0.2	
14	SF Umatilla R	4.0	8/3	47	12	26	35	74	LF	3.8	2.7
14	SF Umatilla R	4.0	11/13	47	10	21	37	79	HF	4.0	

Table E-22. Continued.

SITE #	STREAM	RM	DATE 1995	SITE L(m)	SLOW Water L(m)	%	FAST Water L(m)	%	DISCHG	CPUE (FPM)	MEAN CPUE
15	Birch Creek	5.5	3/28	94	34	36	60	64	MF/HF	0.1	
15	Birch Creek	5.5	9/18	94	58	62	36	38	LF	0	0.1
15	Birch Creek	5.5	11/21	94	30	32	64	68	MF	0.1	
16	Birch Creek	10.0	3/28	77	16	21	61	79	MF/HF	0	
16	Birch Creek	10.0	8/8	77	23	30	54	70	LF	0	0
16	Birch Creek	10.0	11/14	77	23	30	54	70	MF	0	
17	W. Birch Creek	2.0	3/21	49	26	53	23	47	HF	0.2	
17	W. Birch Creek	2.0	8/8	49	42	86	7	14	LF	0.2	0.2
17	W. Birch Creek	2.0	11/14	49	38	76	11	24	MF	0.2	
18	W. Birch Creek	10.5	3/21	33	8	24	25	76	MF/HF	0.5	
18	W. Birch Creek	10.5	8/8	33	0	0	33	100	LF	2.1	1.0
18	W. Birch Creek	10.5	11/14	33	3	9	30	91	MF	0.3	
19	E. Birch Creek	4.5	3/21	45	15	33	30	67	HF	0.3	
19	E. Birch Creek	4.5	8/8	45	0	0	45	100	LF	2.1	0.9
19	E. Birch Creek	4.5	11/14	45	3	7	42	93	MF	0.	
20	E. Birch Creek	13.0	3/21	18	9	50	9	50	MF/HF	1.9	
20	E. Birch Creek	13.0	8/8	18	12	67	6	33	LF	3.5	3.4
20	E. Birch Creek	13.0	11/14	18	13	72	5	28	LF/MF	4.9	
21	Bear Creek	1.0	4/12	29	29	10	0	0	MF	0.5	
21	Bear Creek	1.0	9/22	29	23	79	6	21	LF	0.2	0.3
21	Bear Creek	1.0	11/15	29	17	59	12	41	LF/MF	0.2	
22	Bear Creek	4.5	4/12	77	22	29	55	71	MF	1.5	
22	Bear Creek	4.5	8/8	77	61	79	16	21	MF	1.9	2.8
22	Bear Creek	4.5	11/15	77	34	44	43	56	LF/MF	5.0	
23	Bridge Creek	1.0	3/22	33	16	48	17	52	MF/HF	0.5	
23	Bridge Creek	1.0	8/8	33	13	39	30	61	LF	0.5	0.6
23	Bridge Creek	1.0	11/14	33	8	24	25	76	LF/MF	0.8	
24	Pearson Creek	2.0	3/21	21	12	57	9	43	MF/HF	0.9	
24	Pearson Creek	2.0	8/8	21	4	19	19	81	LF	3.5	2.9
24	Pearson Creek	2.0	11/14	21	9	43	12	57	MF	4.4	
25	Buckaroo Creek	1.0	3/17	17	10	59	8	41	MF/HF	0	
25	Buckaroo Creek	1.0	8/4	17	8	41	10	59	LF	1.3	0.9
25	Buckaroo Creek	1.0	11/8	17	8	47	9	53	LF	1.5	
26	Squaw Creek	2.5	3/23	57	17	30	40	70	MF	0.2	
26	Squaw Creek	2.5	8/7	57	8	14	49	86	LF	3.5	2.6
26	Squaw Creek	2.5	11/8	57	11	19	46	81	LF	4.2	
27	Squaw Creek	7.0	3/23	71	13	18	58	82	MF	0.1	
27	Squaw Creek	7.0	8/7	71	13	18	58	82	LF	6.7	3.1
27	Squaw Creek	7.0	11/30	71	9	13	62	87	MF/HF	2.3	
28	Boston Can. Cr.	0.6	3/20	27	7	26	20	74	MF/HF	2.7	
28	Boston Can. Cr.	0.6	8/4	27	7	26	20	74	LF	3.6	3.2
28	Boston Can. Cr.	0.6	11/13	27	7	26	20	74	MF	3.3	

Table E-22. Continued.

SITE #	STREAM	RM	DATE 1995	SITE L(m)	SLOW Water L(m)	%	FAST Water L(m)	%	DISCHG	CPUE (FPM)	MEAN CPUE
29	Line Creek	0.5	3/17	14	5	36	9	64	MF/HF	3.3	
29	Line Creek	0.5	8/4	14	4	29	10	71	LF	2.3	2.8
29	Line Creek	0.5	11/13	14	4	29	10	71	MF	2.7	
30	Meacham Creek	9.0	4/6	76	0	0	76	100	MF	0.2	
30	Meacham Creek	9.0	8/8	76	0	0	76	100	LF	3	0.9
30	Meacham Creek	9.0	11/29	76	0	0	76	100	HF	0.4	
31	Camp Creek	0.6	3/17	46	11	24	35	76	MF/HF	1.1	
31	Camp Creek	0.6	8/4	46	20	43	26	57	LF	3	2.4
31	Camp Creek	0.6	11/13	46	15	33	31	67	MF	3.1	
32	NF Meacham	0.5	4/14	80	42	53	38	47	MF/HF	0.3	
32	NF Meacham	0.5	8/9	80	54	68	26	32	LF	3.5	1.8
32	NF Meacham	0.5	11/29	80	44	55	36	45	HF	1.7	
33	NF Meacham	1.2	4/13	64	31	48	33	52	MF/HF	0.1	
33	NF Meacham	1.2	8/9	64	34	53	30	47	LF	3.8	2.0
33	NF Meacham	1.2	–	–	–	–	–	–	–	–	
34	Meacham Creek	17.0	4/6	79	42	53	37	47	MF	0.4	
34	Meacham Creek	17.0	8/4	79	45	57	34	43	LF	5.3	2.1
34	Meacham Creek	17.0	11/29	79	22	28	57	72	HF	0.7	
35	E. Meacham Cr.	0.3	3/22	42	21	50	21	50	MF/HF	0.1	
35	E. Meacham Cr.	0.3	8/9	42	23	55	19	45	LF	3.9	2.0
35	E. Meacham Cr.	0.3	–	–	–	–	–	–	–	–	
36	Meacham Creek	28.5	3/29	38	16	42	22	58	MF/HF	0.1	
36	Meacham Creek	28.5	8/9	38	16	42	22	58	LF	4.0	1.4
36	Meacham Creek	28.5	11/29	38	16	42	22	58	HF	0	
37	Ryan Creek	1.0	–	–	–	–	–	–	–	–	
37	Ryan Creek	1.0	–	–	–	–	–	–	–	–	5.1
37	Ryan Creek	1.0	11/16	51	10	20	41	80	MF	5.1	
38	Thomas Creek	2.5	3/20	20	4	20	16	80	MF	0	
38	Thomas Creek	2.5	8/2	20	4	20	16	80	LF	0	0
38	Thomas Creek	2.5	11/8	20	4	20	16	80	LF	0	
39	Spring Creek	0.2	3/20	23	7	30	16	70	MF/HF	0.2	
39	Spring Creek	0.2	8/3	23	10	43	13	57	LF	5.5	3.1
39	Spring Creek	0.2	11/8	23	7	30	16	70	LF	3.5	
40	Shimmiehorn Cr.	0.5	5/5	42	7	17	35	83	MF	0	
40	Shimmiehorn Cr.	0.5	8/3	42	5	12	37	88	LF	3.5	1.8
40	Shimmiehorn Cr.	0.5	–	–	–	–	–	–	–	–	

* L (m) = site length in meters; LF = low flow; MF = medium flow; HF = high flow; CPUE = catch per unit effort; FPM = salmonid/minute.

Table E-23. Fish Passage Barriers in the Umatilla River Basin, Surveyed 3/16-11/8, 1994.

STREAM	RIVER MILE	BARRIER TYPE	COMPOSITION	STEP HEIGHT (m)	DEGREE	RECOMMENDED ACTION
Umatilla River	1.5	Channel Modification	Concrete	0.7	Partial	Modify
Umatilla River	2.4	Irrigation Dam	Concrete	1.0	Partial	Modify
Umatilla River	49.0	Vacated Irrigation Dam	Concrete	1.2	Partial	Remove
Jungle/Windy Springs Creek	0.1	Culvert	Steel	0.15	Partial	Modify
McKay Creek	6.0	Earthen Dam	Earth/Concrete	40	Complete	Leave
Wildhorse Creek	0.1	Vacated Irrigation Dam	Concrete	0.7	Partial	Remove
Wildhorse Creek	18.8	Bridge	Concrete	1.0	Partial	Modify
Greasewood Creek	0.4	Irrigated Dam	Concrete	0.6	Partial	Modify
Mission Creek	1.2	Rip-rap	Concrete Blocks	0.7	Partial	Remove
Mission Creek	1.4	Bridge	Concrete	0.5	Partial	Modify
Mission Creek	1.7	Frame	Steel	0.7	Partial	Remove
Mission Creek	3.3	Culvert	Steel	0.8	Partial	Modify
Cottonwood Creek	0.6	Culvert	Steel	0.8	Partial	Modify
Cottonwood Creek	0.9	Water Pipe and Casing	Concrete	1.1	Partial	Modify
Cottonwood Creek	1.3	Bridge	Concrete	0.7	Partial	Modify
Moonshine Creek	1.0	Bridge	Concrete	1.2	Partial	Modify
Coonskin Creek	.30	Culvert	Steel	0.5	Partial	Modify
Camp Creek	.25	Irrigation Dam	Concrete	1.3	Partial	Remove
Un-named Tributary at RM 1.5 of SF Umatilla River	0.1	Culvert	Steel	0.5	Complete	Modify
Whitman Springs	0.1	Culvert	Steel	0.5	Complete	Modify

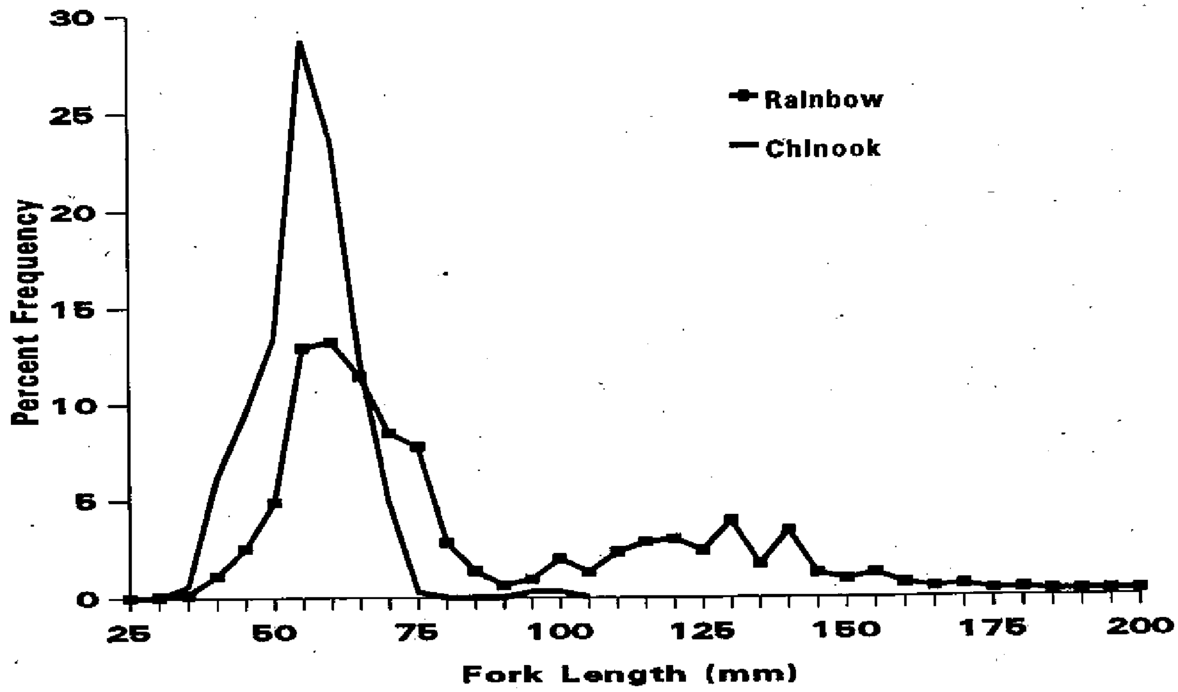


Figure E-1. Length Frequency of Natural Juvenile Chinook Salmon and Natural Rainbow/Steelhead Trout captured during electrofishing in the Umatilla River, RM 81.8-89.6, 8/8-8/25, 1995. (95B-UMT1.CH3)

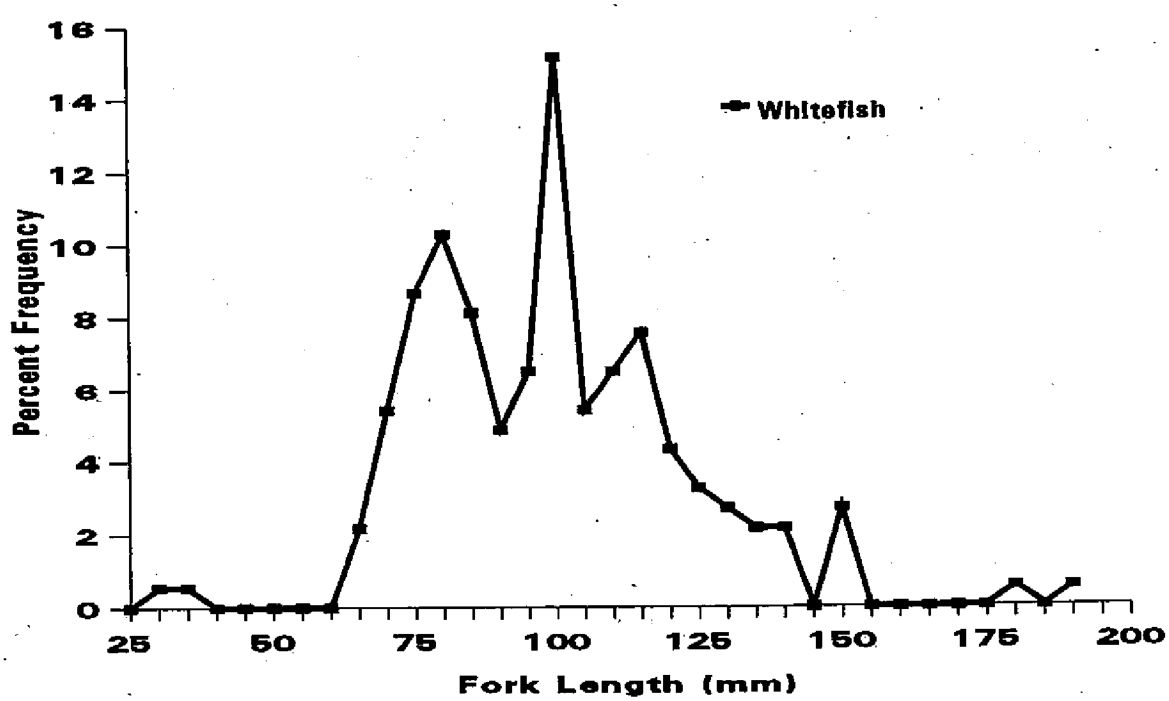


Figure E-2. Length Frequency of Mountain Whitefish captured during electrofishing in the Umatilla River, RM 81.8-89.6, 8/8-8/25, 1995. (95B-UMT2.CH3)

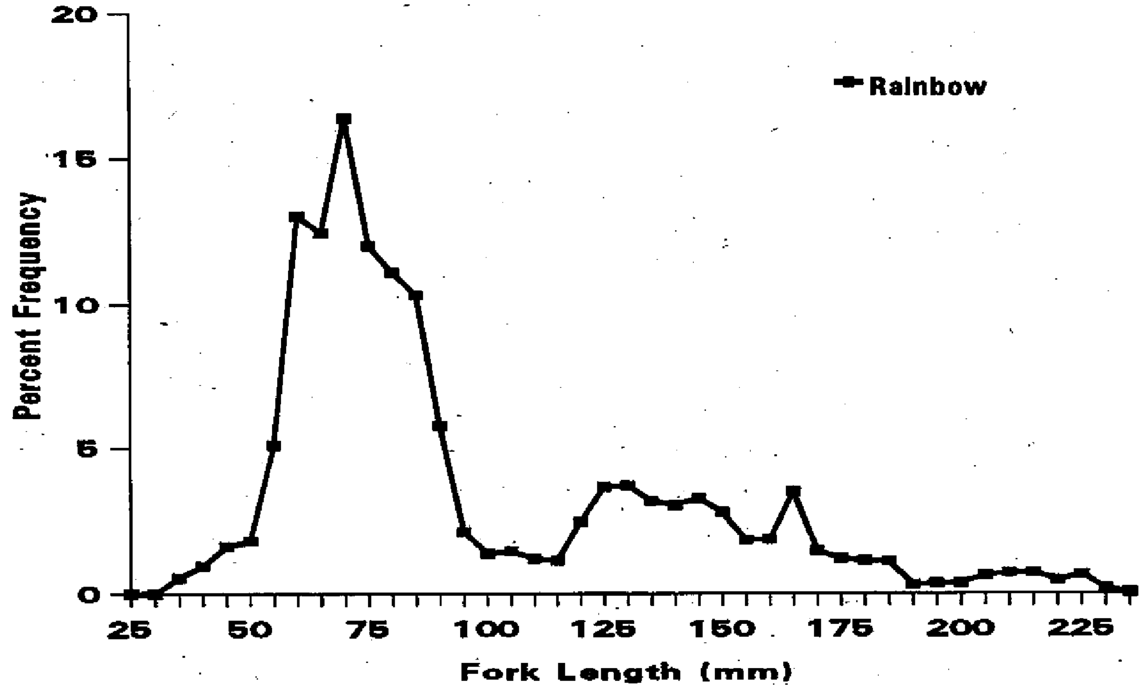


Figure E-3. Length Frequency of Natural Rainbow/Steelhead Trout captured during electrofishing in Moonshine Creek, RM 0-4.4, 9/18-9/21, 1995. (95B-MNS1.CH3)

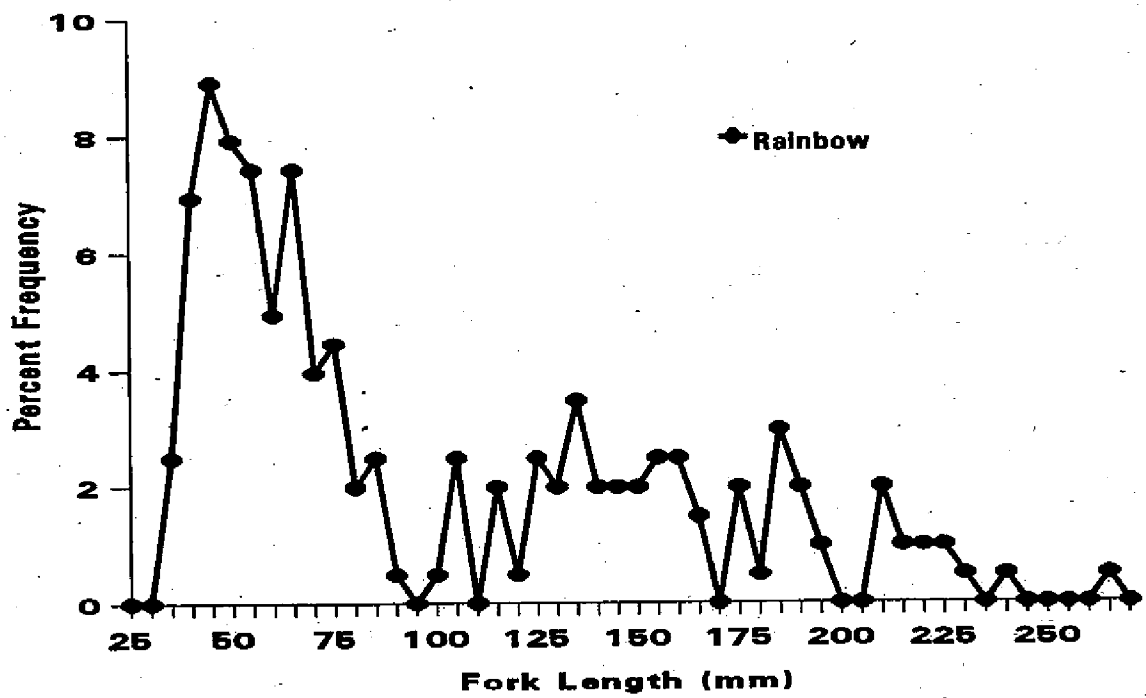


Figure E-4. Length Frequency of Natural Juvenile Coho Salmon and Natural Rainbow/Steelhead Trout captured during electrofishing in Mission Creek, RM 0-4.3, 9/18-9/21, 1995. (95B-MSH1.CH3)

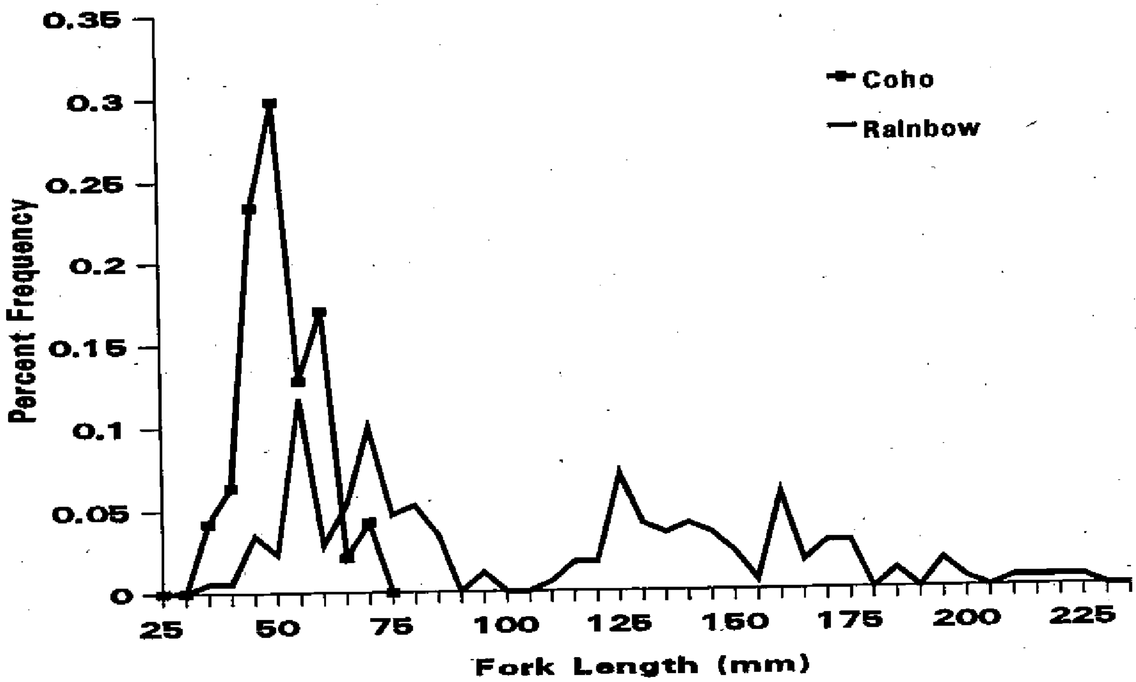


Figure E-5. Length Frequency of Natural Juvenile Coho Salmon and Natural Rainbow/Steelhead Trout captured during electrofishing in Cottonwood Creek, RM 0-4.1, 7/5-8/1, 1995. (95B-CTT1.CH3)

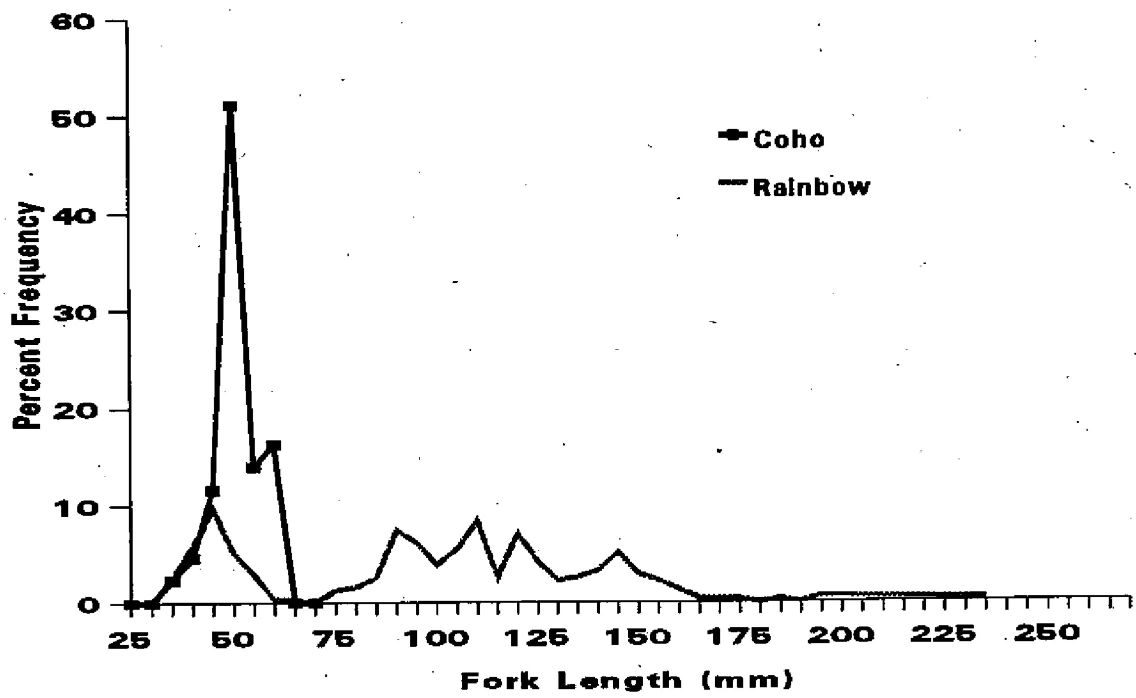


Figure E-6. Length Frequency of Natural Juvenile Coho Salmon and Natural Rainbow/Steelhead Trout captured during electrofishing in Coonskin Creek, RM 0-2.0, 6/29-7/18, 1995. (95B-CSK1.CH3)

APPENDIX F
Adult Passage Examinations 1994-1995

Table F–1: Summer steelhead release dates, migrational timing, passage routes, and passage times (in days, hours and minutes) for Westland, Feed, and Stanfield Dams. Passage times between Three Mile Dam and Westland, Three Mile Dam and Stanfield, Westland and Feed, Feed and Stanfield, and Stanfield and ODFW (RM 56) is also included.

Westland (site 1)

Ch/Code	Rel. Date	Rel. Time	First Date	First Time	Last Date	Last Time	Route	Westland Passage Days	Westland Passage Hrs/Min	Total Hours	Flows (cfs)	Avg. Temps	Westland to Feed days	Westland to Feed hrs/min	Total Hours
7/39	11/10/94	10:25	12/21/94	12:48	12/21/94	13:35	1	0	00:47	0.78	873	45.9	5	14:01	134
7/40	11/17/94	10:05	12/21/94	15:42	12/21/94	16:35	1	0	00:53	0.88	873	45.9	5	06:27	126.5
7/45	11/30/94	10:30	02/04/95	10:55	02/04/95	12:55	2	0	02:00	2	2850	45.4	0	20:36	20.6
7/47	01/27/95	10:25	02/07/95	09:55	02/07/95	11:28	2	0	01:31	1.52	1760	44.9	0	02:56	2.933
7/42	01/13/95	10:25	02/18/95	03:58	02/18/95	11:56	2	0	07:58	7.97	1160	46.3	0	20:20	20.33
7/37	12/05/94	10:00	02/24/95	16:10	02/25/95	13:30	2	0	21:20	21.3	1840	48.8	1	01:08	25.13
7/46	01/18/95	10:10	02/23/95	07:15	02/23/95	18:08	2	0	11:53	11.9	2210	46.7	0	06:28	6.467
7/48	02/08/95	10:30	02/27/95	07:20	03/04/95	12:24	1	5	05:04	125	1263	44.4	4	23:04	119.1
7/3	03/23/95	10:10	03/30/95	15:17	03/30/95	18:16	1	0	02:59	2.98	857	45.2	0	15:38	15.63
7/85	03/14/95	10:20	03/27/95	15:04	03/27/95	18:31	2	0	03:27	3.45	1090	45.9	1	01:14	25.23
7/88	03/13/95	10:45	03/24/95	07:33	03/24/95	12:57	2	0	05:24	5.4	1850	43.2	0	01:49	1.817
7/81	03/06/95	10:45	03/28/95	18:45	03/29/95	01:03	1	0	06:18	6.3	950	47.2	0	19:49	19.82
7/5	03/27/95	10:30	04/06/95	06:54	04/06/95	08:00	2	0	01:06	1.1	868	49.7	0	03:30	3.5
7/82	03/06/95	10:45	04/04/95	07:08	04/04/95	08:59	1	0	01:51	1.85	707	51.4	0	01:19	1.317
7/22	04/07/95	10:25	04/13/95	14:35	04/13/95	15:23	2	0	00:48	0.8	1310	46.5	0	02:58	2.967
7/13	03/30/95	11:00	04/12/95	17:28	04/13/95	09:56	2	0	16:28	16.5	1240	46.6	0	08:01	8.017
						Avg:		0.55		13.1			1.39		33.33

Feed Canal (site 2)

Ch/Code	Rel. Date	Rel. Time	First Date	First Time	Last Date	Last Time	Route	Feed Passage Days	Feed Passage Hrs/Min	Total Hours	Flows (cfs)	Avg. Temps	Feed to Stanfield Days	Feed to Stanfield hrs/min	Total Hours
7/39	11/10/94	10:25	12/27/94	03:36	12/27/94	11:20	1	0	07:44	7.73	1162	46.9	16	11:05	395.1
7/40	11/17/94	10:05	12/26/94	23:02	12/27/94	12:31	1	0	13:29	13.5	782	46.2	20	00:05	480.1
7/45	11/30/94	10:30	02/05/95	09:31	02/05/95	18:14	2	0	08:43	8.72	2448	46.8	1	05:42	29.7
7/47	01/27/95	10:25	02/07/95	14:22	02/26/95	09:08	1	18	18:46	451	1601	45	1	07:49	31.82
7/42	01/13/95	10:25	02/19/95	08:16	02/19/95	14:53	2	0	06:37	6.62	1878	49	2	01:36	49.6
7/37	12/05/94	10:00	02/26/95	14:38	03/10/95	13:04	1	11	22:26	286	774	46.2	0	22:21	22.35
7/46	01/18/95	10:10	02/24/95	01:36	03/09/95	15:57	1	13	14:21	326	891	46.3	2	00:24	48.4
7/48	02/08/95	10:30	03/09/95	11:28	03/09/95	12:04	1	0	00:36	0.6	552	49.8	1	01:54	25.9
7/3	03/23/95	10:10	03/31/95	09:54	04/02/95	18:10	1	2	08:16	56.3	563	50.1	0	18:01	18.02
7/85	03/14/95	10:20	03/29/95	19:45	04/01/95	13:03	1	3	17:18	89.3	621	48	0	06:48	6.8
7/88	03/13/95	10:45	03/24/95	14:46	03/25/95	14:04	2	0	23:18	23.3	1408	43.4	0	20:53	20.88
7/81	03/06/95	10:45	03/29/95	20:52	03/29/95	21:33	1	0	00:41	0.68	665	47.8	1	04:45	28.75
7/5	03/27/95	10:30	04/06/95	11:30	04/07/95	18:20	1	1	06:50	30.8	860	50	3	17:01	89.02
7/82	03/06/95	10:45	04/04/95	10:18	04/04/95	10:38	1	0	00:20	0.33	531	51.4	0	05:43	5.717
7/22	04/07/95	10:25	04/13/95	18:21	04/14/95	06:11	2	0	11:50	11.8	1315	46.5	0	13:42	13.7
7/13	03/30/95	11:00	04/13/95	17:57	04/14/95	15:32	1	0	21:35	21.6	1315	46.5	7	02:32	170.5
						Avg:		3.48		83.4			3.74		89.77

Stanfield (site 3)

Ch/Code	Rel. Date	Rel. Time	First Date	First Time	Last Date	Last Time	Route	Stanfield Passage Days	Stanfield Passage Hrs/Min	Total Hours	Flows (cfs)	Avg. Temps	Stanfield to ODFW Days	Stanfield to ODFW Hrs/Min	Total Hours
7/39	11/10/94	10:25	01/12/95	22:25	01/13/95	02:21	1	0	03:56	3.93	1075	42	14	17:18	353.3
7/40	11/17/94	10:05	01/16/95	12:36	01/16/95	13:45	1	0	01:09	1.15	2280	42	33	20:39	812.6
7/45	11/30/94	10:30	02/06/95	23:56	02/07/95	07:43	2	0	07:47	7.78	2145	43.5	17	04:48	412.8
7/47	01/27/95	10:25	02/27/95	16:57	02/27/95	17:48	1	0	00:51	0.85	1490	45.5	na	na	na
7/42	01/13/95	10:25	02/21/95	16:29	02/21/95	17:58	2	0	01:29	1.48	3420	47.3	na	na	na
7/37	12/05/94	10:00	03/11/95	11:25	03/11/95	12:18	2	0	00:53	0.88	851	50.2	na	na	na
7/46	01/18/95	10:10	03/11/95	16:21	03/11/95	16:57	2	0	00:36	0.6	851	50.2	na	na	na
7/48	02/08/95	10:30	03/10/95	13:58	03/10/95	15:39	2	0	01:41	1.68	731	48.4	na	na	na
7/3	03/23/95	10:10	04/03/95	12:11	04/03/95	12:34	1	0	00:23	0.38	682	54.7	na	na	na
7/85	03/14/95	10:20	04/01/95	19:51	04/01/95	20:30	2	0	00:39	0.65	727	53.3	5	01:04	121.1
7/88	03/13/95	10:45	03/26/95	10:57	03/26/95	12:11	2	0	01:14	1.23	1350	47.7	3	00:46	72.8
7/81	03/06/95	10:45	03/31/95	02:18	03/31/95	03:27	2	0	01:09	1.15	724	52.4	3	06:39	78.65
7/5	03/27/95	10:30	04/11/95	11:21	04/11/95	15:07	1	0	03:46	3.77	1460	51.7	na	na	na
7/82	03/06/95	10:45	04/04/95	16:21	04/04/95	0.701	2	0	00:29	0.48	734	54.3	5	04:06	124.1
7/22	04/07/95	10:25	04/14/95	19:53	04/15/95	0.718	2	0	21:18	21.3	1380	49.1	na	na	na
7/13	03/30/95	11:00	04/21/95	18:04	04/21/95	0.77	2	0	00:25	0.42	804	54.7	5	02:13	122.2
						Avg:		0.12		2.98			10.9		262.2

ODFW (site 4)

Ch/Code	Rel. Date	Rel. Time	First Date	First Time	Last Date	Last Time	3MD to Westland Days	3MD to Westland Hrs/Min	Total Hours	3MD to above Stfld Days	3MD to above Stfld Hrs/Min	Total Hours
7/39	11/10/94	10:25	01/27/95	18:39	01/27/95	18:56	41	02:23	986	63	15:56	1528
7/40	11/17/94	10:05	02/19/95	10:24	02/19/95	10:25	34	05:37	822	60	03:40	1444
7/45	11/30/94	10:30	02/24/95	12:31	02/24/95	13:45	66	00:25	1584	68	21:13	1653
7/47	01/27/95	10:25	na	na	na	na	10	23:30	263	31	07:23	751.4
7/42	01/13/95	10:25	na	na	na	na	35	17:33	858	39	07:33	943.5
7/37	12/05/94	10:00	na	na	na	na	81	06:10	1950	96	02:18	2306
7/46	01/18/95	10:10	na	na	na	na	35	21:05	861	52	06:47	1255
7/48	02/08/95	10:30	na	na	na	na	18	20:50	453	30	05:09	725.2
7/3	03/23/95	10:10	na	na	na	na	7	05:07	173	11	02:24	266.4
7/85	03/14/95	10:20	04/06/95	21:34	04/06/95	22:08	13	04:44	317	18	10:10	442.2
7/88	03/13/95	10:45	03/29/95	12:59	03/29/95	13:17	10	20:48	281	13	01:26	313.4
7/81	03/06/95	10:45	04/03/95	10:06	04/03/95	10:50	22	08:00	536	24	16:42	592.7
7/5	03/27/95	10:30	na	na	na	na	9	20:24	236	15	04:37	364.6
7/82	03/06/95	10:45	04/09/95	20:56	04/09/95	21:30	28	20:23	692	29	06:05	702.1
7/22	04/07/95	10:25	na	na	na	na	6	04:10	148	8	06:46	198.8
7/13	03/30/95	11:00	04/26/95	20:42	04/26/95	21:14	13	06:26	318	22	07:29	535.5
							27.2		654	36.5		878.4

File name: 9495data; * — trap and haul evaluation

Table F-2: Summer Steelhead release dates at Three Mile Falls Dam and days required to successfully migrate from Three Mile Falls Dam to S1 (Westland), S2 (Feed Canal), S3 (Stanfield), and S4 (ODFW Rm 56), Umatilla River, 1994-95.

CH/CODE	3MD RELEASE DATE	3MD TO SITE #1 DAYS	3MD TO SITE #2 DAYS	3MD TO SITE #3 DAYS	3MD TO SITE #4 DAYS
7/39	11/10/94	41.1	46.7	63.5	78.4
7/40	11/17/94	34.2	39.5	60.1	94.0
7/45	11/30/94	66.0	67.0	68.6	86.1
7/47	01/27/95	10.9	11.2	31.3	n/a
7/42	01/13/95	35.7	36.9	39.3	n/a
7/37	12/05/94	81.2	83.2	96.1	n/a
7/46	01/18/95	35.8	36.6	52.3	n/a
7/48	02/08/95	18.8	29.0	30.1	n/a
7/3	03/23/95	7.2	8.0	11.1	n/a
7/85	03/14/95	13.1	14.4	18.4	23.5
7/88	03/13/95	10.8	11.2	13.0	16.1
7/81	03/06/95	22.3	23.4	24.6	28.0
7/5	03/27/95	9.8	10.0	15.0	n/a
7/82	03/06/95	28.8	29.0	29.2	34.4
7/22	04/07/95	6.1	6.3	7.4	n/a
7/13	03/30/95	13.2	14.3	22.3	27.4
	AVERAGE:	**27.2**	**29.2**	**36.4**	**48.5**

Filename: 9495days

Table F-3: Spring Chinook Salmon release dates, migrational timing, passage routes, and passage times (in days, hours and minutes) for Westland, Feed, and Stanfield Dams. Passage times between Three Mile Falls Dam and Westland, Three Mile Falls Dam and Stanfield, Westland and Feed, Feed and Stanfield, and Stanfield and ODFW (RM 56) is also included.

Westland (site 1)

Ch/Code	Rel. Date	Rel. Time	First Date	First Time	Last Date	Last Time	Route	Westland Passage Days	Westland Passage Hrs/Min	Total Hours	Avg. Flows (cfs)	Avg: Temps	Westland to Feed days	Westland to Feed hrs/min	Total Hours
13/32	04/10/95	10:00	04/19/95	18:18	04/19/95	19:40	1	0	01:22	1.37	911	48.64	0	18:20	18.33
13/34	04/11/95	10:20	04/19/95	20:57	04/19/95	22:14	2	0	01:17	1.28	911	48.64	0	14:42	14.7
13/36	04/13/95	10:30	04/23/95	09:57	04/23/95	11:33	1	0	01:36	1.6	797	54.27	0	21:49	21.82
13/37	04/14/95	09:55	04/22/95	19:12	04/23/95	20:45	2	1	01:33	25.5	796	53.97	na	na	na
13/38	04/18/95	10:13	04/23/95	03:18	04/23/95	12:23	2	0	09:05	9.08	797	54.27	0	06:59	6.983
13/40	04/20/95	10:20	04/23/95	04:30	04/23/95	06:21	2	0	01:51	1.85	797	54.27	0	04:34	4.567
13/41	04/19/95	10:15	04/23/95	06:56	04/23/95	08:30	1	0	01:34	1.57	797	54.27	1	03:51	27.85
13/31	04/24/95	10:40	04/26/95	08:05	04/26/95	09:22	2	0	01:17	1.28	805	55.22	0	03:55	3.917
13/35	04/13/95	10:30	04/26/95	13:45	04/26/95	14:35	2	0	00:50	0.83	805	55.22	0	13:25	13.42
13/43	04/24/95	10:40	04/26/95	18:39	04/26/95	19:12	1	0	00:33	0.55	805	55.22	0	09:58	9.967
13/42	04/26/95	10:10	na	na	na	na	na	na	na	na			na	na	na
						Avg:		0.19		4.5			0.56		13.51

Feed Canal (site 2)

Ch/Code	Rel. Date	Rel. Time	First Date	First Time	Last Date	Last Time	Route	Feed Passage Days	Feed Passage Hrs/Min	Total Hours	Avg. Flows (cfs)	Avg. Temps	Feed to Stanfield Days	Feed to Stanfield hrs/min	Total Hours
13/32	04/10/95	10:00	04/20/95	14:00	04/24/95	04:30	2	3	14:30	86.5	739	51.94	0	11:49	11.82
13/34	04/11/95	10:20	04/20/95	12:56	04/25/95	05:14	1	4	16:18	112	721	52.71	0	08:17	8.283
13/36	04/13/95	10:30	04/24/95	09:22	04/24/95	22:29	1	0	13:07	13.1	689	52.32	0	13:58	13.97
13/37	04/14/95	09:55	na	na	na	na	na	na	na	na			na	na	na
13/38	04/18/95	10:13	04/23/95	19:22	04/24/95	15:16	1	0	19:54	19.9	705	53.3	0	09:19	9.317
13/40	04/20/95	10:20	04/23/95	10:55	04/23/95	13:14	1	0	02:19	2.32	720	54.27	0	07:22	7.367
13/41	04/19/95	10:15	04/24/95	12:21	04/26/95	13:41	1	2	01:20	49.3	700	54.7	na	na	na
13/31	04/24/95	10:40	04/26/95	13:17	04/26/95	17:08	2	0	03:51	3.85	737	55.22	2	03:41	51.68
13/35	04/13/95	10:30	04/27/95	04:00	04/27/95	04:48	1	0	00:48	0.8	798	55.74	4	13:03	109
13/43	04/24/95	10:40	04/27/95	05:10	05/22/95	02:38	2	24	21:28	597	2772	52.57	0	08:15	8.25
13/42	04/26/95	10:10	05/18/95	14:02	05/19/95	01:05	2	0	11:03	11.1	1080	55.53	0	13:00	13
						Avg:		3.74		89.7			1.08		25.86

Stanfield (site 3)

Ch/Code	Rel. Date	Rel. Time	First Date	First Time	Last Date	Last Time	Route	Stanfield Passage Days	Stanfield Passage Hrs/Min	Total Hours	Avg. Flows (cfs)	Avg: Temps	Stanfield to ODFW Days	Stanfield to ODFW Hrs/Min	Total Hours
13/32	04/10/95	10:00	04/24/95	16:19	04/24/95	16:40	2	0	00:21	0.35	689	52.32	13	11:31	323.5
13/34	04/11/95	10:20	04/25/95	13:31	04/25/95	14:00	1	0	00:29	0.48	675	56.57	8	04:21	196.4
13/36	04/13/95	10:30	04/25/95	12:27	04/25/95	13:04	2	0	00:37	0.62	675	56.57	20	13:40	493.7
13/37	04/14/95	09:55	na	na	na	na	na	na	na	na			na	na	na
13/38	04/18/95	10:13	04/25/95	00:35	04/25/95	01:39	2	0	01:04	1.07	675	56.57	13	14:35	326.6
13/40	04/20/95	10:20	04/23/95	20:36	04/24/95	08:57	2	0	12:21	12.3	705	53.3	2	19:10	67.17
13/41	04/19/95	10:15	na	na	na	na	na	na	na	na			na	na	na
13/31	04/24/95	10:40	04/28/95	20:49	04/28/95	23:39	2	0	02:50	2.83	1458	52.78	19	18:55	474.9
13/35	04/13/95	10:30	05/01/95	17:51	05/02/95	11:35	2	0	17:44	17.7	3781	47.95	16	14:48	398.8
13/43	04/24/95	10:40	05/22/95	10:53	05/22/95	11:14	2	0	00:21	0.35	657	60.5	2	02:25	50.42
13/42	04/26/95	10:10	05/19/95	14:05	05/19/95	14:36	2	0	00:31	0.52	1008	57	4	12:15	108.2
						Avg:		0.17		4.03			10.2		244

ODFW (site 4)

Ch/Code	Rel. Date	Rel. Time	First Date	First Time	Last Date	Last Time	3MD to Westland Days	3MD to Westland Hrs/Min	Total Hours	3MD to above Stfld Days	3MD to above Stfld Hrs/Min	Total Hours
13/32	04/10/95	10:00	05/08/95	04:11	05/08/95	04:19	9	08:18	224	14	06:40	342.7
13/34	04/11/95	10:20	05/03/95	18:21	05/03/95	19:04	8	10:37	203	14	03:40	339.7
13/36	04/13/95	10:30	05/16/95	02:44	05/16/95	03:08	9	23:27	239	12	02:34	290.6
13/37	04/14/95	09:55	na	na	na	na	8	09:17	201	na	na	na
13/38	04/18/95	10:13	05/08/95	16:14	05/08/95	16:56	4	17:05	113	5	22:44	142.7
13/40	04/20/95	10:20	04/27/95	04:07	04/27/95	11:50	2	18:10	66.2	8	13:19	205.3
13/41	04/19/95	10:15					3	20:41	92.7	13	01:20	313.3
13/31	04/24/95	10:40	05/18/95	18:34	05/18/95	18:50	1	21:25	45.4	28	00:34	672.6
13/35	04/13/95	10:30	05/19/95	02:23	05/19/95	02:45	13	03:15	315	36	04:06	866.1
13/43	04/24/95	10:40	05/24/95	13:39	05/24/95	13:50	2	07:59	56	28	00:34	672.6
13/42	04/26/95	10:10	05/24/95	02:51	05/24/95	03:16	na	na	na	23	13:50	556.4
						Avg.	6.48		156	18.3		440.4

File name: data9495; * — trap and haul evaluation

Table F–4: Summer steelhead passage times (days, hours, minutes) and miles moved per day between Stanfield Dam and ODFW (RM 56), Passage Evaluation, Umatilla River, 1993–95.

1993–94

Ch/Code	Rel. Date	Stanfield Last Date	Stanfield Last Time	ODFW First Date	ODFW First Time	Stan. to ODFW Passage Days	Stan. to ODFW Passage Hrs/Min	Total Hours	Miles/Day
7/1	10/19/94	04/02/94	15:06	04/16/94	15:25	14	00:19	336.3	1.7
7/3	12/07/94	01/15/94	12:49	01/25/94	21:46	10	08:57	249	2.3
7/4	12/13/94	01/10/94	19:06	01/16/94	16:32	5	21:26	141.4	4.0
7/5	01/07/94	01/13/94	11:53	01/25/94	01:53	11	14:00	278	2.0
7/6	01/10/94	03/11/94	17:57	03/28/94	22:30	17	04:33	412.6	1.4
7/10	04/25/94	04/27/94	02:30	04/30/94	00:35	2	22:05	70.08	8.1
7/13	03/11/94	03/15/94	12:59	03/26/94	04:32	10	15:33	255.6	2.2
7/14	03/11/94	03/27/94	23:50	03/31/94	00:25	3	00:35	72.58	7.8
7/17	03/24/94	03/30/94	19:06	04/02/94	02:53	2	07:47	55.78	10.2
7/18	03/28/94	04/21/94	00:33	04/22/94	23:12	1	22:39	46.65	12.1
7/23	04/04/94	04/07/94	00:30	04/09/94	06:25	2	05:55	53.92	10.5
7/26	04/11/94	04/17/94	03:58	05/02/94	22:00	15	18:02	378	1.5
7/27	04/14/94	04/17/94	00:22	04/18/94	19:58	1	19:36	43.6	13.0
							Avg:	184.1	5.9

1994–95

Ch/Code	Rel. Date	Stanfield Last Date	Stanfield Last Time	ODFW First Date	ODFW First Time	Stan. to ODFW Passage Days	Stan. to ODFW Passage Hrs/Min	Total Hours	Miles/Day
7/39	11/10/94	01/13/95	02:21	01/27/95	19:39	14	17:18	353.3	1.6
7/40	11/17/94	01/16/95	13:45	02/19/95	10:24	33	20:39	812.6	0.7
7/45	11/30/94	02/07/95	07:43	02/24/95	12:31	17	04:48	412.8	1.4
7/85	03/14/95	04/01/95	20:30	04/06/95	21:34	5	01:04	121.1	4.7
7/88	03/13/95	03/26/95	12:11	03/29/95	12:59	3	00:48	72.8	7.8
7/81	03/06/95	03/31/95	03:27	04/03/95	10:06	3	06:39	78.65	7.2
7/82	03/06/95	04/04/95	0.701	04/09/95	20:56	5	04:06	124.1	4.6
7/13	03/30/95	04/21/95	0.77	04/26/95	20:42	5	02:13	122.2	4.6
							Avg:	262.2	4.1

Table F–5: Summer steelhead passage times (days, hours, minutes) and miles moved per day between the release site (Barnhart Nolin) and ODFW (RM 56), Upstream Transport Evaluation, Umatilla River, 1993–95.

1993–94

Ch/Code	Rel. Site	Release Date	Release Time	ODFW First Date	ODFW First Time	Rel. Site to ODFW Days	Rel. Site to ODFW Hrs/Min	Total Hours	Miles/Day
7/8	Barnhart	02/28/94	11:00	03/06/94	06:14	5	19:14	139.2	2.4
7/10	Nolin	03/09/94	11:00	03/13/94	03:29	3	16:29	88.48	6.1
7/12	Barnhart	03/10/94	11:10	03/13/94	20:47	3	09:37	81.62	4.1
7/15	Nolin	03/14/94	11:00	03/24/94	02:41	9	15:41	231.7	2.3
7/16	Barnhart	03/22/94	10:40	03/24/94	13:36	2	02:56	50.93	6.5
7/21	Nolin	03/31/94	10:50	04/02/94	18:58	2	08:08	56.13	9.6
							Avg:		5.2

1994–95

Ch/Code	Rel. Site	Release Date	Release Time	ODFW First Date	ODFW First Time	Rel. Site to ODFW Days	Rel. Site to ODFW Hrs/Min	Total Hours	Miles/Day
7/49	Nolin	02/27/95	11:00	03/27/95	19:53	28	08:53	680.9	0.5
7/6	Nolin	03/27/95	11:30	03/31/95	20:11	4	08:41	104.7	3.2
7/20	Barnhart	04/07/95	10:45	04/11/95	20:55	4	10:10	106.2	3.1
7/38	Barnhart	11/10/94	10:30	01/29/95	23:21	80	12:51	1933	0.2
							Avg:		1.7

file name: 9395#1

Table F-6: Spring Chinook Salmon passage times (days, hours, minutes) and miles moved per day between the release site (Barnhart) and ODFW (RM 56). Upstream Transport Evaluation, Umatilla River, 1993-94.

1993-94

		Release		ODFW First		Rel. Site to ODFW		Total	
Ch/Code	Rel. Site	Date	Time	Date	Time	Days	Hrs/Min	Hours	Miles/Day
13/21	Barnhart	05/02/94	11:30	05/05/94	23:01	3	11:31	83.52	4.0
13/22	Barnhart	05/06/94	11:00	05/10/94	03:28	3	16:28	88.47	3.7
13/44	Barnhart	05/10/94	13:30	05/12/94	23:03	2	09:33	57.55	5.8
13/15	Barnhart	05/13/94	15:00	05/16/94	01:19	2	10:19	58.32	5.7
							Avg:	71.96	4.8

Table F-7: Spring Chinook Salmon passage times (days, hours, minutes) and miles moved per day between Stanfield Dam and ODFW (RM 56), Passage Evaluation, Umatilla River, 1993-95.

1993-94

		Stanfield Last		ODFW First		Stan. to ODFW Passage		Total	
Ch/Code	Rel. Date	Date	Time	Date	Time	Days	Hrs/Min	Hours	Miles/Day
13/14	04/14/94	04/20/94	10:20	04/24/94	07:34	3	21:14	93.23	6.1
13/17	04/27/94	05/06/94	04:41	05/08/94	22:03	2	17:22	65.37	8.7
13/18	04/29/94	05/23/94	17:39	05/25/94	17:06	1	23:27	47.45	11.9
							Avg:	68.68	8.9

1994-95

		Stanfield Last		ODFW First		Stan. to ODFW Passage		Total	
Ch/Code	Rel. Date	Date	Time	Date	Time	Days	Hrs/Min	Hours	Miles/Day
13/32	04/10/95	04/24/95	16:40	05/08/95	04:11	13	11:31	323.5	1.8
13/34	04/11/95	04/25/95	14:00	05/03/95	18:21	8	04:21	196.4	2.9
13/36	04/13/95	04/25/95	13:04	05/16/95	02:44	20	13:40	493.7	1.1
13/38	04/18/95	04/25/95	01:39	05/08/95	16:14	13	14:35	326.6	1.7
13/40	04/20/95	04/24/95	08:57	04/27/95	04:07	2	19:10	67.17	8.4
13/31	04/24/95	04/28/95	23:39	05/18/95	18:34	19	18:55	474.9	1.2
13/35	04/13/95	05/02/95	11:35	05/19/95	02:23	16	14:48	398.8	1.4
13/43	04/24/95	05/22/95	11:14	05/24/95	13:39	2	02:25	50.42	11.2
13/42	04/26/95	05/19/95	14:36	05/24/95	02:51	4	12:15	108.2	5.2
							Avg:	271.1	3.9

file name: 9395#2

Table F-8. Fall chinook salmon mainstem passage data at John Day, McNary, and Ice Harbor Dams, 1990-93.

Year	Dam	Aug 1-15 No.	%	Aug 16-31 No.	%	Sep 1-15 No.	%	Sep 16-30 No.	%	Oct 1-15 No.	%	Oct 16-31 No.	%	Total No.
1990	John Day	2147	2.3	11223	12	49115	52.7	22393	24	6663	7.1	1652	1.8	93193
	McNary	2686	3.3	4504	5.5	40375	49.2	21343	26	10037	12.2	3053	3.7	81998
	Ice Harbor	102	1.9	202	3.7	1716	31.8	1598	29.6	1169	21.7	604	11.2	5391
1991	John Day	1132	1.4	3653	4.5	34358	42.7	30592	38	8434	10.5	2341	2.9	80510
	McNary	1340	1.8	2832	3.8	25055	33.9	31196	42.2	10638	14.4	2872	3.9	73933
	Ice Harbor	87	1.4	54	0.9	1989	32.5	2064	33.7	1367	22.3	563	9.2	6124
1992	John Day	1225	1.7	6320	8.6	33363	45.5	24777	33.8	6160	8.4	1413	1.09	73258
	McNary	1470	2.1	4294	6	26679	37.3	25282	35.3	11602	16.2	2280	3.2	71607
	Ice Harbor	67	1.2	156	2.8	1732	31.1	1984	35.6	1078	19.3	556	10	5573
1993	John Day	1761	2.6	8828	13	29623	43.9	22044	32.7	3805	5.6	1411	2.1	67472
	McNary	2137	3.3	6098	9.5	28042	43.6	20051	31.2	6182	9.6	1820	2.8	64327
	Ice Harbor	132	4.1	199	6.2	988	30.7	1099	34.1	539	16.7	262	8.1	3219
Total	John Day	6265	2	30024	9.5	146459	46.6	99806	31.7	25062	8	6817	2.2	314433
	McNary	7630	2.6	17728	6.1	12011	41.2	97872	33.5	38459	13.2	10025	3.4	291865
	Ice Harbor	388	1.9	611	3	6425	31.6	6745	33.2	4153	20.5	1985	9.8	20307

file name: chfmnstm

Table F-9: Percent of Fall Chinook Salmon homing to the Umatilla River versus straying into fish hatcheries and spawning grounds above McNary Dam. Average attraction flows exiting the Umatilla River during September are also included. Numbers represent estimated coded-wire tag recoveries.

Recovery Year	No. Above McNary	No. to Uma. R.	Total No.	Percent Home	Percent Stray	Avg. Flow Sept 1-15	Avg. Flow Sept 16-30
1990	152	223	375	59.5	41	4 cfs	21 cfs
1991	182	145	327	44.3	56	50 cfs	130 cfs
1992	92	29	121	24	76	1.5 cfs	1 cfs
1993	67	39	106	36.8	63	78 cfs	100 cfs
1994	88	110	198	55.6	44	59 cfs	62 cfs

Table F-10. Umatilla River fall chinook salmon homing and straying rates for acclimated (Minthorn) versus direct (near Minthorn) releases. Numbers represent estimated coded-wire tag recoveries.

Brood Yr.	Tag Code	Rel. Loc.	No. Tagged	Rel. Age	No. Above McNary	No. to Uma. R.	Percent Home	Percent Stray
87	539-41	Minthorn	13260	0++	6	2	25.0	75.0
87	536-38	Nr. Minthorn	73148	0++	24	49	67.1	32.9
88	753,54,57	Minthorn	76824	0++	11	13	54.2	45.8
88	758,60,63	Nr. Minthorn	76425	0++	11	9	45.0	55.0
89	325-27	Minthorn	66426	0++	2	7	77.8	22.2
89	322-24	Nr. Minthorn	70450	0++	4	1	20.0	80.0
90	563,601,602	Minthorn	76411	0+	15	15	50.0	50.0
90	560-62	Nr. Minthorn	73454	0+	20	14	41.2	58.8

file name: 9495chf1

Table F–11: Umatilla River homing and straying data for yearling (1+) fall chinook salmon (includes acclimated and dire releases). Numbers represent estimated coded–wire tag recoveries.

Brood Yr.	Tag Code	Rel. Loc.	No. Tagged	Rel. Age	No. Above McNary	No. To Uma. R.	% home	% stray
84	073327	Bon/Minth	88396	1+	101	55	35.3	64.7
85	073823–27	Minthorn	49635	1+	53	100	65.4	34.6
85	073828–32	Bonifer	50492	1+	36	63	63.6	36.4
86	074038–39	Minthorn	81046	1+	67	234	77.7	22.3
86	074036–37	Bonifer	77914	1+	39	170	81.3	18.7
91	071460,461	RM 73.5	47102	1+	1	5	83.3	16.7

Table F–12: Umatilla River homing and straying data for sub–yearling (0+,0++) fall chinook salmon (includes acclimat and direct releases). Numbers represent estimated coded–wire tag recoveries.

Brood Yr.	Tag Code	Rel. Loc.	No. Tagged	Rel. Age	No. Above McNary	No. To Uma. R.	% home	% stray
89	075403–05	RM 70–79	159020	0+	46	27	37.0	63.0
89	075325–27	Minthorn	66426	0++	2	24	92.3	7.7
89	075322–24	Nr. Mintorn	70450	0++	4	1	20.0	80.0
90	075563,601–02	Minthorn	76411	0+	16	9	36.0	64.0
90	075560–62	Nr. Minthorn	73454	0+	20	14	41.2	58.8
91	071429–38	RM 42.5	304968	0+	0	2	100.0	0.0
90	075225–26	RM 70–79	103980	0+	15	18	54.5	45.5
90	075328	RM 70–79	48266	0+	14	13	48.1	51.9
90	075449,50,51	RM 70–79	152739	0+	33	38	53.5	46.5
90	070016	RM 70–79	48301	0+	13	7	35.0	65.0

file name:9495chf2

Table F-13: Umatilla River homing and straying data for coho salmon. Numbers represent estimated coded-wire tag recoveries only.

Brood Yr.	Tag Code	No. Tagged	Rel. Location	No. to Uma. R.	No. to Cascade	No. to Other	Percent Home	Percent Stray
87	074609	27062	Nr. Minthorn	19	4	0	82.6	17.4
87	74610-11	53155	Minthorn	75	18	2	78.9	21.1
88	074814-15	55259	Minthorn	175	93	32	58.3	41.7
88	074813	26881	RM 63-70	72	31	5	66.7	33.3
89	075535	24584	Minthorn	6	0	0	100.0	0.0
89	075534	25338	RM 56-60	8	3	0	72.7	27.3
89	075533	25407	RM 63-70	12	0	0	100.0	0.0
90	075620	27908	RM 56	45	12	2	76.3	23.7
90	075621-22	55163	RM 60	119	31	4	77.3	22.7
91	071521	28273	RM 60	36	0	0	100.0	0.0
91	071522-23	55805	RM 42	76	0	0	100.0	0.0

Table F-14: Umatilla River coho salmon homing and straying data for acclimated versus direct releases. Numbers repre estimated coded-wire tag recoveries.

Brood Yr.	Tag Code	No. Tagged	Rel. Location	No. to Uma. R.	No. to Other	Total No.	Percent Home	Percent Stray
87	074609	27062	Nr. Minthorn	19	4	23	41.3	58.7
87	074610	26416	Minthorn	37	8	45	41.1	58.9
87	074611	26739	Minthorn	38	12	50	38.0	62.0
88	074814	28033	Minthorn	81	48	129	31.4	68.6
88	074813	26881	Nr. Minthorn	72	36	108	33.3	66.7
88	074815	27226	Minthorn	94	77	171	27.5	72.5
89	075535	24584	Minthorn	6	0	6	50.0	50.0
89	075534	25905	RM 56-60	8	3	11	36.4	63.6
89	075533	24851	RM 63-70	12	0	12	50.0	50.0

file name: 9495cho1

Table F–15: Percent of Spring Chinook Salmon homing to the Umatilla River versus straying into fish hatcheries and spawning grounds above and below McNary Dam. Numbers represent estimated coded–wire tag recoveries.

Recovery Year	No. Above McNary	No. to Uma. R.	No. to Other	Total No.	Percent Home	Percent Stray
1990	9	770	4	783	98.3	9.5
1991	0	710	1	711	99.9	0.1
1992	22	326	3	351	92.9	22.9
1993	17	753	1	771	97.7	17.1
1994	13	157	0	170	92.4	13.0

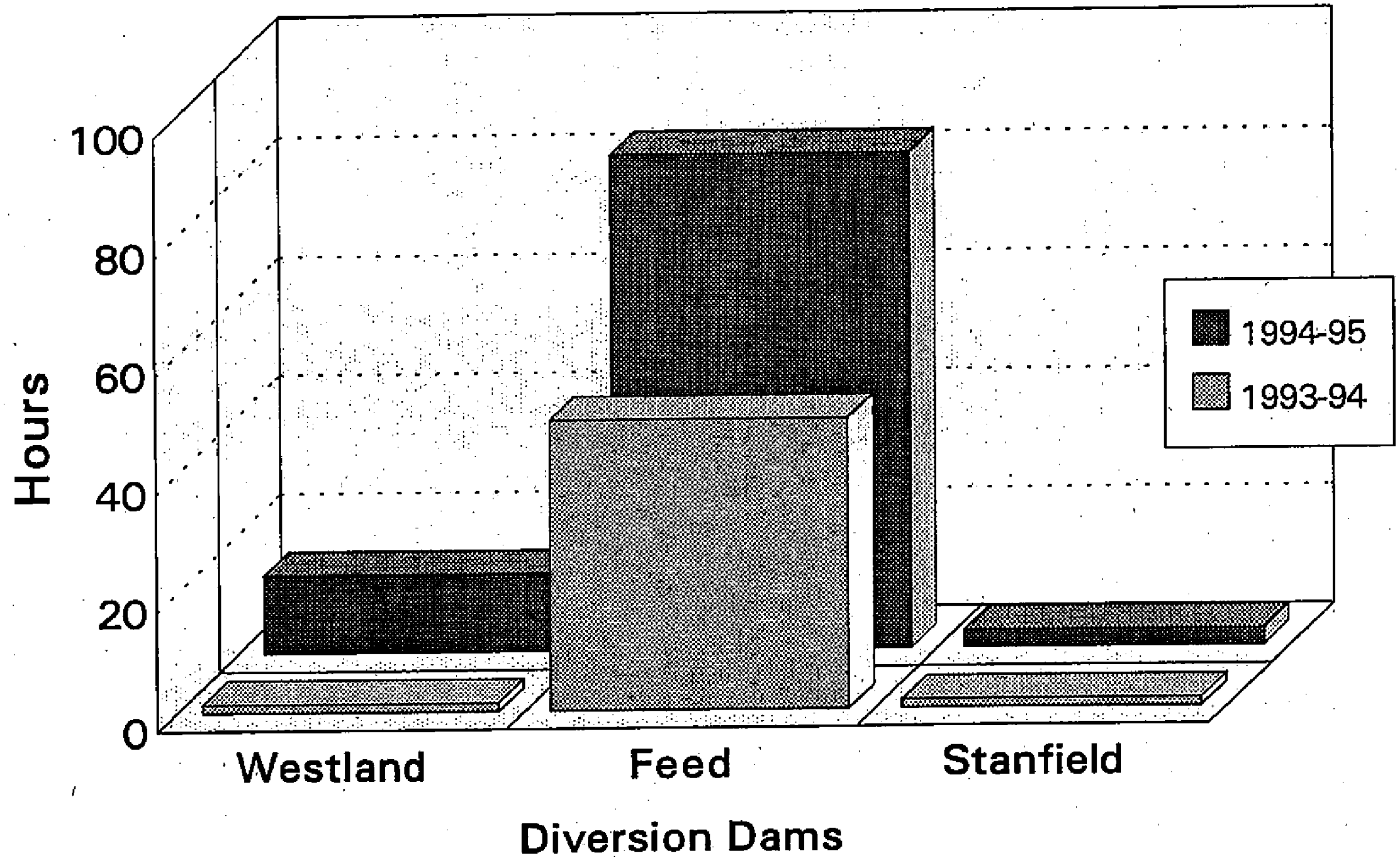
file name: 9495chs1

Figure F-1

Summer Steelhead Mean Passage Times

for Westland, Feed, and Stanfield Diversion Dams

Umatilla River, 1993-95



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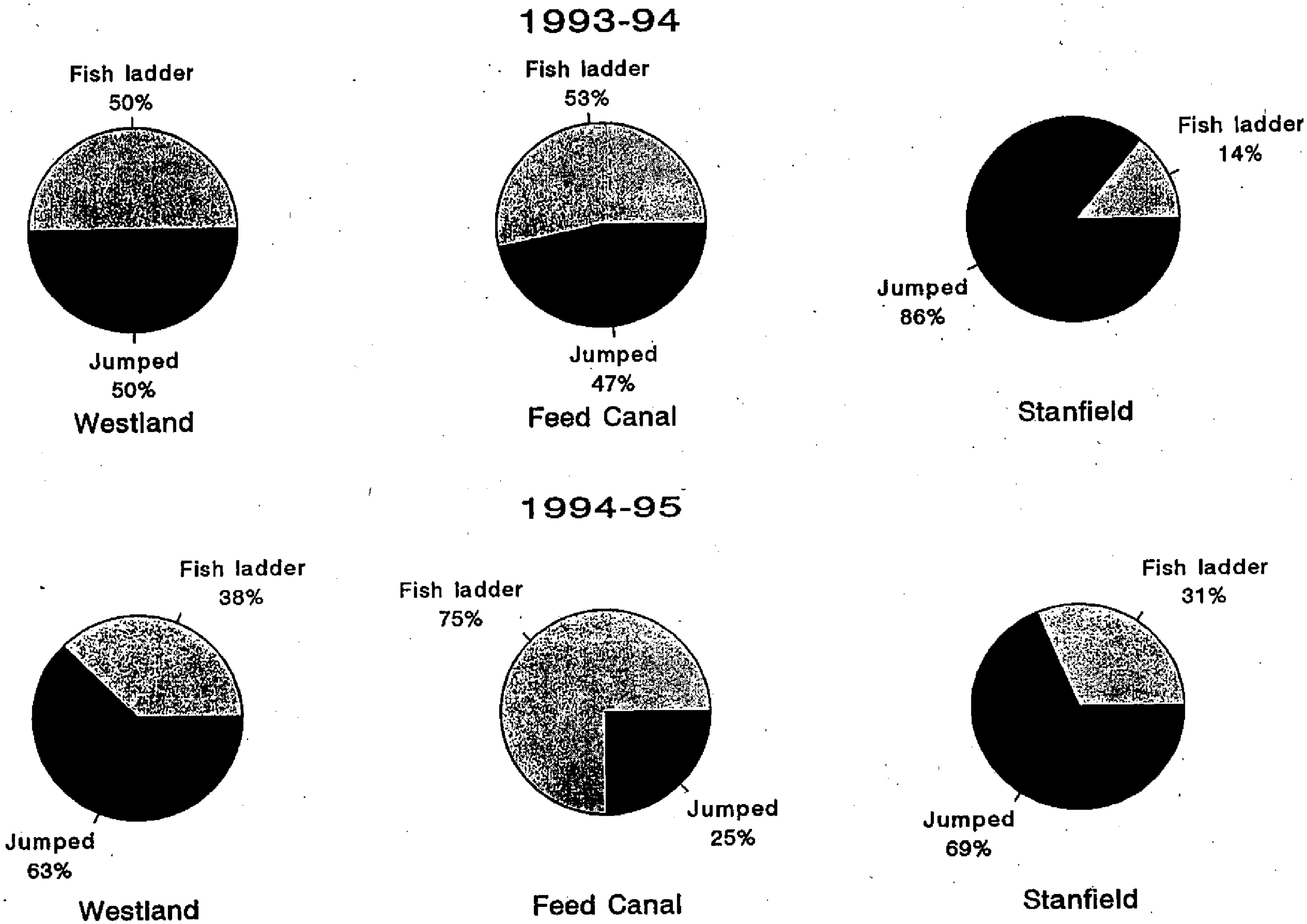


Figure F-2. Summer Steelhead migrational routes for Westland, Feed and Stanfield Dams, 1993-95.
File name: ladders

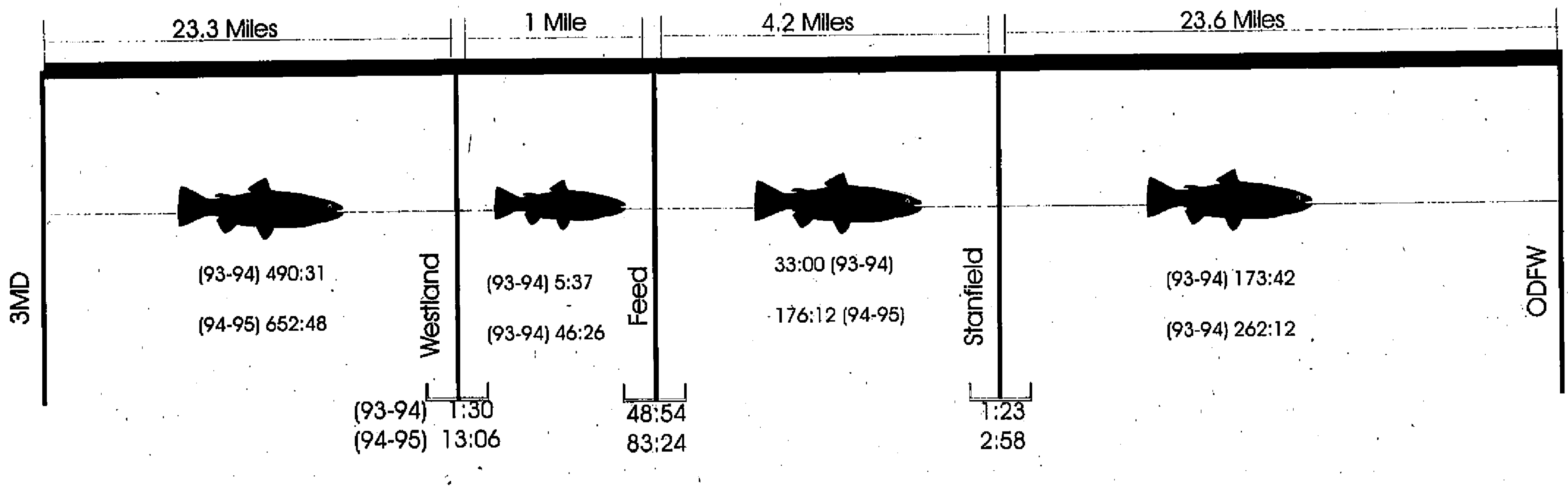


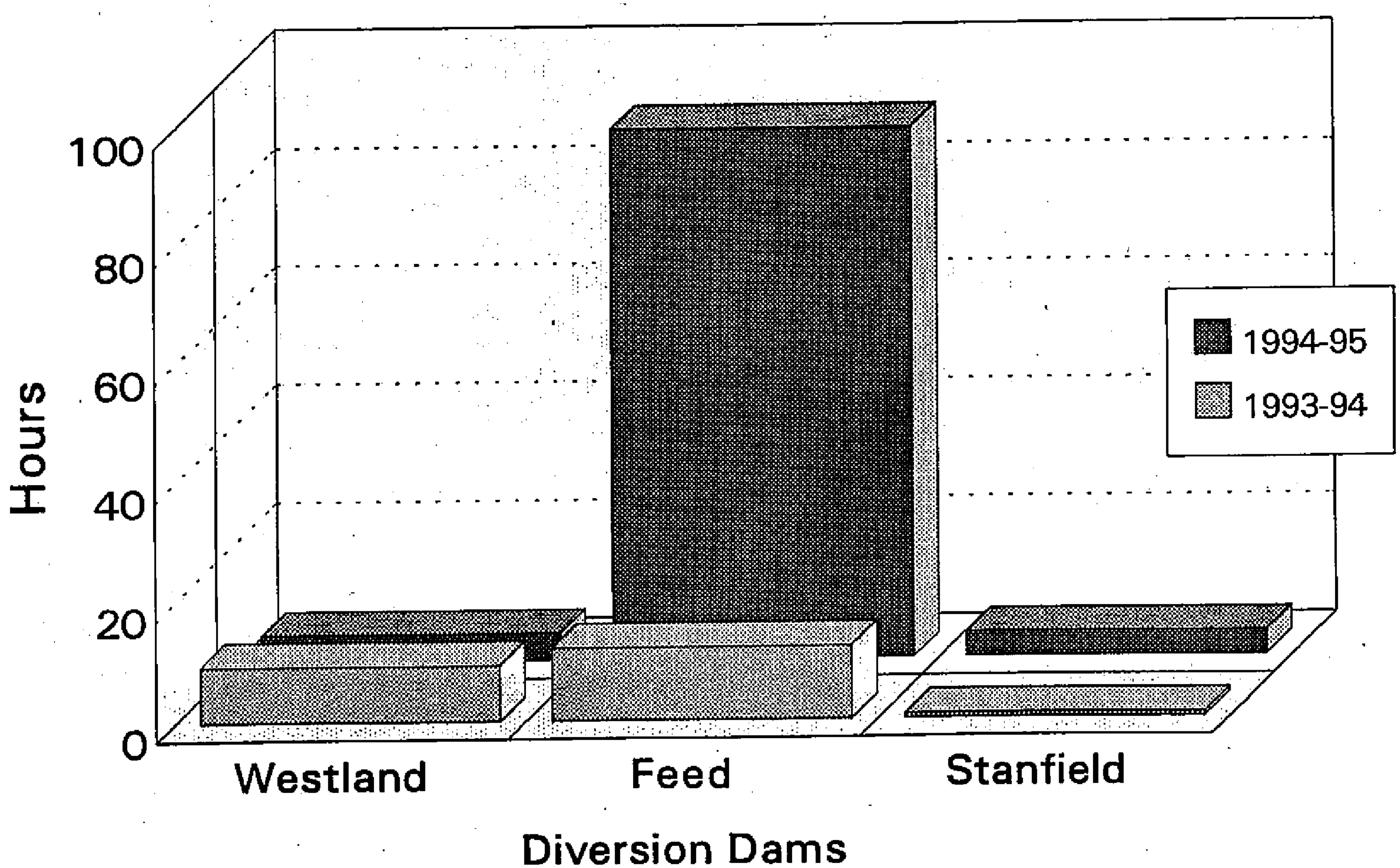
Figure F-3. Radio telemetry data depicting average migrational times (hours and minutes) for Summer Steelhead between dams versus passage times over dams, Umatilla River 1993-1995.

Figure F-4

Spring Chinook Mean Passage Times

for Westland, Feed, and Stanfield Diversion Dams

Umatilla River, 1993-95



File name: chs9495

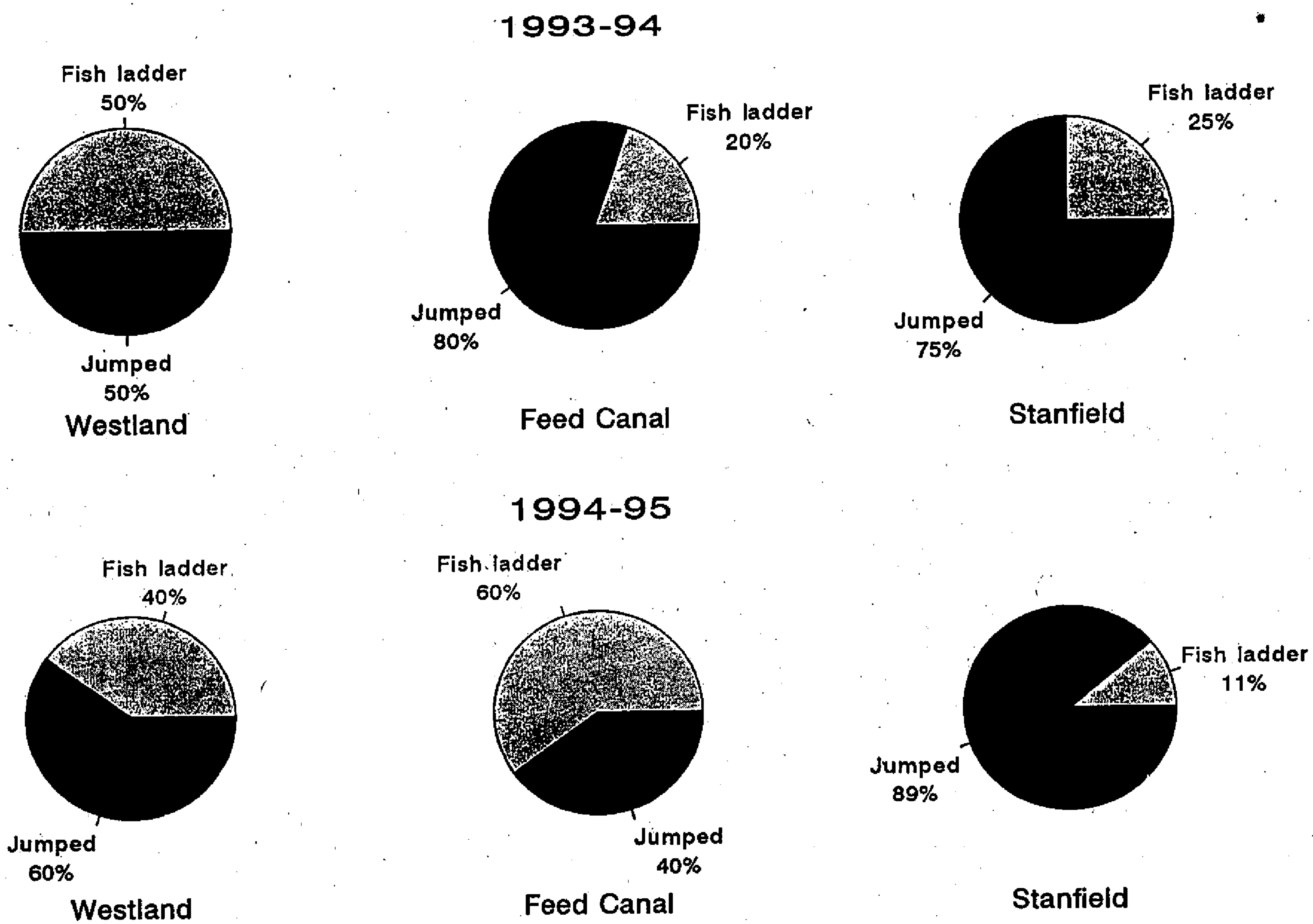
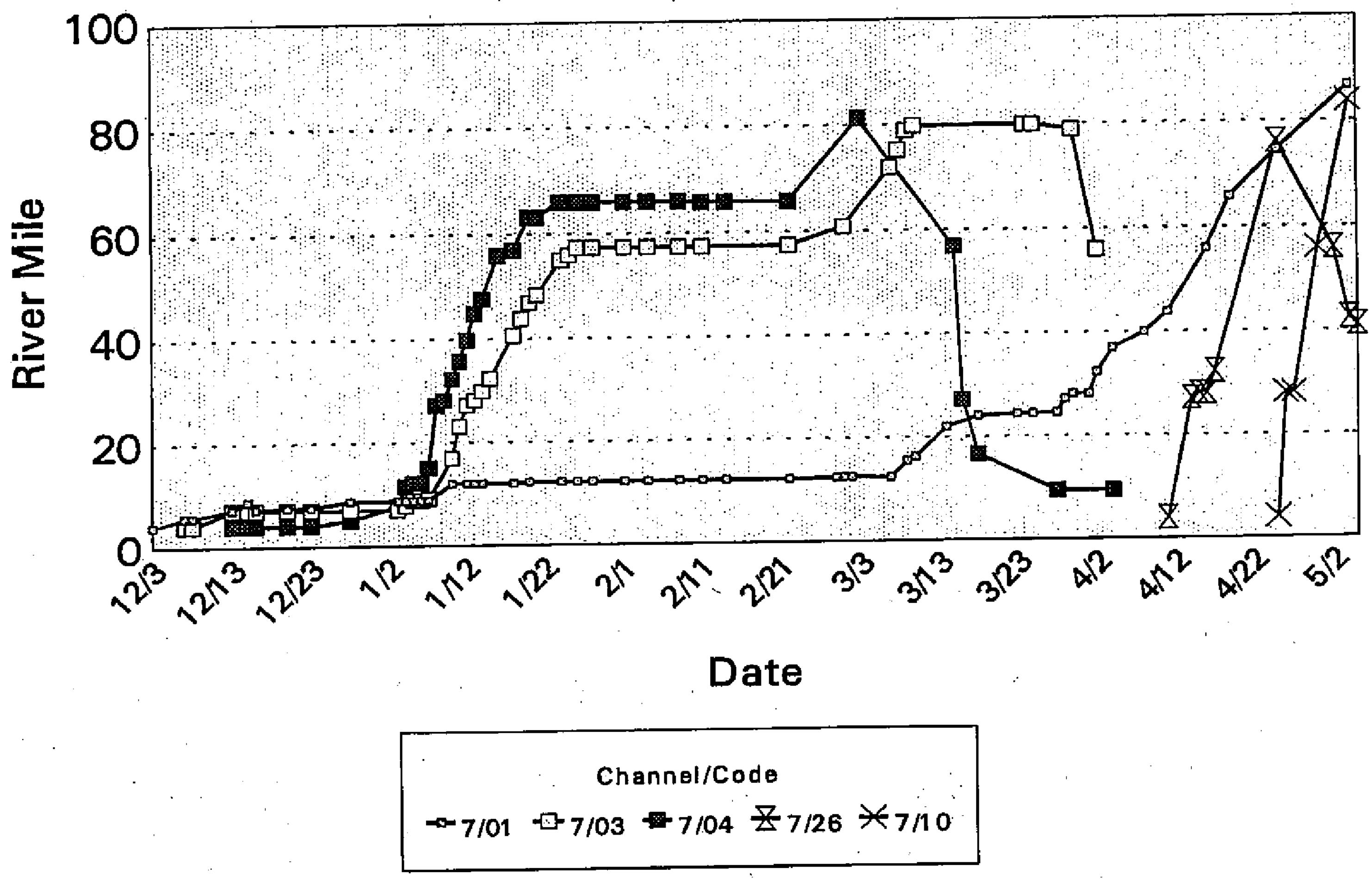


Figure F-5. Spring Chinook migrational routes for Westland, Feed and Stanfield Dams, 1993-95.
File name: ladder#1

Figure F-6

Summer Steelhead Migrational Behavior

Umatilla River 1993-94

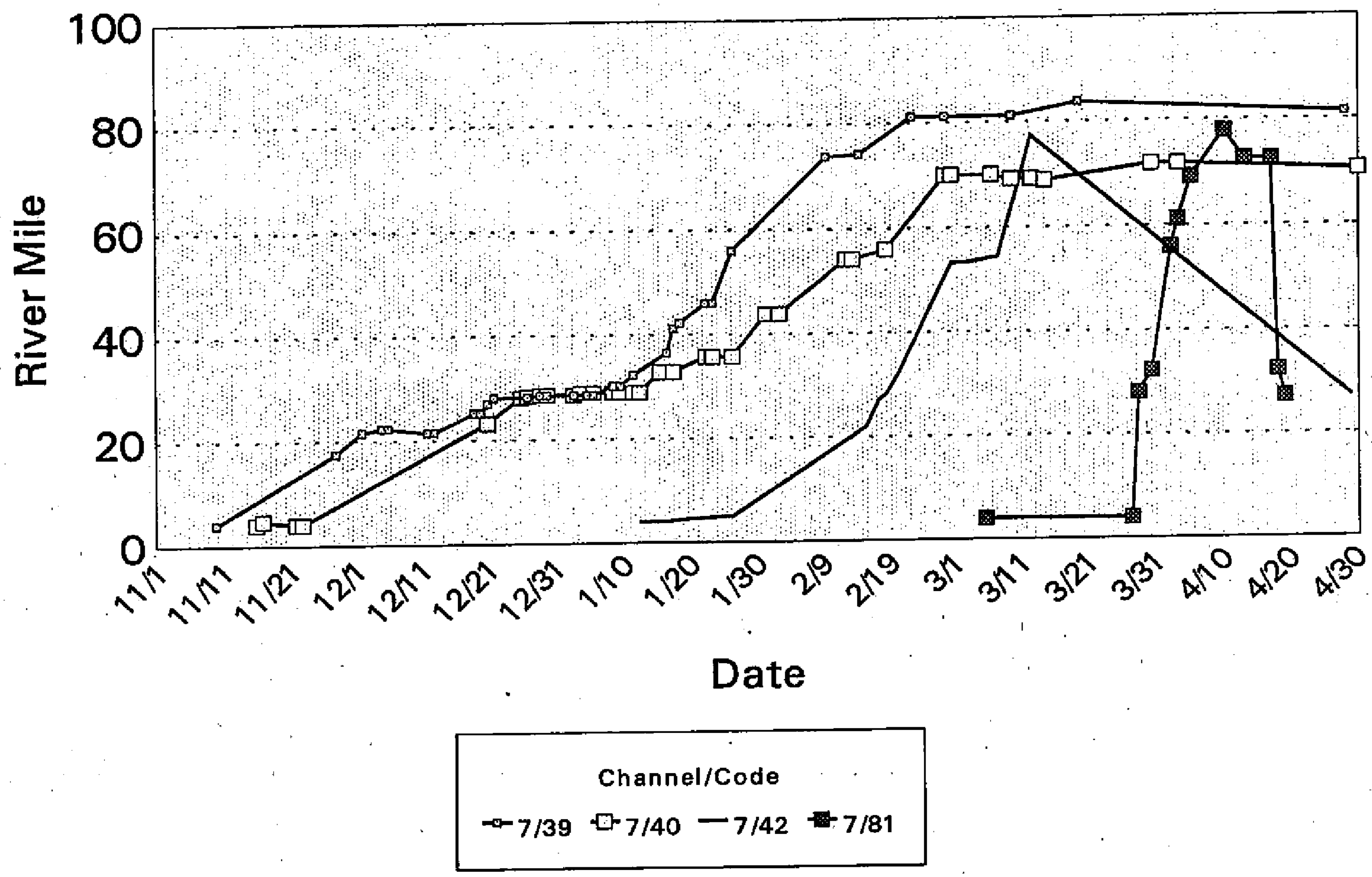


Passage Evaluation
Release site RM4-3MD
File Name sts9394

Figure F-7

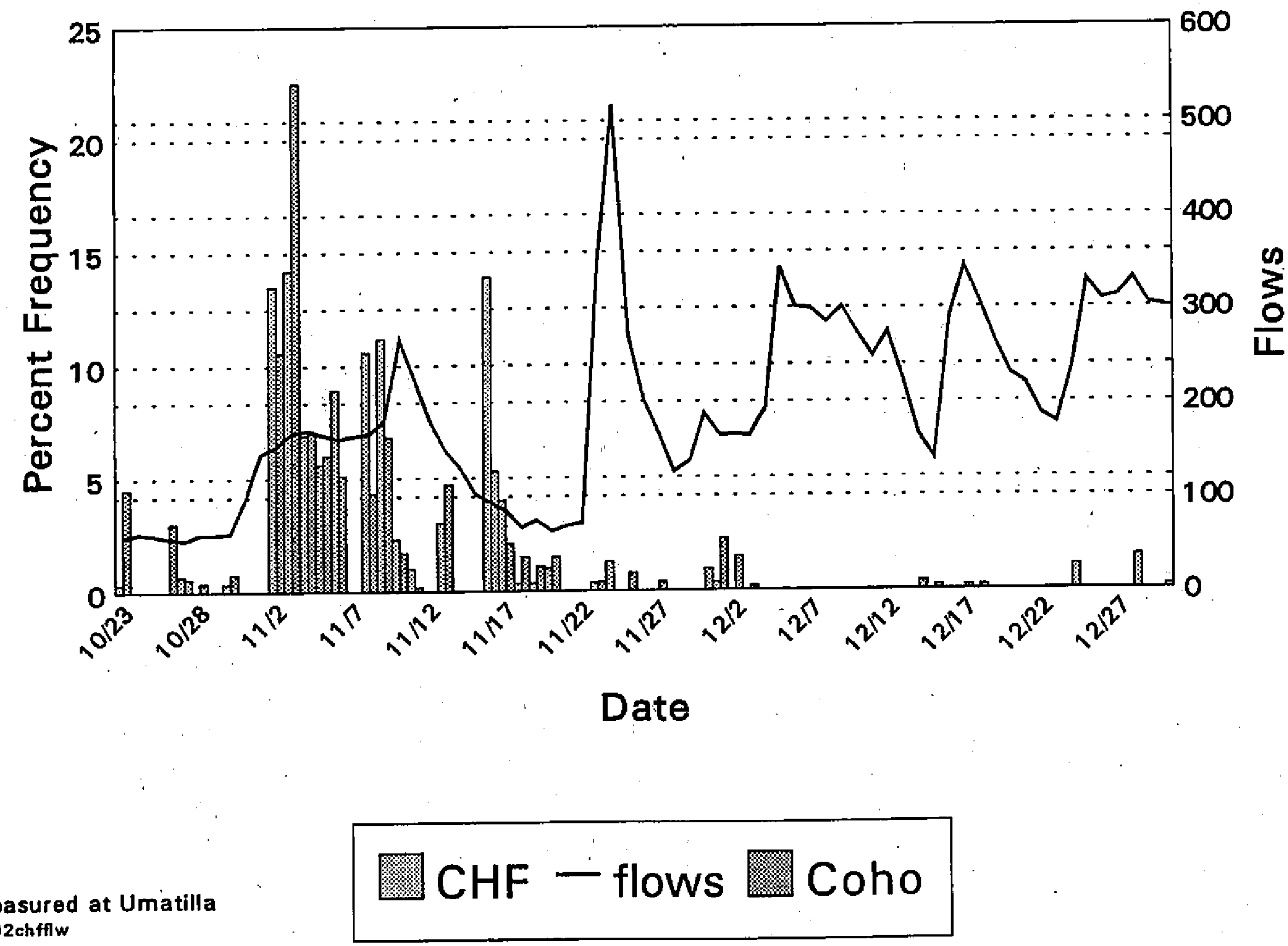
Summer Steelhead Migrational Behavior

Umatilla River 1994-95



Passage Evaluation
Release site RM4-3MD
File Name sts9495

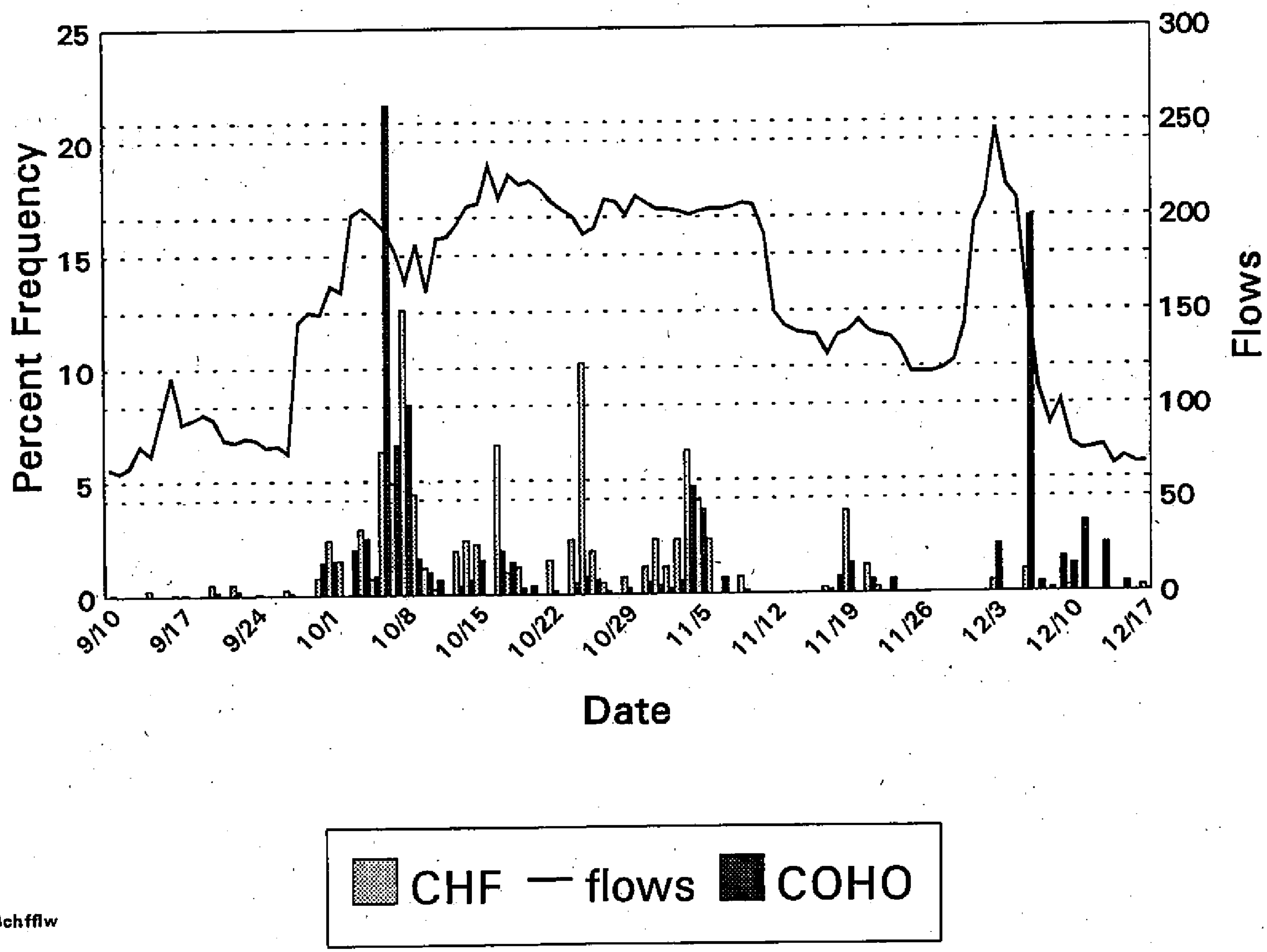
Figure F-8 Fall Chinook and Coho Returns Versus Flows
Umatilla River 1992



Flows measured at Umatilla
File name: 92chfflw

Figure F-9 **Fall Chinook and Coho Returns Versus Flows**

Umatilla River 1993

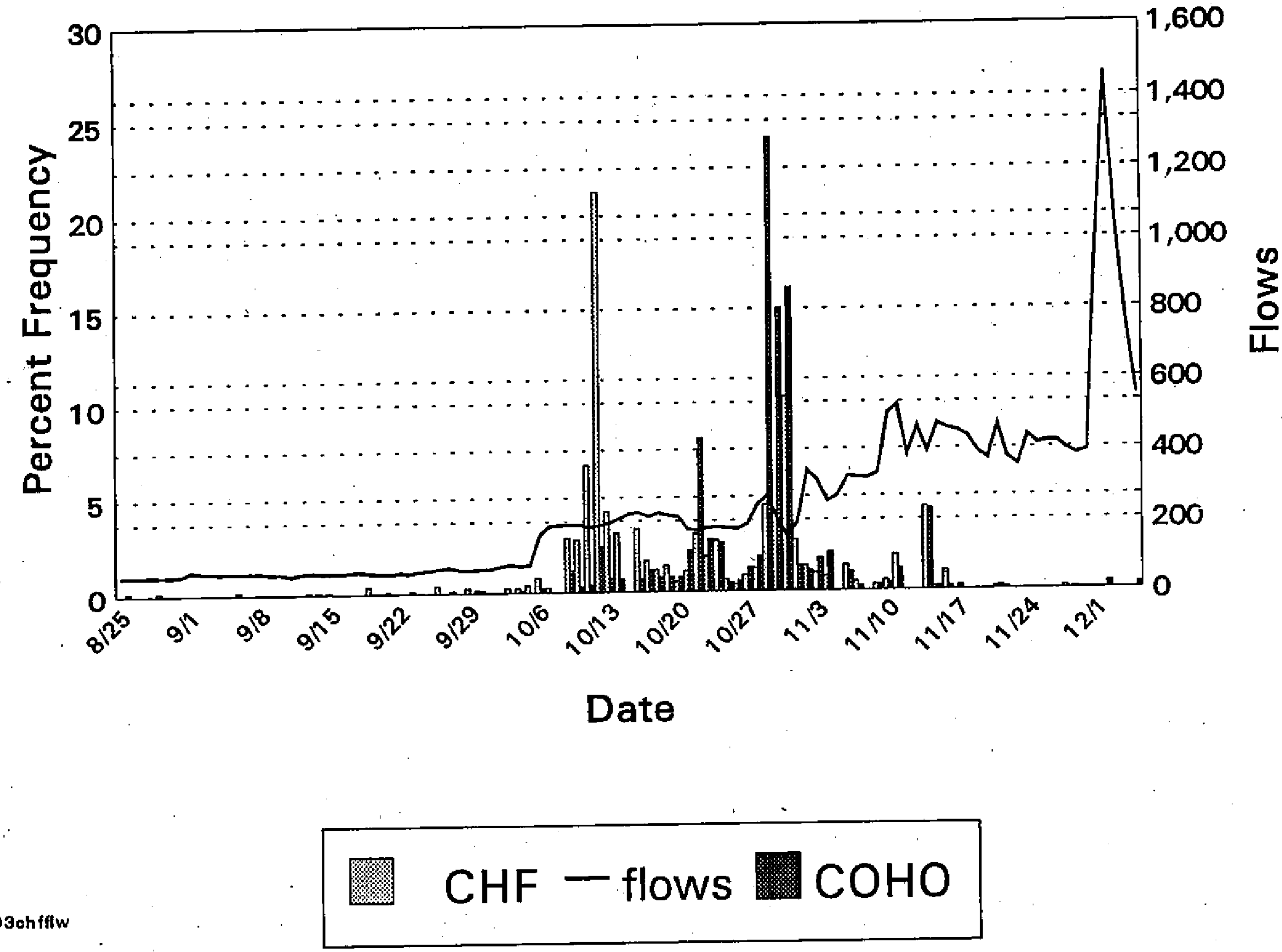


File name: 93chfflw

Figure F-10

Fall Chinook and Coho Returns Versus Flows

Umatilla River 1994

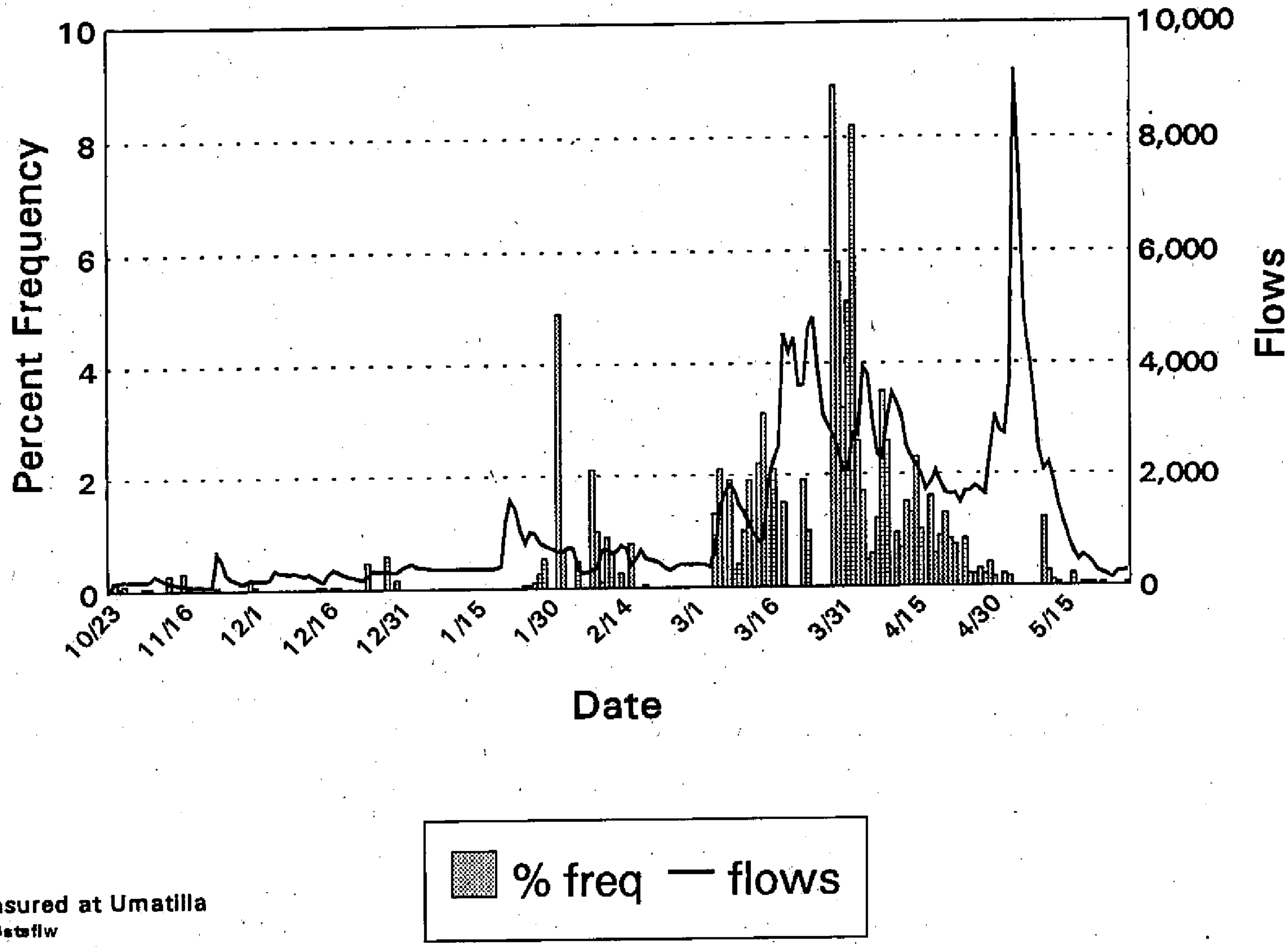


File name: 93chfflw

Figure F-11

Summer Steelhead Returns Versus Flows

Umatilla River 1992-93



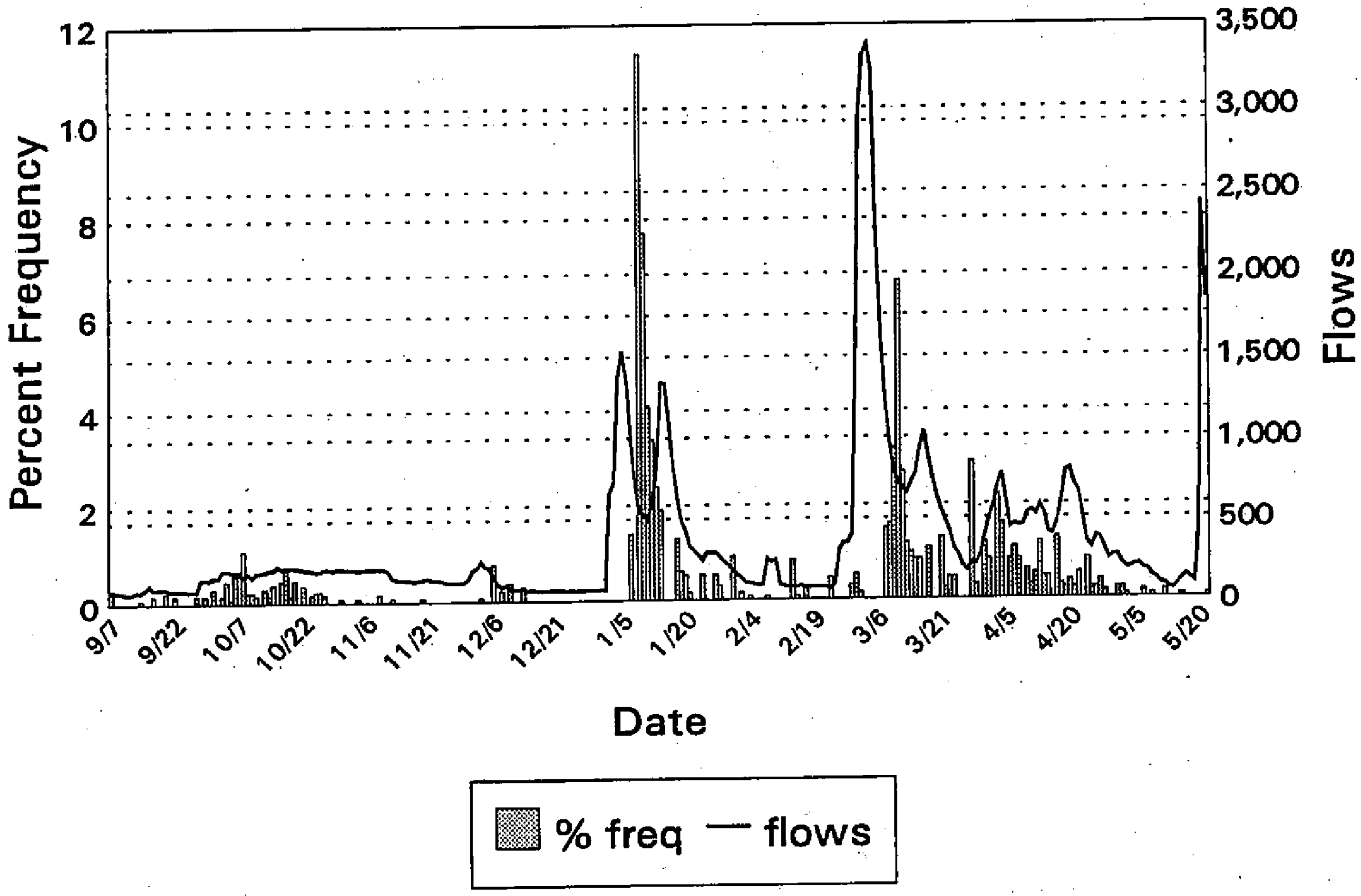
Flows measured at Umatilla

File name: 93stsflw

Figure F-12

Summer Steelhead Returns Versus Flows

Umatilla River 1993-94



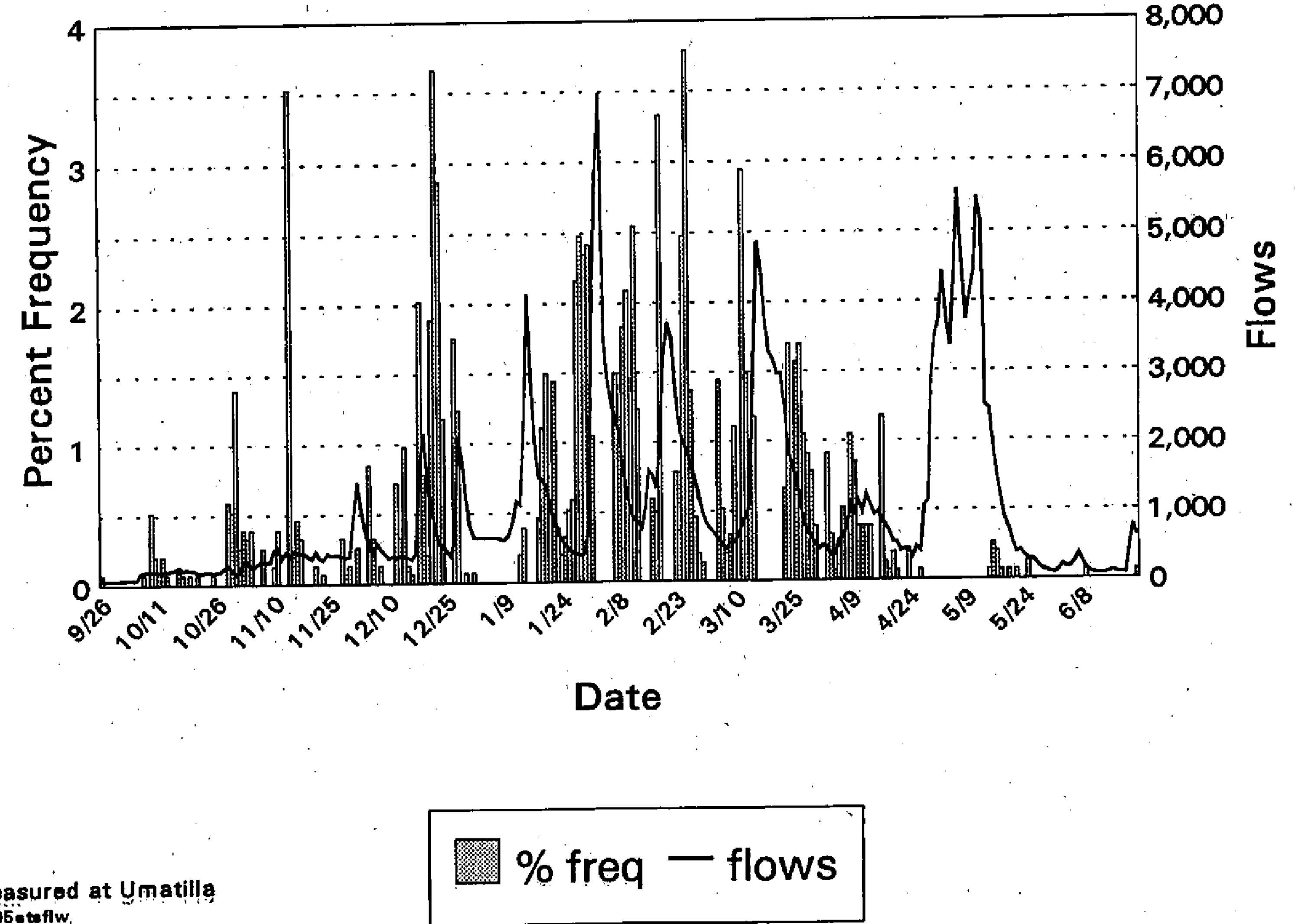
Three Mile Falls Dam

File name: 94stsflw

Figure F-13

Summer Steelhead Returns Versus Flows

Umatilla River 1994-95

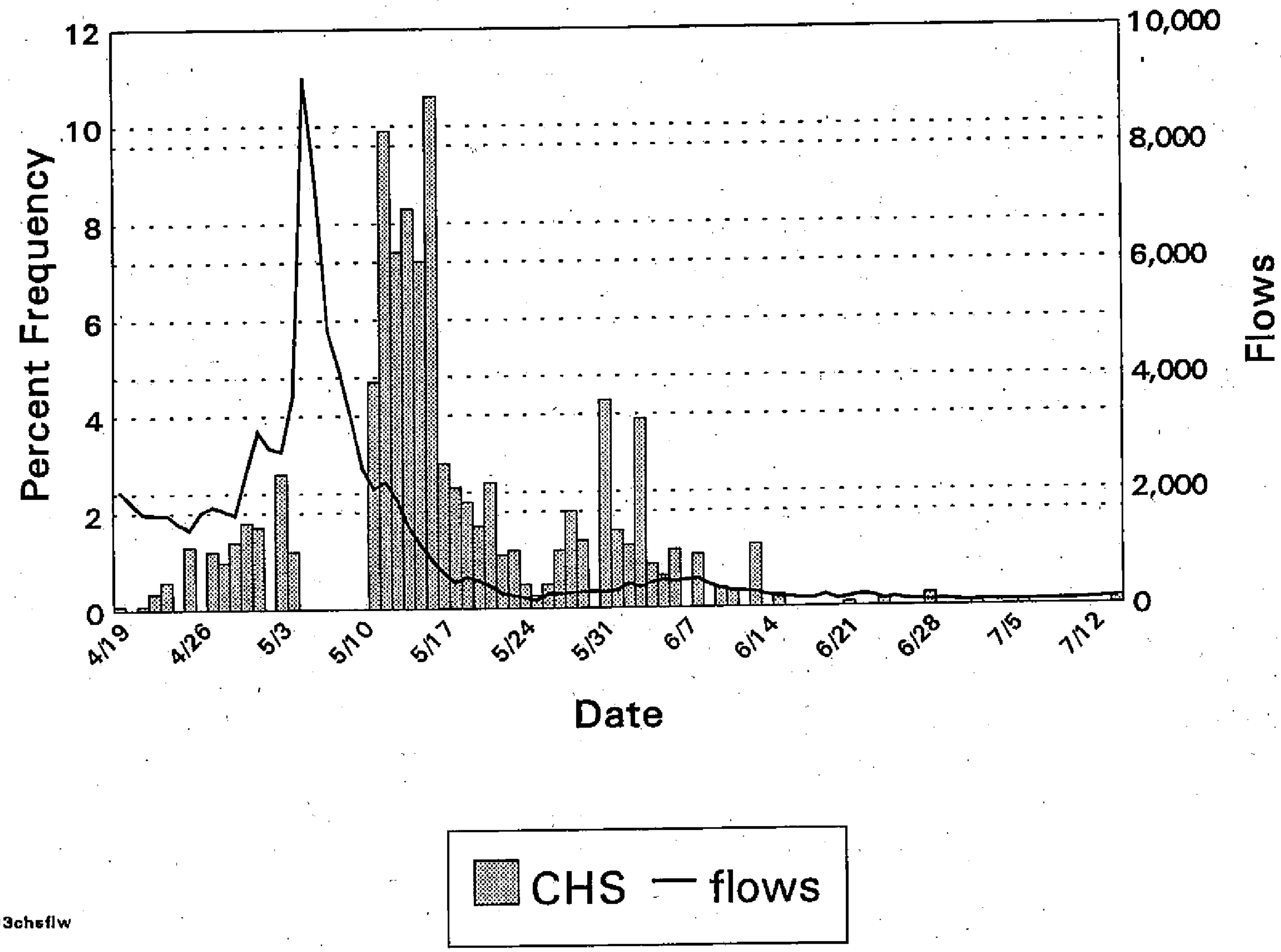


Flows measured at Umatilla
File name: 95etsflw.

Figure F-14

Spring Chinook Salmon Versus Flows

Umatilla River 1993

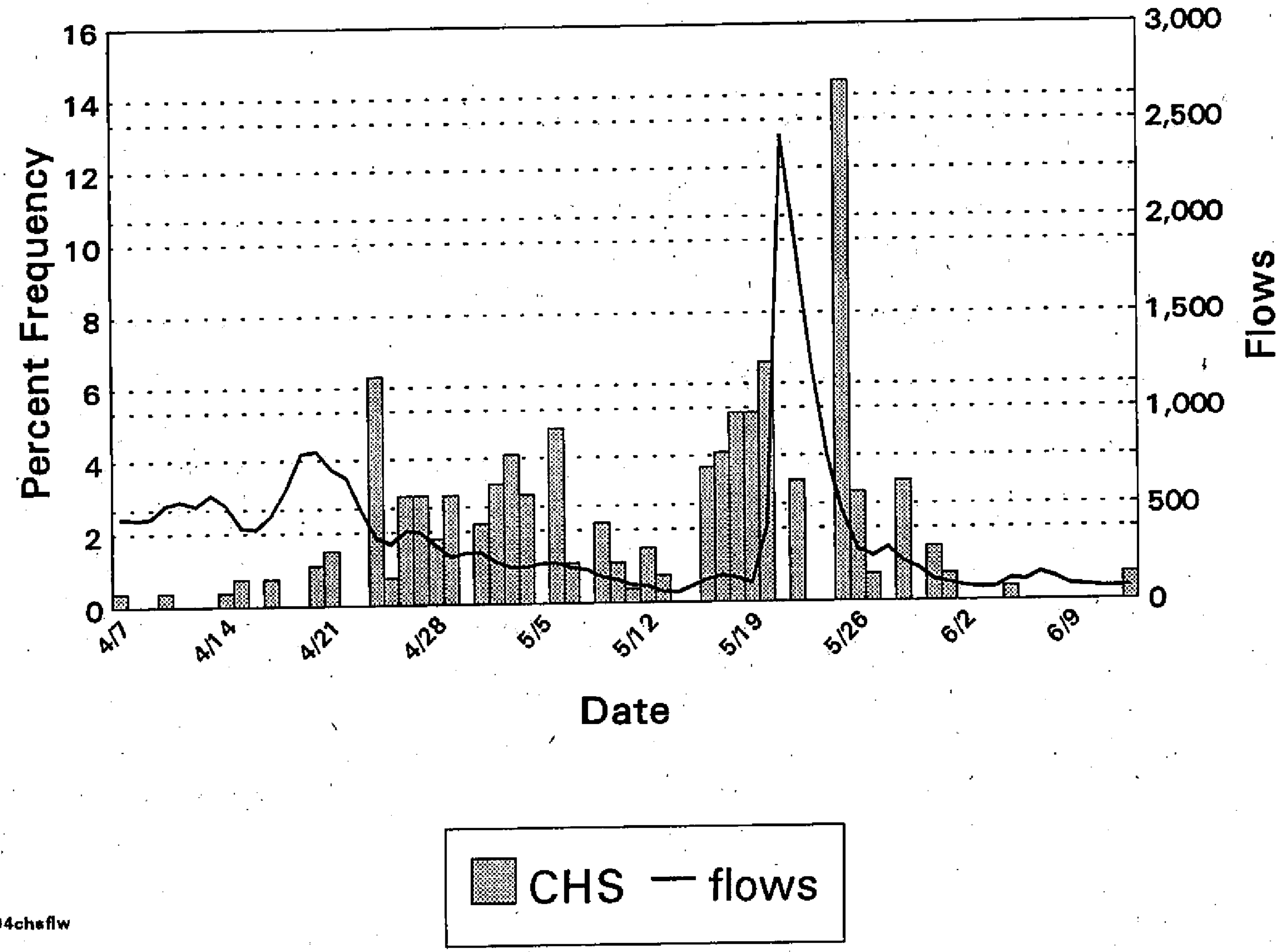


File name: 93chsflw

Figure F-15

Spring Chinook Salmon Versus Flows

Umatilla River 1994

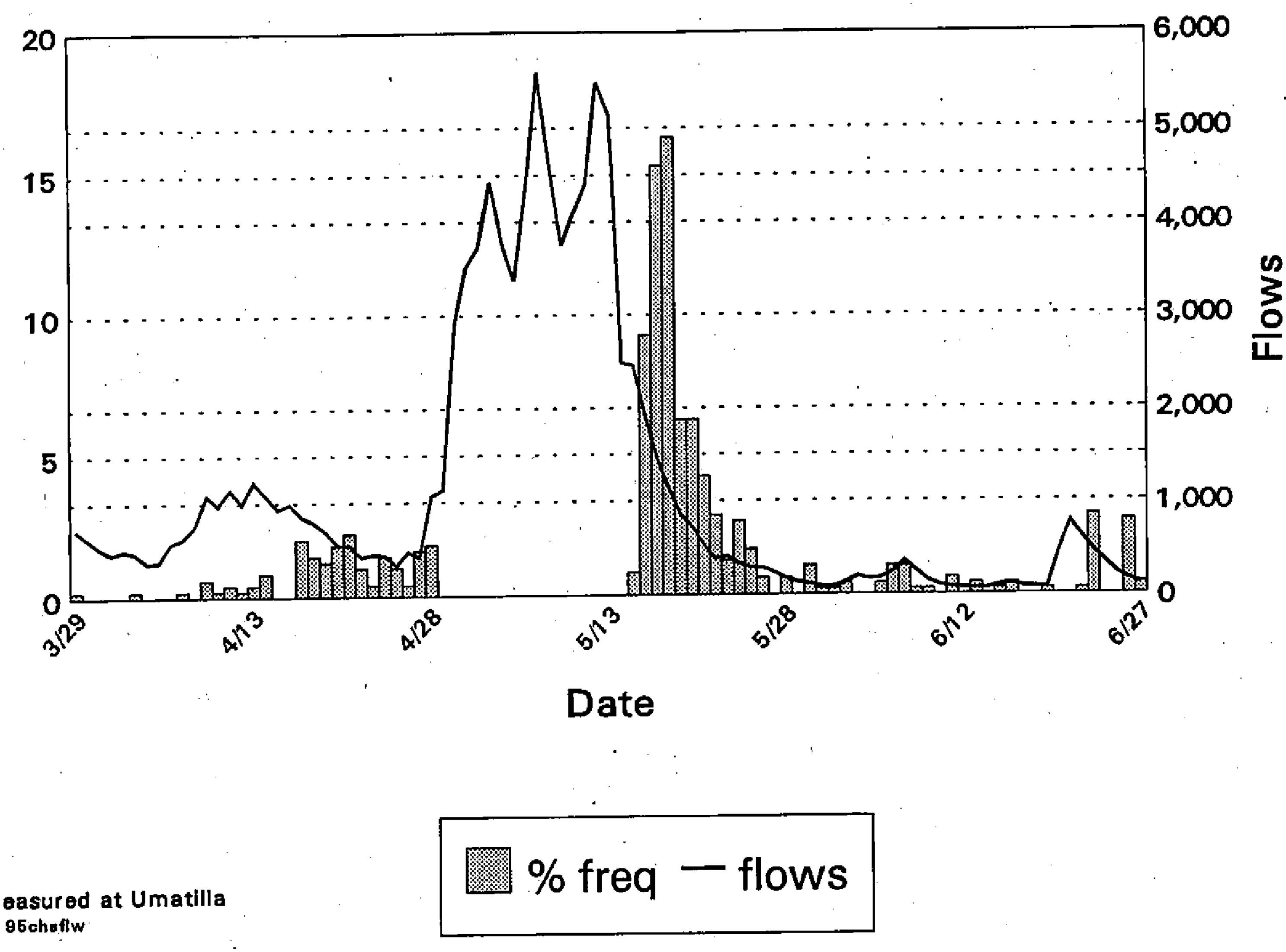


File name: 94chsflw

Figure F-16

Spring Chinook Salmon Versus Flows

Umatilla River 1995



Flows measured at Umatilla
File name: 95chsflw

APPENDIX G
Spawning Survey Data for 1993-1994

Table G-1. Summary of Summer Steelhead Escapement Surveys, Umatilla River Basin, 1995.

Redd #	River Mile	Area Description	Habitat Type	Date Observed	Total Steelhead On Redds On That Date	Total Steelhead Holding On That Date
CAMP CREEK - MOUTH TO FORKS TO WATERFALL Surveyed March 10, 28*, April 17						
1	0.4	Red Cabin	Riffle	3/28	1	
2	1.0		Tailout	4/17		
3	1.5		Tailout	4/17		
4	1.6		Tailout	4/17		
5	2.9		Tailout	4/17		1
NORTH FORK MEACHAM CREEK - MOUTH TO POT CREEK (5.0 Miles) Surveyed March 30*, April 3*						
6	1.7			3/30	3	
7	2.0			3/30		
8	2.1		Tailout	3/30		
9	2.5	Small anabranch	Riffle	3/30		
10	2.7	Small anabranch	Riffle	3/30		
11	3.1	Cabin above Bear Creek	Riffle	3/30		
12	3.2	100 yards above cabin	Riffle	3/30		
13	3.3	141 yards above cabin	Riffle	3/30		
14	3.4	175 yards above cabin	Tailout	3/30		
15	4.0	.5 miles above Forest Service upper fence	Riffle	3/30		
16	4.0	8 yards above redd #15	Riffle	3/30		
17	4.1	.6 miles above Forest Service upper fence	Tailout	3/30		
18	4.1	100 yards upstream of redd #17	Tailout	3/30		
19	4.8		Riffle	4/3		

Table G-1. Continued

Redd #	River Mile	Area Description	Habitat Type	Date Observed	Total Steelhead On Redds On That Date	Total Steelhead Holding On That Date
SQUAW CREEK - MOUTH TO LITTLE SQUAW CREEK (6.7 Miles) Surveyed March 8, 27, 28, April 4, 5, 6, May 18						
20	0.2	50 yard below Highway Bridge	Riffle	4/6	19	2
21	0.3	Old pipe trap site	Riffle	4/6		
22	0.4	250 yards above Highway Bridge	Tailout	4/6		
23	0.4	300 yards above Highway Bridge	Riffle	4/6		
24	0.5	Below Walt Farrow's (WF) house	Riffle	4/6		
25	0.5	Below WF house	Riffle	4/6		
26	0.6	Same area as redd #25	Riffle	4/6		
27	0.6	Below WF house, redd not visible after high water of 3/14-23	Riffle	3/8	3	
28	0.9	175 yards below WF house	Tailout	4/6		
29	1.0	70 yards below WF house	Riffle	4/6		
30	1.0	50 yards below WF house	Riffle	4/6		
31	1.2	10 yards below Bedrock Falls above WF house	Riffle	4/6		
32	1.3	In anabranch	Riffle	3/8		
33	1.3	Mile 1.9 below Bachelor canyon	Riffle	4/6		
34	1.3	Mile 1.9 below Bachelor canyon	Riffle	4/6		
35	1.6	20 yards below redd #34	Riffle	4/6		
36	1.6	1.6 miles below Bachelor canyon	Riffle	4/6		
37	1.7	1.5 miles below Bachelor canyon	Riffle	4/6		
38	1.7	Visible after high water of 3/14-23	Riffle	3/8		
39	1.9	41 yards above falls - not visible after high water of 3/14-23	Riffle	3/8		
40	1.9	80 yards above falls	Riffle	4/6		
41	2.1	303 yards below Cliff Picard's old cabin	Riffle	3/8		
42	2.1	300 yards below Cliff Picard's old cabin	Tailout	4/6		
43	2.5	200 yards below old log cabin with silver roof	Riffle	3/28	4	2

Table G-1. Continued.

Redd #	River Mile	Area Description	Habitat Type	Date Observed	Total Steelhead On Redds On That Date	Total Steelhead Holding On That Date
44	2.6	16 yards below old log cabin with silver roof	Riffle	3/28		
45	2.6	Across from old log cabin with silver roof	Riffle	4/6		
46	2.8	200 yards below new log home	Tailout	4/6		
47	3.1	150 yards below Bachelor canyon	Riffle	4/6		
48	3.2	100 yards below Bachelor canyon	Riffle	4/6		
49	3.5	507 yards above Bachelor canyon	Riffle	4/6		
50	4.0	50 yards below first crossing	Tailout	3/27		
51	4.0	33 yards above first crossing	Tailout	3/8		
52	4.1	150 yards above first crossing	Riffle	4/6		
53	4.1	175 yards above first crossing	Tailout	3/27		
54	4.1	200 yards above first crossing	Riffle	3/27		
55	4.2	250 yards above first crossing	Tailout	3/27		
56	5.0	100 yards above 2nd crossing - not visible after high water of 3/14-23	Riffle	3/8		
57	5.1	125 yards above second crossing	Riffle	3/27		
58	5.2	Third crossing - redd not visible - truck drove over	Riffle	3/8		
59	5.5	500 yards above third crossing	Tailout	3/27		
60	6.0	75 yards above excellent old spawning area - not visible after high water	Riffle	3/8		
61	6.0	150 yards above excellent old spawning area	Riffle	5/18		
62	6.5	Big pool on corner - 300 yards below Little Squaw Creek	Tailout	3/8		
63	6.5	Spawning in same place as redd #62	Tailout	4/6		
64	6.7	100 yards below Little Squaw Creek confluence	Riffle	3/8		

Table G-1. Continued

Redd #	River Mile	Area Description	Habitat Type	Date Observed	Total Steelhead On Redds On That Date	Total Steelhead Holding On That Date
BUCKAROO CREEK - MOUTH TO 3.0 MILES UPSTREAM Surveyed March 9, 24, April 14						
65	0.0	23 yards above mouth - not visible -high w. of 3/14-23	Riffle	3/9		
66	0.3	Across from yellow house	Riffle	3/9		
67	0.6	200 yards above first road crossing - not visible - high water of 3/14-23	Riffle	3/9		
68	0.6	75 yards above redd #67	Tailout	3/24	1	
69	1.1	Falls pool - not visible - high water of 3/14-23	Tailout	3/9		
70	1.1	Falls pool	Tailout	3/24		
NORTH FORK - UMATILLA RIVER - MOUTH TO 1.5 MILES ABOVE COYOTE CREEK Surveyed March 29*, April 19						
71	0.1	NF Gage	Tailout	3/29	1	
SOUTH FORK - UMATILLA RIVER - MOUTH TO 1.0 MILES ABOVE SHIMMIEHORN CREEK Surveyed March 29*						
72	0.9	0.9 miles above mouth	Riffle	3/29		
73	1.2	1.2 miles above mouth	Riffle	3/29		2
74	1.2	1.2 miles above mouth	Riffle	3/29		
75	1.4	1.4 miles above mouth	Riffle	3/29		
MEACHAM CREEK - MOUTH TO 18.2 MILES UPSTREAM Surveyed April 18*						
76	13.9		Riffle	4/18	4	1
77	13.6	NF railroad bridge	Riffle	4/18		
78	13.5		Riffle	4/18		
79	13.5		Riffle	4/18		
80	13.1		Riffle	4/18		
81	12.3	200 yards above white RR switch building	Riffle	4/18		
82	12.3	50 feet downstream	Riffle	4/18		
83	12.2	100 yards downstream	Riffle	4/18		
84	11.2	.5 miles above Duncan	Riffle	4/18		
85	11.1		Riffle	4/18		
86	10.8		Riffle	4/18		
87	10.7	Duncan	Riffle	4/18		
BOSTON CANYON CREEK - MOUTH TO FORKS, Surveyed March 13, 21, 31, April 14						
MINTHORN SPRINGS CREEK, Surveyed April 14						
MAINSTEM - RM 80.0 -74.5, Surveyed May 30						

* Partial Survey

Table G-2. Comparison of Umatilla River Adult Summer Steelhead Released above Three Mile Falls Dam, Redds and Redds per Mile surveyed, 1985 - 1995 (* estimated).

YEAR	STEELHEAD ESCAPEMENT		REDDS OBSERVED	MILES SURVEYED	REDDS PER MILE SURVEYED
	NATURAL	HATCHERY			
1985	3197*	0	33	23.5	1.4
1986	2885*	0	134	20.9	6.4
1987	3444*	0	156	52.5	3.0
1988	2144	160	275	61.0	4.5
1989	1934	353	128	50.2	2.5
1990	1290	102	High Water	High Water	High Water
1991	623	234	High Water	High Water	High Water
1992	2007	315	300	67.2	4.4
1993	1166	455	51 - High Water	46.6	High Water
1994	852	252	235	75.6	3.1
1995	784	530	126	35.3	3.6

Table G-3. Summary of Summer Steelhead Escapement Survey Data in the Umatilla River Basin, 1985-1995.

Year	Squaw Creek			Buckaroo Creek			Meacham Creek			NF Meacham Creek			Camp Creek			Boston Canyon Creek			NF Umatilla		
	Redds	STS	Miles	Redds	STS	Miles	Redds	STS	Miles	Redds	STS	Miles	Redds	STS	Miles	Redds	STS	Miles	Redds	STS	Miles
1985	14	3	5.0	2	0	2.0	0	0	1.5	1	8	3.0	4	2	2.5	10	9	1.0			
1986	25	0	3.5	3	0	2.0	49	2	6.4	27	0	3.0	8	7	2.5	8	0	1.0			
1987	25	13	6.6	0	0	2.0	49	0	9.0	7	2	3.0	12	3	2.5	0	0	1.0	6	2	2.5
1988	95	0	6.6	20	3	3.5	51	1	9.0	10	0	3.0	6	0	2.5	2	0	1.0	1	0	2.5
1989*	46	0	6.6	10	2	3.5	24	0	9.0	4	2	3.0	1	0	4.0	9	0	1.0	3	0	1.5
1990	High water and poor survey conditions																				
1991	High water and poor survey conditions																				
1992	77	10	6.7	5	0	3.0	120	39	18.0	30	18	5.0	8	9	2.5	0	0	1.0	17	3	2.5
1993*	10	12	6.7	6	4	3.0	6	5	15.8	3	1	3.3	7	4	2.5	6	3	1.0			
1994	36	4	6.7	0	0	3.0	40	5	18.2	11	6	5.0	6	2	2.5	3	4	1.0	4	0	4.0
1995**	45	21	6.7	6	1	3.0	12	5	3.1	14	3	5.0	5	1	2.5	0	0	1.0	1	1	2.0

NOTES:
1) Variability in areas surveyed, surveyors and survey conditions make direct comparisons of redd data difficult.
2) Steelhead observed were number observed during peak survey.
3) 1992 - Fifteen redds observed in mainstem not listed.
4) 1994 - Five redds observed in mainstem not listed.
5) *High water was believed to wash out some redds.
6) **High water after April 18 washed out redds previously marked - good surveys before the washout.
7) Steelhead redds have also been observed in the following tributaries that are not annually surveyed: Duncan Canyon Creek, East Fork Meacham Creek, Owsley Creek, Buck Creek, Thomas Creek, Moonshine and Westgate Canyon Creek.

AREAS PRESENTLY SURVEYED:

Squaw Creek - Mouth to Little Squaw Creek Confluence - 6.7 miles
Buckaroo Creek - Mouth to top of Timber Breakout Meadow - 3.0 miles
Meacham Creek - Mouth to 18.2 miles upstream - Top of USFS Habitat Improvement Area
North Fork Meacham Creek - Mouth to Pot Creek Confluence - 5.0 miles
Camp Creek - Mouth to Large Fork - 2.5 miles
Boston Canyon - Mouth to Forks - 1.0 miles
North Fork Umatilla - Mouth to 1.0 miles above Coyote Creek - 4.0 miles
South Fork Umatilla - Mouth to Forks - 3.2 miles
Ryan Creek - Mouth to 3.0 miles upstream - 3.0 miles (lower .3 miles not currently surveyed - private land)
Minthorn Springs - Mouth to Confluence of Umatilla - .3 miles
Pearson Creek - Mouth to 6.0 miles upstream - Culvert Crossing - 6.0 miles
West Birch Creek - Bridge Creek to RM 16.0
East Birch Creek - RM 8.5- RM 15.0

Table G-3. Continued

Year	South Fork Umatilla			Ryan Creek			Minthorn Springs			Pearson Creek			West Birch Creek			East Birch Creek		
	Redds	STS	Miles	Redds	STS	Miles	Redds	STS	Miles	Redds	STS	Miles	Redds	STS	Miles	Redds	STS	Miles
1985				2	0	2.0												
1986				13	0	2.0												
1987	3	0	3.0	10	0	2.0				22	0	6.0				11	0	5.5
1988	5	1	2.0	9	0	2.0				15	13	6.0	2	0	2.0	39	10	11.0
1989*	7	0	2.0	16	0	3.0												
1990	High water and poor survey conditions																	
1991	High water and poor survey conditions																	
1992	15	9	4.2	3	0	2.0	5	0	.2	1	1	6.0	0	0	3.3	4	0	1.0
1993*	8	4	4.2							3	5	8.0	3	0	4.5	11	2	4.5
1994	8	0	4.2	3	0	3.0	1	2	.2	31	9	5.0	20	5	6.0	61	9	7.0
1995**	4	2	3.2							8	1	2.0				31	5	6.5

*High water was believed to wash out some redds. **High water after April 18 washed out redds previously marked - good surveys before the washout.

Table G-4. Summary of Spring Chinook Salmon Escapement Survey Data, Umatilla River Basin, 1995.

Redd #	River Mile	Area Description	Habitat Type	Date Observed	Prespawning Mortalities Sampled F	M	Spawned Outs Sampled F	M
NORTH FORK OF THE UMATILLA RIVER, RM 0.0 TO RM 3.0 SURVEYED JULY 11, 31, AUGUST 7, 14, 21, 28, SEPTEMBER 5, 12								
1	0.1	Just below highway Bridge	Riffle	9/5	0	1	8	5 (1)
2	0.1	Just above highway Bridge	Riffle	9/5				
3	0.5	250 yards below index site	Tailout	8/14				
4	0.7	Lower index site	Riffle	8/28				
5	0.8	100 yards above index site	Riffle	9/5				
6	0.9	250 yards below Bear's old start	Riffle	8/21				
7	0.9	200 yards below Bear's old start	Riffle	8/14				
8	1.0	Camping area	Riffle	8/28				
9	1.4	Mile 1.4	Rifle	8/14				
10	1.5	Mile 1.5	Riffle	8/28				
11	1.6	Mile 1.6	Riffle	8/28				
12	2.0	Mile 2.0 (200 yards above good old area)	Riffle	8/21				
13	2.8	Mile 2.8	Riffle	8/14				
MAINSTEM UMATILLA RIVER, RM 89.6 TO RM 86.6 (FORKS TO BAR M ENTRANCE) SURVEYED JULY 6, 31, AUGUST 8, 14, 24*, 28, SEPTEMBER 1, 8, 12								
14	89.5	30 feet below Forks	Riffle	7/31	5	6 (1)	17	24 (1)
15	89.5	35 feet below Forks	Riffle	8/28				
16	89.5	First habitat structure below Forks	Tailout	8/21				
17	89.5	First habitat structure below Forks	Tailout	8/24				
18	89.5	First habitat structure below Forks	Tailout	9/6				
19	89.4	100 yards below Forks	Riffle	8/21				
20	89.3	Second habitat structure	Tailout	8/21				
21	89.1	Just above third habitat structure	Riffle	8/8				
22	89.1	Just above third habitat structure	Riffle	8/21				
23	88.3	Mile 1.2 below Forks	Riffle	8/21				
24	88.0	Top of big braid - at beaver diggings	Tailout	8/28				
25	88.0	Top end of big braid	Tailout	8/21				
26	88.0	Big braid	Tailout	9/1				
27	88.0	Big braid	Riffle	8/24				
28	87.9	Big braid	Tailout	9/1				
29	87.9	Big braid	Riffle	9/1				
30	87.9	Bottom of big braid	Riffle	8/28				
31	87.7	River Mile 87.7	Riffle	9/8				
32	87.5	Upper tin shed	Riffle	8/28				
33	87.5	Upper tin shed	Riffle	8/28				
34	86.3	125 yards below footbridge at Bar M	Tailout	9/1				
MAINSTEM UMATILLA, RM 86.6 TO 83.6 SURVEYED JULY 6, AUGUST 1, 8, 22, 31, SEPTEMBER 6, 14								
35	85.9	Area start riffle	Riffle	9/6	2	2	9	12 (2)
36	85.8	In beaver workings	Riffle	9/6				
37	85.7	River Mile 85.7	Riffle	8/31				
38	84.8	Stage coach stop	Riffle	8/31				
39	84.8	Stage coach stop	Riffle	8/22				
40	84.6	Lower stage coach stop	Riffle	8/31				

Table G-4. Continued

Redd #	River Mile	Area Description	Habitat Type	Date Observed	Prespawning Mortalities Sampled F	M	Spawned Outs Sampled F	M
41	84.4	Log truck house	Riffle	9/6				
42	84.4	Log truck house	Riffle	8/31				
43	83.7	A-Frame Gulch	Riffle	8/31				
44	83.7	A-Frame Gulch	Riffle	9/6				
MAINSTEM UMATILLA, RM 83.6 TO 80.0 SURVEYED JUNE 13, JULY 5, AUGUST 1, 15, 22, 31 SEPTEMBER 6, 14								
45	82.3	Homemade fence	Tailout	9/14	1	2	9	12 (2)
46	81.9	Corner above Dabulskis	Riffle	8/31				
47	81.8	150 yards downstream	Riffle	8/31				
48	81.4	London bridge	Riffle	8/31				
49	81.3	Footbridge	Riffle	9/14				
50	81.0	Gage	Tailout	8/31				
51	81.0	100 feet below Gage	Riffle	8/31				
52	80.8	100 feet above lower structure at Emmit Williams	Riffle	8/31				
53	80.8	100 feet above lower structure at Emmit Williams	Riffle	9/14				
54	80.7	Below lower structure at Emmit Williams	Tailout	9/14				
55	80.5	River Mile 80.5	Riffle	9/14				
56	80.3	New house above corn cob county	Riffle	9/14				
57	80.3	New house above corn cob county	Riffle	9/14				
MAINSTEM UMATILLA RM 80.0 TO 76.7 (FRED GRAY'S BRIDGE TO SQUAW CREEK) SURVEYED MAY 24, 30, JUNE 13, 21, 27, JULY 5, 27, AUGUST 2, 9, 15, 23, 30, SEPTEMBER 7, 13, 18								
58	79.8	300 yards below Fred Gray's bridge	Riffle	9/13	13	6 (4)		
59	79.7	200 yards above rotary screw trap (RST) at Fred Gray's	Riffle	9/7				
60	79.7	200 yards above RST at Fred Gray's.	Riffle	9/13				
61	79.5	125 feet above RST	Riffle	9/7				
62	79.5	125 feet above RST	Riffle	9/7				
63	79.5	115 feet above RST	Riffle	9/18				
64	79.4	75 yards below RST	Riffle	9/13				
65	79.3	200 yards below RST	Tailout	9/13				
66	79.3	225 yards below RST	Tailout	9/7				
67	79.3	230 yards below RST	Riffle	9/13				
68	79.2	250 yards below RST	Tailout	9/7				
69	79.2	275 yards below RST	Riffle	9/18				
70	79.0	100 feet above Meacham Creek con.	Riffle	9/7				
71	78.8	250 feet below Meacham Creek con.	Riffle	9/13	11	9 (4)	7	3
72	77.5	125 feet above Gibbon RR crossing	Riffle	9/13				
73	77.2	New house	Riffle	9/7				
74	77.2	New house	Riffle	9/7				
75	77.1	100 yards below new house	Riffle	9/7				
76	77.1	100 yards below new house	Riffle	8/30				
77	77.0	300 yards below new house	Riffle	9/7				

Table G-4. Continued

Redd #	River Mile	Area Description	Habitat Type	Date Observed	Prespawn Mortality Sampled Type F	Prespawn Mortality Sampled Type M	Spawned Outs Sampled F	Spawned Outs Sampled M
MAINSTEM UMATILLA, RM 76.7 TO RM 73.5 (SQUAW CREEK TO THORNHOLLOW BRIDGE) SURVEYED MAY 30, JUNE 28, AUGUST 2, 9, 18, 23, SEPTEMBER 7, 13, 18								
78	74.7	Twin bluffs above Wither's	Riffle	9/18	15	3 (1)	4	9 (1)
79	74.5	Above Wither's pool	Riffle	9/13				
80	74.3	300 yards below Wither's pool	Riffle	9/13				
81	73.6	200 yards above Thornhollow bridge	Riffle	9/13				
MAINSTEM UMATILLA, RM 73.5 TO RM 70.0 (THORNHOLLOW BRIDGE TO LOUIE DICK'S FENCE), SURVEYED JUNE 14, 29, JULY 28								
MAINSTEM UMATILLA, RM 70.0 TO RM 64.5 (LOUIE DICK'S FENCE TO MINTHORN SPRINGS), SURVEYED JUNE 30, JULY 28								
MAINSTEM UMATILLA, RM 64.5 TO RM 59.5 (MINTHORN SPRINGS TO MISSION BRIDGE), SURVEYED JUNE 7, AUGUST 17								
MAINSTEM UMATILLA, RM 59.5 TO RM 55.5 (MISSION BRIDGE TO HIGHWAY 11 BRIDGE, SURVEYED JULY 24								
MAINSTEM UMATILLA, RM 49.0 TO RM 33.8 (REITH BRIDGE TO CUNNINGHAM SHEEP BRIDGE), SURVEYED AUGUST 3, 4								
MEACHAM CREEK - MOUTH TO RM 3.0, SURVEYED JUNE 1, 15, JULY 7, 26, AUGUST 11, 16, SEPTEMBER 11, 19								
82	2.0	Mile 2.0	Tailout	9/11	0	0	1	1
83	2.9	Mile 2.9	Riffle	9/11				
84	2.9	Mile 2.9	Riffle	9/19				
MEACHAM CREEK - RM 3.0 TO RM 6.0 SURVEYED JUNE 20, JULY 7, 26, AUGUST 10, 16 SEPTEMBER 11, 19								
85	3.1	Mile 3.1	Riffle	9/19	0	0	1	1
86	3.5	Mile 3.5	Tailout	9/11				
87	5.0	Mile 5.0	Riffle	9/11				
88	5.8	Mile 5.8	Riffle	9/11				
MEACHAM CREEK - RM 6.0 TO RM 9.8 SURVEYED JUNE 20, JULY 12, 26*, SEPTEMBER 11*, 19								
89	6.1		Riffle	9/19	0	0	2	0
90	9.8	100 feet below Duncan Bridge	Tailout	9/19				
MEACHAM CREEK - RM 9.8 to RM 13.8 (NORTH FORK), SURVEYED JUNE 26, JULY 12								
MEACHAM CREEK - RM 13.8 to 19.8, SURVEYED JULY 25								
NORTH FORK MEACHAM CREEK - RM 0.0 TO 3.0 (BEAR CREEK), SURVEYED JULY 25								

Total Prespawning Mortalities Sampled			Total Spawned Outs Sampled	
Females	Males	Unknown Sex	Females	Males
41	30 (9)	1	73	72 (11)

* Partial Survey

( ) jack salmon which were included in total

Table G-5. Disposition of Umatilla River Spring Chinook Salmon above Three Mile Falls Dam, 1989-1995.

YEAR	1989	1990	1991	1992	1993	1994	1995
Total Observed at TMD	164	2190	1330	464	1221	271	496
Chinook Sacrificed/Mort. at TMD	36	26	234	200	165	31	56
Chinook Taken For Brood Stock	0	200	0	0	0	0	0
Number Released Above TMD	128	1965	1096	264	1056	234	424
Number Released at TMD	–	–	–	–	9	6	16
Number of Adipose Clipped Fish Released Above TMD	3	685	479	135	603	133	156
Estimated Harvest Above TMD	?	?	?	CLOSED	191	CLOSED	0
Number of Chinook Sampled on Spawning Grounds	6	272	264	79	474	113	217
Percent Recovered (all chinook)	4.7	13.8	24.1	29.9	44.9	47.1	49.3
Number of Ad. Clipped Chinook Recovered	0	83	136	39	356	50	78
Percent Recovered (ad. clipped)	0.0	12.1	28.4	28.9	59.0	37.6	50.0
Prespawning Mortalities Examined	0	0	88	22	125	20	72
Spawned Out Carcasses Examined	0	0	130	48	338	93	145
Redds Observed	14	287	144	59	224	74	90
Spawned Out Females Sampled	–	–	81	37	205	56	73

Table G-6. Umatilla River Spring Chinook Salmon Redd Distributions, 1989-1995.

YEAR	1989	1990	1991	1992	1993	1994	1995
Total # Redds Observed	14	287	144	59	224	74	90
RIVER SECTION	NUMBER OF REDDS OBSERVED / PERCENT BY REACH						
North Fork Umatilla River	0 / 0	68 / 23.5	13 / 9.0	10 / 16.9	27 / 12.1	16 / 21.6	13 / 14.4
River Mile 86 to 89.5	14 / 100	174 / 60.3	21 / 14.6	13 / 22.0	25 / 11.2	13 / 17.6	21 / 23.3
River Mile 83 to 86			29 / 20.1	15 / 25.4	14 / 6.5	6 / 8.1	10 / 11.1
River Mile 80 to 83	0 / 0		26 / 18.1	13 / 22.0	31 / 13.8	9 / 12.2	13 / 14.4
River Mile 78.9 to 80	0 / 0		20 / 13.9	6 / 10.2	39 / 17.4	14 / 18.9	13 / 14.4
River Mile 76.7 to 78.9	0 / 0	36 / 12.5					7 / 7.8
River Mile 73.6 to 76.7	0 / 0		0 / 0	0 / 0	25 / 11.1	2 / 2.7	4 / 4.4
River Mile 70.0 to 73.6	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
River Mile 67.5 to 70.0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
River Mile 63.8 to 67.5	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
River Mile 59.5 to 63.8	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Meacham Creek (RM 1-15)	0 / 0	11 / 3.7	35 / 24.3	1 / 1.7	63 / 28.1	14 / 18.9	9 / 10.0

Table G-7. Minimum Estimate of Fall Chinook Salmon and Coho Salmon Adult Returns to the Umatilla River, 1989-1994. (Excludes Jacks)

YEAR	ADULTS ENUMERATED AT THREE MILE DAM	ADULTS FOUND BELOW THREE MILE DAM	TOTAL	PERCENT SAMPLED BELOW DAM
COHO				
1989	4,154	44	4,198	1.0%
1990	409	2	411	0.5%
1991	1,732	107	1,839	5.8%
1992	356	22	378	5.8%
1993	1,531	122	1,653	7.4%
1994	984	19	1,003	1.9%
CHINOOK				
1989	271	89	360	27.2%
1990	329	110	439	25.1%
1991	522	16	538	3.0%
1992	225	85	310	27.4%
1993	412	70	482	14.5%
1994	688	23	711	3.2%

Table G-8. Summary of Fall Chinook and Coho Salmon Escapement Data, Umatilla River Basin, 1994.

REDD #	RIVER MILE	SPECIES	AREA DESCRIPTION	DATE OBSERVED	FISH ON REDDS		FISH HOLDING		FISH SAMPLED	
					FALL CHINOOK	COHO	FALL CHINOOK	COHO	FALL CHINOOK	COHO
FRED GRAY'S BRIDGE TO SQUAW CREEK CONFLUENCE, Surveyed November 21										
1	78.8	Chin	250 yards below Meacham Creek confluence	11/21	5	0	0	0	1	0
2	77.4	Chin	200 yards below Gibbon RR siding	11/21						
3	77.4	Chin	200 yards below Gibbon RR siding	11/21						
SQUAW CREEK TO THORNHOLLOW BRIDGE, Surveyed November 21										
			No redds observed in area		0	0	0	0	1	0
THORNHOLLOW BRIDGE TO LOUIE DICK'S FENCE, Surveyed November 18										
4	73.1	Chin	.4 miles below Thornhollow bridge	11/18	19	2	0	0	0	0
5	72.8	Coho	.7 miles below Thornhollow bridge	11/18						
6	72.7	Chin	.8 miles below Thornhollow bridge	11/18						
7	72.7	Chin	.8 miles below Thornhollow bridge	11/18						
8	72.7	Chin	.8 miles below Thornhollow bridge	11/18						
9	72.7	Chin	.8 miles below Thornhollow bridge	11/18						
10	71.7	Chin	Highway - RR crossing	11/18						
11	71.7	Chin	Highway - RR crossing	11/18						
12	71.7	Chin	200 feet below Highway - RR crossing	11/18						
13	71.3	Chin	.2 miles below Thornhollow RR bridge	11/18						
14	71.2	Chin	.3 miles below Thornhollow RR bridge	11/18						
15	71.2	Chin	.3 miles below Thornhollow RR bridge	11/18						
16	71.0	Chin	Behind Darryl's house	11/18						
17	70.7	Chin	40 yards below lower Thornhollow release site (LTRS)	11/18						
18	70.6	Chin	150 yards below LTRS	11/18						
19	70.6	Chin	150 yards below LTRS	11/18						

Table G-8. Continued

Redd #	River Mile	Species	Area Description	Date Observed	Fall Chinook on Reds	Coho on Redds	Fall Chinook Holding	Coho Holding	Fall Chinook Sampled	Coho Sampled
20	70.6	Chin	150 yards below LTRS	11/18						
21	70.3	Chin	.3 miles above Louie Dick's fence	11/18						
22	70.3	Chin	.3 miles above Louie Dick's fence	11/18						
23	70.2	Chin	.2 miles above Louie Dick's fence above finish cover	11/18						
24	70.1	Chin	100 yards above Louie Dick's fence	11/18						
LOUIE DICK'S FENCE TO CAYUSE RR BRIDGE, Surveyed November 14, 29										
25	69.5	Chin	.5 miles below Louie Dick's fence	11/14	3	2	0	8	4	0
26	69.5	Chin	.5 miles below Louie Dick's fence	11/14						
27	69.3	Chin	.75 miles below Louie Dick's fence	11/14						
28	69.0	Unknw	1.0 miles below Louie Dick's fence	11/14						
29	69.0	Unknw	1.0 miles below Louie Dick's fence	11/29						
30	67.5	Coho	50 yards below Cayuse bridge	11/14						
31	67.4	Unknw	.1 miles below Cayuse bridge	11/14						
32	66.5	Coho	1 mile below Cayuse bridge	11/14						
CAYUSE RR BRIDGE TO MINTHORN SPRINGS, Surveyed November 14, 29										
33	66.6	Unknw	.4 miles below Cayuse RR bridge	11/29	9	6	1	0	2	2
34	66.6	Coho	.4 miles below Cayuse RR bridge	11/29						
35	66.6	Coho	.4 miles below Cayuse RR bridge	11/14						
36	66.6	Unknw	.4 miles below Cayuse RR bridge	11/14						
37	66.5	Coho	.5 miles below Cayuse RR bridge	11/14						
38	66.3	Chin	.7 miles below Cayuse RR bridge	11/14						
39	66.3	Unknw	.7 miles below Cayuse RR bridge	11/14						
40	65.0	Chin	2.0 miles below Cayuse RR bridge	11/14						
41	65.0	Chin	2.0 miles below Cayuse RR bridge	11/29						

Table G-8. Continued

Redd #	River Mile	Species	Area Description	Date Observed	Fall Chinook on Redds	Coho on Redds	Fall Chinook Holding	Coho Holding	Fall Chinook Sampled	Coho Sampled
42	64.7	Coho	Anabranch above Minthorn Springs	11/29						
43	64.7	Chin	Anabranch above Minthorn Springs	11/29						
44	64.7	Chin	Anabranch above Minthorn Springs	11/14						
45	64.6	Chin	Mainstem - just downstream	11/14						
46	64.6	Chin	Mainstem - just downstream	11/14						
47	64.6	Chin	Mainstem - just downstream	11/14						
MINTHORN SPRINGS TO MISSION HOLES, Surveyed November 16, 28										
48	64.5	Coho	Minthorn Springs Creek - 50 yards below facility	11/16	36	7	5	0	17	7
49	64.5	Coho	Minthorn Springs Creek - 125 yards above facility	11/16						
50	64.5	Coho	Minthorn Springs Creek - 50 yards above mouth	11/16						
51	64.5	Chin	Minthorn Mainstem	11/16						
52	64.4	Chin	100 yards below Minthorn Springs Creek	11/16						
53	64.4	Chin	100 yards below Minthorn Springs Creek	11/16						
54	64.4	Chin	175 yards below Minthorn Springs Creek	11/16						
55	64.3	Chin	250 yards below Minthorn Springs Creek	11/28						
56	64.3	Chin	250 yards below Minthorn Springs Creek	11/16						
57	64.3	Chin	300 yards below Minthorn Springs Creek	11/16						
58	64.3	Chin	300 yards below Minthorn Springs Creek	11/16						
59	64.3	Chin	320 yards below Minthorn Springs Creek	11/28						
60	64.3	Chin	360 yards below Minthorn Springs Creek	11/16						
61	64.3	Chin	360 yards below Minthorn Springs Creek	11/16						
62	64.3	Chin	360 yards below Minthorn Springs Creek	11/16						
63	64.3	Chin	360 yards below Minthorn Springs Creek	11/16						
64	64.3	Chin	360 yards below Minthorn Springs Creek	11/16						

Table G-8. Continued

Redd #	River Mile	Species	Area Description	Date Observed	Fall Chinook on Redds	Coho on Redds	Fall Chinook Holding	Coho Holding	Fall Chinook Sampled	Coho Sampled
65	64.1	Chin	600 yards below Minthorn Springs Creek	11/16						
66	64.0	Chin	750 yards below Minthorn Springs Creek	11/16						
67	63.9	Chin	1000 yards below Minthorn Springs Creek	11/28						
68	63.9	Coho	1000 yards below Minthorn Springs Creek	11/16						
69	60.5	Chin	440 yards above Mission swim hole access	11/28						
70	60.3	Chin	225 yards above Mission swim hole access	11/28						
71	60.3	Chin	200 yards above Mission swim hole access	11/16						
72	60.3	Chin	200 yards above Mission swim hole access	11/16						
73	60.3	Chin	200 yards above Mission swim hole access	11/16						
74	60.3	Chin	200 yards above Mission swim hole access	11/16						
75	60.3	Chin	200 yards above Mission swim hole access	11/16						
76	60.3	Chin	200 yards above Mission swim hole access	11/16						
77	60.3	Chin	200 yards above Mission swim hole access	11/16						
78	60.3	Chin	200 yards above Mission swim hole access	11/16						
79	60.3	Chin	167 yards above Mission swim hole access	11/16						
80	60.3	Chin	167 yards above Mission swim hole access	11/16						
81	60.3	Chin	100 yards above Mission swim hole access	11/16						
MISSION HOLES TO BEDROCK CORNER, Surveyed November 17										
82	60.2	Chin	50 feet above Mission swim hole access	11/16						
83	60.2	Chin	Mission swim hole access (SHA)	11/17	11	1	1	0	0	2
84	60.1	Coho	150 yards below SHA	11/17						
85	60.1	Chin	155 yards below SHA	11/17						
86	60.1	Chin	155 yards below SHA	11/17						
87	59.8	Chin	.4 miles below SHA	11/17						

Table G-8. Continued

Redd #	River Mile	Species	Area Description	Date Observed	Fall Chinook on Redds	Coho on Redds	Fall Chinook Holding	Coho Holding	Fall Chinook Sampled	Coho Sampled
88	59.8	Chin	.4 miles below SHA	11/17						
89	59.8	Coho	.4 miles below SHA	11/17						
90	59.8	Chin	.4 miles below SHA	11/17						
91	59.8	Chin	.4 miles below SHA	11/17						
92	59.8	Chin	.4 miles below SHA	11/17						
93	59.7	Chin	.5 miles below SHA	11/17						
94	59.7	Chin	.5 miles below SHA	11/17						
95	59.7	Chin	125 yards above finish	11/17						
96	59.7	Chin	115 yards above finish	11/17						
MCKAY DAM TO UMATILLA CONFLUENCE, Surveyed November 1										
97	3.8	Coho	Above Carl Scheeler's house	11/1	2	3	0	2	2	6
98	3.8	Chin	Above Carl Scheeler's house	11/1						
99	2.0	Coho	Mckay Park lower road to confluence	11/1						
100	2.0	Coho	McKay Park lower road to confluence	11/1						
101	2.0	Coho	McKay Park lower road to confluence	11/1						
102	2.0	Coho	McKay Park lower road to confluence	11/1						
103	2.0	Coho	McKay Park lower road to confluence	11/1						
104	2.0	Coho	McKay Park lower road to confluence	11/1						
105	2.0	Coho	McKay Park lower road to confluence	11/1						
BARNHART RELEASE SITE TO 3.7 MILES UPSTREAM, Surveyed November 22, December 7										
106	45.5	Chin	RM 45.5	11/22	5	0	0	0	12	4
107	43.5	Chin	200 yards below Bedrock bridge	11/22						
108	42.0	Chin	.25 miles above Barnhart	12/7						

Table G-8. Continued

Redd #	River Mile	Species	Area Description	Date Observed	Fall Chinook on Redds	Coho on Redds	Fall Chinook Holding	Coho Holding	Fall Chinook Sampled	Coho Sampled
BARNHART RELEASE SITE TO 3.0 MILES DOWNSTREAM, Surveyed November 22, December 8 No redds observed										
3.0 MILES BELOW BARNHART TO STANFIELD JUVENILE RETURN., Surveyed December 12										
109	36.6	Chin	650 yards below Yokum Bridge	12/12	0	0	0	0	4	3
STANFIELD JUVENILE BYPASS RETURN TO ECHO BRIDGE, Surveyed November 23, December 14										
110	31.6	Coho	.8 miles below Stanfield Return	12/14	0	1	0	0	1	7
111	28.1	Coho	200 yards below Cold Springs Diversion	11/23						
112	27.4	Coho	300 yards above Westland	11/23						

Table G-9. Fall Chinook and Coho Salmon Escapement Surveys, 1989-1994

YEAR	MILES SURVEYED	REDDS	OBSERVED LIVE FISH				RECOVERED CARCASSES			
			CHF	COHO	UNKNOWN	TOTAL	CHF	COHO	UNKNOWN	SUM
ABOVE THREE MILE FALLS DAM										
1989	32.5	92	5	30	0	35	20	37	10	67
1990	42.8	50	19	3	11	33	12	6	1	19
1991	29.0	18	12	15	1	28	5	11	1	17
1992	9.0	12	0	11	3	14	2	8	1	11
1993	42.0	44	0	12	0	12	1	14	0	15
1994	42.3	112	97	33	0	130	49	41	0	90
BELOW THREE MILE FALLS DAM										
1989	2.5	-	8	4	15	27	92	52	17	161
1990	2.5	-	15	9	11	35	120	5	8	133
1991	2.5	-	16	68	0	84	16	107	1	124
1992	2.5	-	50	19	0	69	88	22	0	110
1993	2.5	-	6	23	0	29	50	122	0	172
1994	2.5	-	13	13	0	26	25	19	0	44

Table G-10. Average Fecundity of Salmonids Returning to the Umatilla River, 1990-1995.

SPECIES	STOCK	BROOD YEAR	FECUNDITY	MEAN FECUNDITY
Steelhead	Umatilla	1990	5870	5669
Steelhead	Umatilla	1991	6412	
Steelhead	Umatilla	1992	5545	
Steelhead	Umatilla	1993	5435	
Steelhead	Umatilla	1994	4884	
Steelhead	Umatilla	1995	5870	
Spring Chinook	Carson	1991	4387	4376
Spring Chinook	Carson	1992	3991	
Spring Chinook	Carson	1993	4653	
Spring Chinook	Carson	1994	4328	
Spring Chinook	Carson	1995	4519	
Fall Chinook	Upriver Brights	1991	3783	3735
Fall Chinook	Upriver Brights	1992	3373	
Fall Chinook	Upriver Brights	1993	4050	
Coho	Tanner Creek	1993	2356	2356
Coho	Tanner Creek	1995	not available	

Table G-11. Spring Chinook Salmon Escapement Data Umatilla River, 1995.

MEHP	FL	SCALES	SEX	AREA CODE	AREA SAMPLED	HATCHERY/BROOD	TAG CODE	MARKS	SPAWNING STATUS	DATE	REMARKS:
820		yes	M	01	NF-old good area log jam				partial	8/21/95	Dead 2 days-upper caudal punch
770		yes	M	03	NF Index Area				partial	8/28/95	Dead 1 week+
780	955	yes	M	04	Corporation				partial	08/14/95	Dead 1 day
455		no	M	12	40 feet above Fred Gray's Bridge			LV	Partial	9/18/95	
645	810	yes	M	12	RST to Meacham Con.			RV	Partial	9/13/95	
670	860	yes	M	15	1.3 miles below Squaw Creek			RV	Partial	9/18/95	Dead 2 days
625	800	yes	M	15	1.0 miles below Squaw Creek			RV	Partial	9/18/95	Dead 1 day
615	820	yes	M	16	Wither's Pool			RV	Partial	9/13/95	
480		no	M	09	Corner above Dubalski's			LV	Partial	9/14/95	
460	565	no	M	12	RST to Meacham Con.			LV	Partial	9/13/95	
405		no	J	09	Dubalski's Dam			LV	Partial	9/14/95	
840	1090	yes	M	12	Fred Gray's Trap				Partial	9/11/95	Dead 1 day
440	550	no	J	05	Big Braid			LV	Partial	9/1/95	Sacrificed
590		yes	F	17	80 feet below Thornhollow Bridge			RV	PM	7/25/95	Dead 1+ week
635	780	no	F	11	Lower Emmit Williams			RV	PM	9/14/95	Poached-Riped open
660	820	yes	F	06	.1 miles above Bar M			RV	PM	7/31/95	Bad gills- dead 2 days
635	780	yes	F	13	75 yards below Meacham Con			RV	PM	8/23/95	Dead 2 days- good gills
675	850	no	M	11	200 yards above Emitt Williams			RV	PM	9/14/95	Dead 1 day
655	815	no	F	12	100 yards below Fred Gray's Outlet			RV	PM	9/18/95	Bad Gills
650		yes	F	14	Gibbon RR Siding			RV?	PM	8/30/95	Dead 4 days-bad gills-poor RV
220		no	M	13	just below Meacham Con.			RV	PM	7/05/95	Dead one day
660		yes	M	10	London Bridge			RV	PM	8/01/95	Dead 1+ weeks
640	790	yes	M	14	Gibbon RR Siding			RV	PM	7/27/95	Bad gills- dead 3+ days
715	915	no	M	14	150 yards below New House			RV	PM	9/18/95	
605	740	yes	F	13	250 yards below Meacham Con.			RV	PM	8/15/95	Dead 4 days
585		no	F	15	.75 miles below Squaw Creek			RV	PM	8/18/95	Dead 1 week+,lost scale envelope at Wither's
680		yes	F	16	150 yards above Thornhollow Bridge			RV	PM	6/14/95	Heavy fungus on head- many deep head cuts from jumping
615	740	yes	F	15	1.0 miles below Squaw Creek			??	PM	9/13/95	
440	550	no	M	12	RST to Meacham Con.			LV	PM	9/13/95	Dead 1 day
500	635	no	M	13	Meacham Con to Squaw Creek			LV	PM	9/13/95	
395	490	no	M	12	250 yards below RST			LV	PM	9/13/95	
465	580	no	J	13	Old Meacham Con.			LV	PM	9/7/95	Died today- bad gills
475	610	no	M	12	250 yards below RST			LV	PM	9/13/95	
510	620	yes	M	15	Below split channel merge-below Squaw			LV	PM	9/7/95	Very old mort-Radio 7-23
415	520	no	J	13	Gibbon RR Siding			LV	PM	9/12/95	Dead several days- no scales
620	780	yes	F	14	150 yards below new house			RV	PM	8/23/95	Died today- fungused gills- green color on skeins and liver
655		yes	F	14	Gibbon RR siding			RV	PM	6/27/95	Dead one week+ couldn't tell cause
840		yes	M	12	First corner below RG Bridge			NM?	PM	7/27/95	Possible poor RV clip-dead 1 week+
460	570	no	J	13	Gibbon RR Siding			LV	PM	9/12/95	Dead several days- no scales
705	890	yes	M	14	Gibbon RR Siding			RV	PM	9/7/95	Dead 2 days- old shaker injury
655	780	yes	F	15	Wither's			RV	PM	9/7/95	
660	815	yes	F	13	Gibbon RR Siding			RV	PM	8/23/95	Dead 2-3 days- gills good-fungus patches on side(2)
?		no	M	13	just below Meacham Con.			?	PM	7/05/95	poached mort??only gut track present
460		no	J	05	Big Braid			LV	PM	9/8/95	Dead 5 days
790	1010	yes	M	03	.5 miles above NF Mouth				PM	8/07/95	Dead 1 day-dorsal+ ventral fungus-radio tagged 13-35
605	885	yes	F	04	100 yards below Forks-Umatilla				PM	7/06/95	A few jump marks on head- 5 days old
745	910	yes	F	12	RST to Meacham Con.				PM	9/13/95	
690	825	yes	F	04	50 yards below NF				PM	8/28/95	
800	980	yes	M	05	Big Braid				PM	9/1/95	Dead 1 week+
435	545	yes	M	12	RST				PM	9/18/95	WILD FISH??
670	810	yes	F	15	Below split channel merge-below Squaw				PM	9/7/95	
	940	yes	F	07	200 yards below Bar M				PM	7/26/95	Habitat survey
710	895	yes	F	07	.2 miles below Bar M				PM	8/08/95	Dead 3 days
800		yes	M	06	Upper Bar M Horse Crossing				PM	8/08/95	Dead 1 week+++
745	925	yes	M	07	.7 miles below Bar M				PM	8/15/95	
785	975	yes	M	05	.5 miles below Umatilla National Forest				PM	8/02/95	Dead 1 week+ Habitat Survey
705		yes	M	05	Braided area below Forks				PM	8/24/95	Very old mort
665	785	yes	F	15	.6 miles below Squaw Creek				PM	8/23/95	Dead 3 days

Table G-11. Continued

MEHP	FL	SCALES	SEX	AREA CODE	AREA SAMPLED	HATCHERY/BROOD	TAG CODE	MARKS	SPAWNING STATUS	DATE	REMARKS:
Adult		no	F	16	Wither's Swim Hole				PM	8/23/95	Trail of eggs moving up bank– animal
660		yes	F	14	75 feet above Squaw Creek Con.				PM	6/13/95	nose about gone, dead 2 days– gill fungus–marks on head behind eye
665	795	yes	F	25	Meacham – RM 3.0			RV	R10	9/21/95	
765		yes	F	04	300 yards below Forks				R10	8/07/95	Dead 2 days
660	780	yes	F	05	Mile 1.2 below Forks				R100	9/1/95	Dead 2 days– Large growth on right side
610		no	F	11	RM 80.3			RV	R100	9/14/95	
670		yes	F	15	.5 miles below Squaw Creek			RV	R12	9/13/95	
650		yes	F	12	Fred Gray's Rotary Trap				R20	9/28/95	
760	890	yes	F	04	.2 miles below Forks				R20	8/21/95	
655		no	F	12	275 yards below Rotary Trap			RV	R20	9/16/95	
610		yes	F	16	Thornhollow Bridge			RV	R30	9/22/95	Radio Tagged
620		no	F	12	RST Fred Gray's			RV	R50	9/13/95	Dead 1 day
810	1030	yes	M	05	115 yards below Big Braid				SO	9/1/95	Dead 2 days
765	1000	yes	M	04	200 yards below Forks				SO	8/24/95	good gills– died today
855	1090	yes	M	04	.2 miles below Forks				SO	8/24/95	
855	1070	yes	M	04	Corporation				SO	08/14/95	Dead 3 days
745		yes	F	03	NF–250 yards below Bear's start				SO	8/28/95	Dead 1 day
670	850	yes	M	08	Just upstream of Larson's Driveway				SO	9/6/95	Dead 1 week+
455	560	yes	J	08	1.5 miles below Bar M			LV	SO	9/14/95	
460	565	yes	J	08	1.9 miles below Bar M			LV	SO	9/14/95	
810	1015	yes	M	04	200 yards below Forks				SO	8/24/95	good gills– died three days ago
440	550	yes	M	16	2.1 miles below Squaw Creek			LV	SO	9/13/95	
795		yes	M	03	NF– .4 miles above mouth				SO	8/21/95	dead 4 days
665	840	yes	F	05	2.0 miles below NF				SO	9/12/95	just below Big Braid
805	870	yes	F	04	300 yards below NF				SO	8/28/95	
480	570	no	M	11	Lower Emmit Williams			LV	SO	9/14/95	
435		no	J	03	NF–250 yards below Bear's start			LV	SO	8/28/95	Near SO female→ dead several days
710		yes	F	04	25 yards below 2nd habitat structure below Forks				SO	9/1/95	Dead 1 day
710		yes	F	12	RST to Meacham Con.				SO	9/13/95	
475	575	no	F	05	Big Braid			LV	SO	9/6/95	Dead 2 days
780		yes	F	01	.2 miles below Coyote Creek				SO	8/28/95	Dead 1 day
605	745	yes	F	07	Below Bar M				SO	9/14/95	
770		yes	F	02	Mile 1.5 below Coyote Creek				SO	9/5/95	Sacrificed– last day of life
		no	M	17	100 yards below Thornhollw Bridge				SO	9/28/95	no scale envelope
800	1020	yes	M	05	Big Braid				SO	9/1/95	Sacrificed
640		yes	F	03	500 yards below Bear's start			RV	SO	8/28/95	Dead 1 day
670		yes	F	04	Below first habitat structure below Forks			RV	SO	9/5/95	Dead 2 days
690	890	no	M	12	50 yards below Outlet Fred Gray's			RV	SO	9/18/95	
695	880	no	M	12	Outlet Fred Gray's			RV	SO	9/18/95	
670	845	yes	M	12	Rotary Trap			RV	SO	9/20/95	
640	800	no	M	12	50 yards below RST			RV	SO	9/18/95	Shaker
690	870	yes	M	24	Meacham Creek–RR Bridge below Bon			RV	SO	9/19/95	
630	770	no	M	05	Mile 1.7BF			RV	SO	9/1/95	Dead 3 days
650	800	no	F	14	New House			RV	SO	9/18/95	
675	780	yes	F	15	Wither's			RV	SO	9/18/95	
500	555	yes	M	04	.2 miles below Forks			RV	SO	8/24/95	
615	745	yes	F	15	1.5 miles below Squaw Creek			RV	SO	9/13/95	
610		no	F	29	Meacham Creek– mile 6.1			RV	SO	9/19/95	Dead 5 days
665	810	yes	F	05	2.0 miles below NF			RV	SO	9/12/95	just below Big Braid
810	1050	yes	M	05	Big Braid				SO	9/8/95	Dead 1 week+
745	940	yes	M	05	Big Braid				SO	9/8/95	Dead 2 days
665	820	yes	F	04	400 yards below NF				SO	8/28/95	
775	970	yes	M	01	NF– good old area				SO	8/28/95	Dead 2 days
810	1030	yes	M	04	Corner below 3rd habitat structure below Forks				SO	9/1/95	Dead 2 days
685	720	yes	M	07	.1 miles below Bar M			RV	SO	8/31/95	
705	900	yes	M	04	200 yards below Forks				SO	9/1/95	Dead 2 days– Tail punch 1" in
790		yes	M	08	Clark's Bridge				SO	9/6/95	Dead 5 days
615	785	yes	M	08	1.5 miles below Bar M			RV	SO	9/14/95	

Table G-11. Continued

MEHP	FL	SCALES	SEX	AREA CODE	AREA SAMPLED	HATCHERY/BROOD	TAG CODE	MARKS	SPAWNING STATUS	DATE	REMARKS
650	775	yes	F	11	Corn Cob County			RV	SO	9/20/95	
600		yes	F	03	200 yards below Bear's start			RV	SO	9/5/95	Dead 3 days
625	790	no	M	05	Tin Shed– mile2.0 BF			RV	SO	9/8/95	Dead 1 week–no scales
750		no	F	13	50 yards below old Meacham Con.			RV	SO	9/18/95	
615	725	yes	F	13	Gibbon Store			RV	SO	9/27/95	
605	715	yes	F	32	Meacham Creek– Duncan Bridge			RV	SO	9/27/95	
645		no	F	10	40 yards below Footbridge			RV	SO	9/14/95	
660		no	F	10	London Bridge			RV	SO	9/14/95	
665		yes	F	11	Emmitt Williams			RV	SO	9/20/95	
645		no	F	14	200 yards above Squaw Creek Con.			RV	SO	9/13/95	
625	770	no	F	12	100 yards above RST			RV	SO	9/18/95	
605	770	no	M	05	Mile 1.9 BF			RV	SO	9/8/95	Died today–no scales
660	830	yes	M	15	Split channel merge below Squaw Creek			RV	SO	9/7/95	
660	840	yes	M	05	100 yards below Big Braid			RV	SO	9/8/95	Dead 5 days
605	750	yes	M	16	Thornhollow Bridge			RV	SO	10/02/95	
670	810	yes	F	12	200 yards above Rotary Trap–FG			RV	SO	9/7/95	Dead 1 day–bad gills
700		yes	F	14	225 yards below new house			RV	SO	9/7/95	Dead 3 days
615		yes	F	12	RST			RV	SO	9/18/95	
665		yes	F	05	30 yards below Big Braid			RV	SO	9/8/95	Dead 3 days
640		no	F	10	200 yards below Footbridge			RV	SO?	9/14/95	
670		no	M	12	300 yards below Fred Gray's Outlet				SO?	9/22/95	old mort
660		no	F	11	200 yards below Lower Emmit Williams			RV	SO?	9/14/95	
405		no	J	10	Larson's to Fred Gray's Bridge			??	??	9/14/95	Eatten By Crayfish
685	855	yes	M	15	1.3 miles below Squaw Creek	BON–91	071455	95J2241	PM	9/13/95	
690	840	yes	F	12	300 yards below Fred Gray's Outlet	BON–91	071455	95J2292	PM	9/18/95	
640	795	yes	F	16	Thornhollow Bridge	BON–91	071455	95J2214	PM	9/22/95	
610	740	yes	F	07	.6 miles below Bar M	BON–91	071455	95J2239	R20	8/31/95	
670		yes	F	12	100 feet above Rotary Screw Trap– FG	BON–91	071455	95J2276	R60	9/8/95	
705	835	yes	F	08	1.5 miles below Bar M	BON–91	071455	95J2248	SO	9/14/95	
600		no	M	05	Mile 1.7 BF	BON–91	071455	95J2265	SO	9/8/95	Dead 1 week+ no scales
570	720	no	M	07	.1 miles below Bar M	BON–91	071455	95J2245	SO	9/14/95	AD+RV???
660	795	no	F	11	Lower Emmit Williams	BON–91	071455	95J2234	SO	9/14/95	
680	825	yes	F	05	Big Braid	BON–91	071455	95J2251	SO	9/1/95	Dead 4 days
645	830	yes	M	05	Mile 1.8 BF	BON–91	071455	95J2286	SO	9/8/95	Dead 3 days
680	760	no	F	08	Below Bar M	BON–91	071455	95J2222	??	9/14/95	Ad??
615	790	no	M	13	100 yards above Gibbon RR Siding	BON–91	071455	95J2294	??	9/18/95	
625		no	M	11	RM 80.3	BON–91	071456	95J2237	Partial	9/14/95	
770	845	yes	F	12	200 Yards below Fred Gray's release site	BON–91	071456	95J2201	PM	5/30/95	skin on nose peeled back 2 inches – release mort??
635	800	yes	F	13	Old Meacham Con.	BON–91	071456	95J2202	PM	6/13/95	Died today–dorsal, anal, caudal fungus
625	790	yes	M	12	First corner below RG Bridge	BON–91	071456	95J2207	PM	7/27/95	Dead 5 days
690	830	yes	F	06	Behind Bar M	BON–91	071456	95J2221	PM	8/22/95	Dead 1 week +
660		yes	F	12	Fred Gray's Trap	BON–91	071456	95J2220	SO	9/11/95	Dead 2 days
670	850	yes	M	14	Gibbon RR Siding	BON–91	071456	95J2295	SO	9/18/95	
715	920	yes	M	08	1.0 miles below Bar M	BON–91	071456	95J2247	SO	9/14/95	
625		yes	F	05	Mile 1.2 BF	BON–91	071456	95J2264	SO	9/8/95	Died today
740	900	yes	F	12	250 yards above Meacham Creek Confluence	BON–89–MEACHAM	075440	95J2218	PM	8/09/95	Dead 3 days– very small adipose fin– nothing obvious
615	730	yes	F	12	100 yards above Meacham Creek Con.	UM–91	075740	95J2206	PM	7/05/95	Dead 4 days– lower gill arch and jaw split
675	815	yes	F	15	1.0 miles below Squaw Creek	UM–91	075741	95J2224	PM	8/02/95	Dead 2 days
650	795	yes	M	08	Bar M Barn	UM–91	075741	95J2217	PM	8/08/95	Dead 2 days– .5 of tail rotten
610	750	yes	F	15	1.4 miles below Squaw Creek	UM–91	075741	95J2231	R 3000	9/18/95	Dead 1 day
630	780	yes	M	15	Beaver Farm	UM–91	075741	95J2216	SO	9/20/95	
580		no	F	28	Meacham Creek– mile 5.8	UM–91	075741	95J2296	SO	9/19/95	Dead 4 days
630		yes	F	14	Meacham Con. to Squaw Creek	UM–91	075741	95J2230	SO	9/13/95	
645		no	F	01	200 yards below old good spawning area	UM–91	075742	95J2255	SO	9/5/95	Dead 5 days
640	770	yes	F	08	1.7 miles below Bar M	UM–91	075742	95J2205	SO	9/14/95	
600	725	yes	F	07	Just below Bar M Driveway	UM–91	075742	95J2242	SO	9/14/95	
835	1040	yes	M	04	500 yards below NF	BON–90–MEACHAM	075828	95J2238	SO	8/28/95	
820	1040	yes	M	12	RST to Meacham Con	BON–90–MEACHAM	075830	95J2273	Partial	9/13/95	

Table G-11. Continued

MEHP	FL	SCALES	SEX	AREA CODE	AREA SAMPLED	HATCHERY/BROOD	TAG CODE	MARKS	SPAWNING STATUS	DATE	REMARKS:
705	900	no	M	12	300 yards below Fred Gray's Outlet	BON-90-MEACHAM	075832	95J2293	SO	9/18/95	
680	840	yes	F	15	1.0 miles below Squaw Creek	BON-90-MEACHAM	075837	95J2240	PM	9/13/95	
740	920	yes	M	04	125 yards below Forks	BON-90-MEACHAM	075837	95J2256	SO	9/5/95	Dead 3 days
Adult		no	?	15	.75 miles below Squaw Creek	BON-91-FALL R.	076042	95J2219	PM	8/18/95	Dead 1 week+, only 50% of fish left
630	780	yes	F	05	Big Braid	BON-91-FALL R.	076042	95J2261	PM	9/6/95	Bad Gills
685	855	yes	M	12	Above RST Fred Gray's	BON-91-FALL R.	076042	95J2271	PM	9/13/95	
700	885	yes	M	05	Mile 1.8 BF	BON-91-FALL R.	076042	95J2267	SO	9/8/95	Dead 3 days
625	765	yes	F	05	Tin Shed-mile 2.0 BF	BON-91-FALL R.	076042	95J2254	SO	9/1/95	Dead 2 days
740	920	yes	M	07	.2 miles below Bar M	BON-91-FALL R.	076043	95J2243	SO	9/14/95	
635		yes	F	04	200 yards below Forks	BON-91-FALL R.	076043	95J2283	SO	9/8/95	Dead 1 day
670		yes	F	14	Gibbon RR siding	BON-91-FALL R.	076044	95J2203	PM	8/27/95	Dead one week+ couldn't tell cause-AD area gone
685	835	yes	F	05	Big Braid	BON-91-FALL R.	076044	95J2262	SO	9/8/95	Dead 4 days
680	835	yes	F	15	Top of new channel below Squaw Creek	BON-91-FALL R.	076045	95J2250	PM	8/23/95	Dead 1 day
670	820	yes	F	14	200 yards above Squaw Creek Con.	BON-91-FALL R.	076045	95J2225	PM	9/13/95	
670		no	F	11	RM80.5	BON-91-FALL R.	076045	95J2235	SO	9/14/95	Ad???
680	830	yes	F	12	.25 miles below Fred Gray's Bridge	BON-91-FALL R.	076046	95J2208	PM	8/30/95	Dead 1 week
630		yes	F	12	Above RST Fred Gray's	BON-91-FALL R.	076046	95J2272	R60	9/13/95	Dead 2 days
630	780	yes	M	08	1.5 miles below Bar M	BON-91-FALL R.	076046	95J2249	SO	9/14/95	
640	770	yes	F	07	.5 miles below Bar M	BON-91-FALL R.	076046	95J2244	SO	9/14/95	
655		no	F	12	75 yards above Meacham Con.	BON-91-FALL R.	076046	95J2274	SO	9/13/95	
730	940	yes	M	05	Mile 1.7BF	BON-91-FALL R.	076046	95J2253	SO	9/1/95	Dead 4 days
715		yes	F	02	NF- 1.7 miles above Mouth	BON-91-FALL R.	076046	95J2269	SO	9/12/95	Dead 4 days
675		yes	F	13	200 yards below Old Meacham Con.	BON-91-FALL R.	076047	95J2215	R10	9/22/95	
735		yes	F	02	Mile 1.5 below Coyote	BON-91-FALL R.	076047	95J2210	SO	8/28/95	Dead several days
750	945	no	M	11	Lower Emmit Williams	BON-91-FALL R.	076047	95J2233	SO	9/14/95	
740	915	yes	M	04	1.0 miles below Forks		NT	95J2204	SO	8/21/95	
645	800	yes	F	16	200 yards above Thornhollow Bridge-bad gill		NT	95J2209	PM	8/30/95	Dead 1 day- bad gill
735	890	yes	M	15	Below split channel merge-below Squaw		NT	95J2228	PM	9/7/95	
655	780	yes	F	15	150 yards below Squaw Creek Con.		NT	95J2229	PM	9/7/95	
625		no	F	11	Emmit Williams		NT	95J2232	SO	9/14/95	
660		no	F	09	80 yards above Dubalski's		NT	95J2236	SO??	9/14/95	
630	755	yes	F	07	.6 miles below Bar M		NT	95J2246	SO	9/14/95	
620	750	yes	F	05	100 yards below Big Braid		TL	95J2252	SO	9/1/95	Dead 1 day
690	870	yes	M	07	.4 miles below Bar M		NT	95J2257	PM	9/6/95	Dead 2 weeks+
705	910	yes	M	07	Stage Coach Stop		NT	95J2258	SO	9/6/95	Dead 5 days- small adipose
700	860	yes	F	08	300 yards below Stage Coach Stop		NT	95J2259	SO	9/6/95	Dead 3 days
710	875	yes	M	08	Gulch A-Frame		NT	95J2260	Partial	9/6/95	Dead 4 days
615	780	yes	M	28	Meacham- mile 5.7		NT	95J2268	PM	9/11/95	Dead 2 days-bad gills
595		no	F	13	Gibbon RR Siding		NT	95J2270	PM	9/12/95	Dead 2 weeks+ - no scales
770	960	yes	M	13	300yards below Meacham Con.		NT	95J2275	SO	9/13/95	Dead 4 days
620		yes	F	12	FG Trap		NT	95J2277	R70	9/12/95	Dead 1 day
710	915	yes	M	16	Just above Thornhollow Bridge		NT	95J2286	Partial	9/18/95	Dead 1 day
585		yes	F	12	150 yards above RST		NT	95J2291	R15	9/18/95	Ad??

APPENDIX H
Emigrant Trapping Tables and Figures

Table H-1. Summary of Trap Catch Data from the Barnhart, Tumla and Imeques Traps sites, 1994/95; Expanded Migration Estimates Include Days the Traps were not Operated within the Trapping Dates.

	TRAPS		
	BARNHART (RM 42.2)	**TUMLA (RM 76)**	**IMEQUES (79.5)**
Trapping Dates	03/05/95 to 06/01/95	09/22/94 to 01/13/95	05/05/95 to 06/16/95
Trapping days over total days	87 / 125	63 / 113	43 / 43
Natural Chinook			
Number Captured	247	1,368	102
Number Marked and Released	112	1,207	95
Total Number Recaptured	5	348	10
Average % Recaptured	4.5%	28.9%	10.5%
Expanded Migration Estimate	14,542	11,035	1093
Mean Fork Length (mm)	94.2	93.8	70.9
Number Measured	134	1363	100
Sample Standard Deviation	18.3	8.2	9.8
Average % Containment	87%	72%	85%
Number of containment trials	4	12	5
Natural Rainbow/Steelhead			
Number Captured	105	596	304
Number Marked and Released	52	516	273
Total Number Recaptured	3	47	18
Average % Recaptured	5.7%	9.9%	6.6%
Expanded Migration Estimate	4,789	14,029	7,435
Mean Fork Length (mm)	165	115.5	106
Number Measured	64	596	301
Sample Standard Deviation	33.2	35.2	27.4
Average % Containment	100%	44%	78%
Number of containment trials	2	13	4

CONTINUED ON THE FOLLOWING PAGE

TABLE H-1 CONTINUED	TRAPS		
	BARNHART (RM 42.2)	TUMLA (RM 76)	IMEQUES (RM 79.5)
Natural Coho Captured	5	0	0
Mean Fork Length (mm)	111	94	
Range (mm)	66-139	92-95	
Hatchery Chinook Captured	6,265	41	289
Marked and Released	684	0	263
Recaptured	18	0	44
Average % Recaptured	2.6%		16.7%
Expanded Migration Estimate	626,876		1,728
Mean Fork Length (mm)	140	142	128
Number Measured	445	107	5
Standard Deviation or Range	26.8	29	83-240 (mm)
Hatchery STS Captured	467	0	0
Marked and Released	258	0	0
Recaptured	6		
Average % Recaptured	2.3%		
Expanded Migration Estimate	52,844		
Mean Fork Length (mm)	213		
Number Measured	267		
Sample Standard Deviation	20.1		
Hatchery Coho Captured	16,844	0	0
Marked and Released	3047	0	0
Recaptured	226		
Average % Recaptured	7.4%		
Expanded Migration Estimate	599,000		
Mean Fork Length (mm)	138		
Number Measured	638		
Sample Standard Deviation	10.7		
Bull Trout	0	15	4
Mean Fork Length (mm)		281.7	158.8
Range (mm)		220-395	147-175
Whitefish	0	36	0
Redside Shiner	296	1,065	151
Sucker	63	71	154
Dace	262	1,289	2,653
Sculpin	12	694	63
Squawfish	30	84	26
Chiselmouth	52	8	39
Yellow Perch	1	0	0
Brown Bullhead	2	0	0

Table H-2. Estimated number of adult natural steelhead that would have been produced in the absence of the supplementation project (TMD = Three Mile Falls Dam, * = assuming same survival rates as cohorts, ** = portion of run contributed by each brood year estimated from scale samples).

Return Year	Brood Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
	Total Natural Steelhead Enumerated at TMD	1298	768	1264	2314	3197	2885	3444	2316	2104	1422	724	2247	1297	946	875
	Natural Brood Taken	80	160	161	52	104	69	148	133	160	107	99	237	125	93	86
	Natural Steelhead Less Brood Taken	1281	608	1103	2262	3093	2816	3296	2183	1944	1315	625	2010	1172	853	789
	Total Natural Steelhead Return															
80/81	1298															
81/82	768															
82/83	1264	**														
83/84	2314	879														
84/85	3197	1535	1215													
85/86	2885	404	1385	1096												
86/87	3444		482	1653	1309											
87/88	2316			324	1112	880										
88/89	2104				295	1010	800									
89/90	1422					199	683	540								
90/91	724						101	346	275							
91/92	2247							315	1079	854						
92/93	1297								182	623	493					
93/94	946									132	454					
94/95	875										123					
Total Adult Progeny (Natural Production)		2818	3082	3073	2716	2089	1584	1201	1536	1609	1070					
Adult to Adult Percent Survival		220	507	279	120	68	56	36	70	83	81	Mean, 152% (Adult to Adult Survival)				
Additional Adults Produced Had Brood Not Been Taken for Supplementation (Through 1994/1995 Return) *		176	811	449	62	71 120	39 454	53 162	93 43	133 59	87 32	Total, 2844 (Estimated Natural Adult Steelhead Lost Because of Broodstock Mining)				
Number of Hatchery Steelhead Collected at Three Mile Falls Dam (Through 1994/95 Return).												Total, 3306				

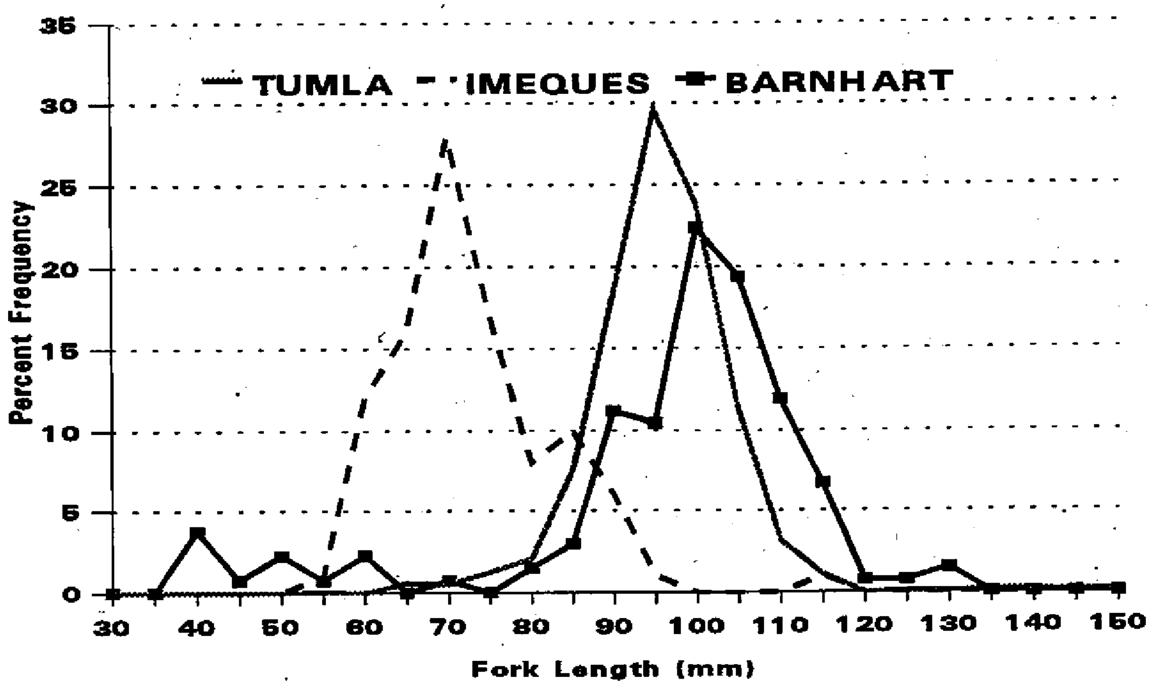


Figure H-1. Length Frequencies of Juvenile Natural Chinook Salmon Captured by the Rotary Screw Traps in the Umatilla River; Tumla Trap (RM 76, n=1363) from September 22, 1994 to January 13, 1995; Imeques Trap (RM 79.5, n=100) from May 5, 1995 to June 16, 1995, and Barnhart Trap (RM 42.2, n=134) from March 5, 1995 to June 1, 1995 (TPCN945L.CH3).

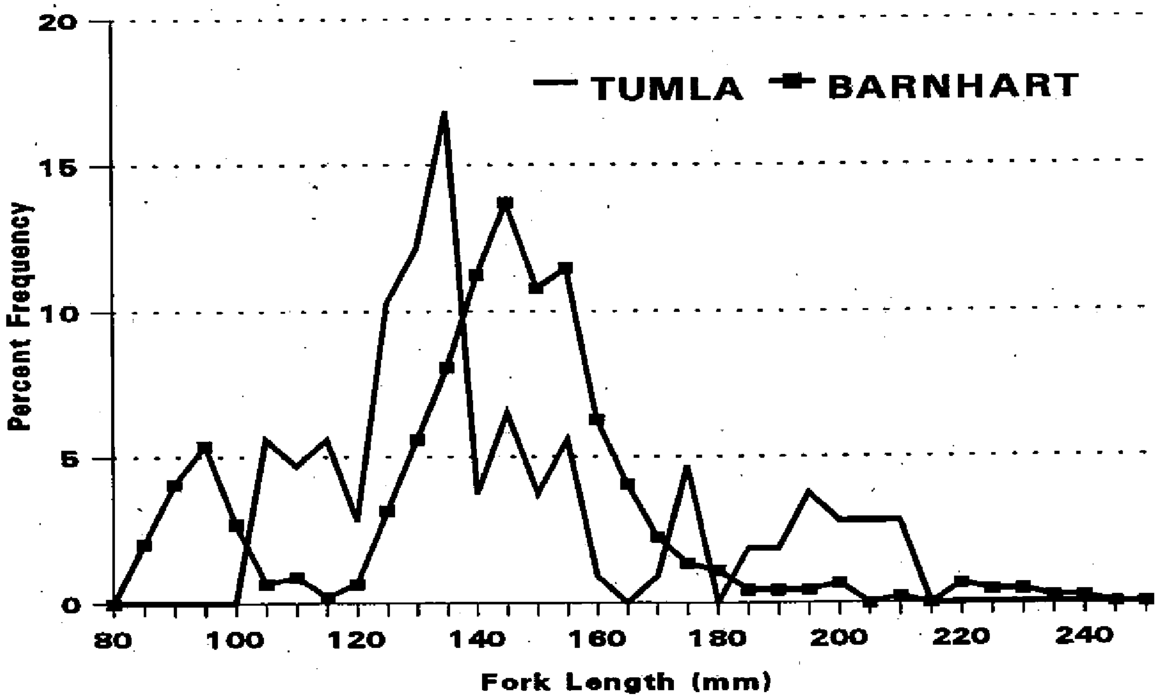


Figure H-2. Length Frequency of Juvenile Hatchery Chinook Salmon Captured by the Rotary Screw Traps in the Umatilla River; Tumla Trap (RM 76, n=107) from September 22, 1994 to January 13, 1995, and Barnhart Trap (RM 42.2, n=445) from March 5, 1995 to June 1, 1995 (TPCH945L.CH3).

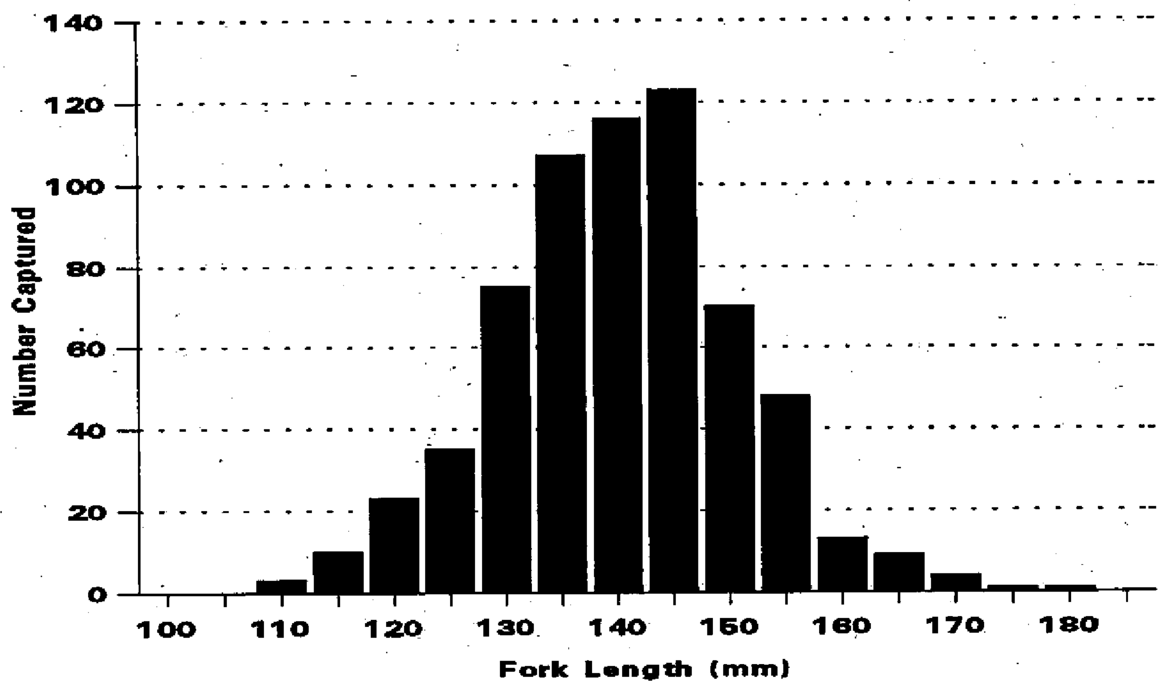


Figure H-3. Length Frequencies of Juvenile Hatchery Coho Salmon Captured by the Rotary Screw Traps in the Umatilla River, Barnhart Trap (RM 42.2, n=638) from March 5, 1995 to June 1, 1995 (TPHH945L.CH3).

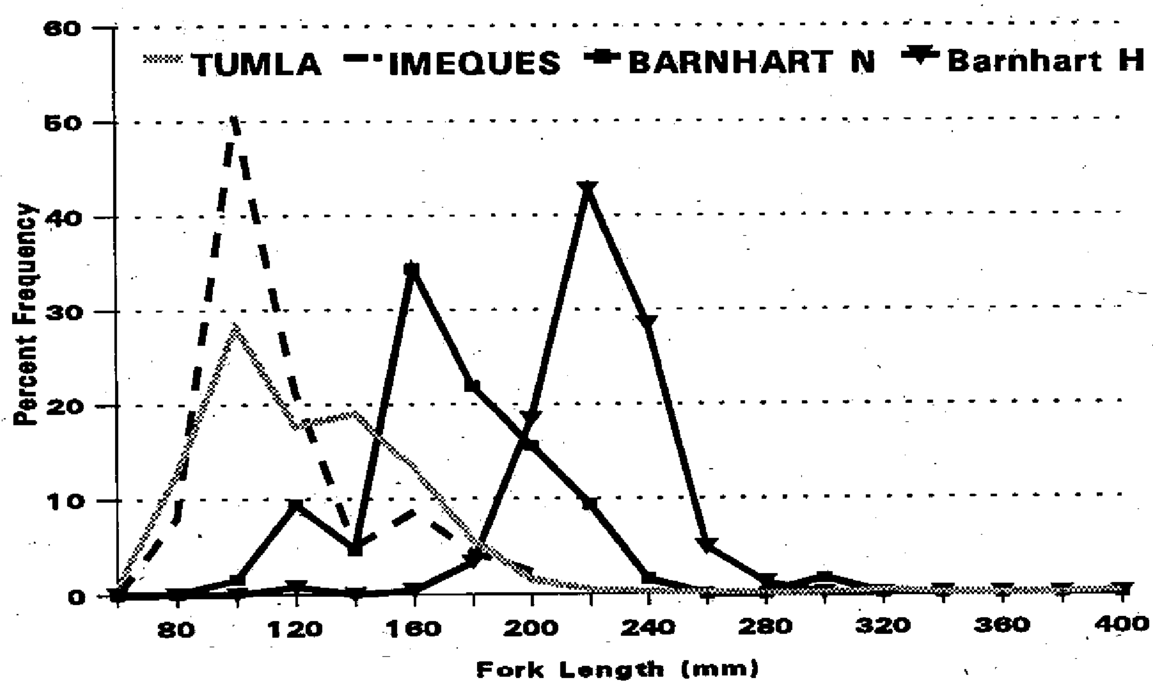


Figure H-4. Length Frequencies of Juvenile Natural and Hatchery Summer Steelhead Captured by the Rotary Screw Traps in the Umatilla River; Tumla Trap (RM 76, n=596) from September 22, 1994 to January 13, 1995; Imeques Trap (RM 79.5, n=301) from May 5, 1995 to June 16, 1995, and Barnhart Trap (RM 42.2, Natural n=64, Hatchery n=267) from March 5, 1995 to June 1, 1995 (TPSN945L.CH3).

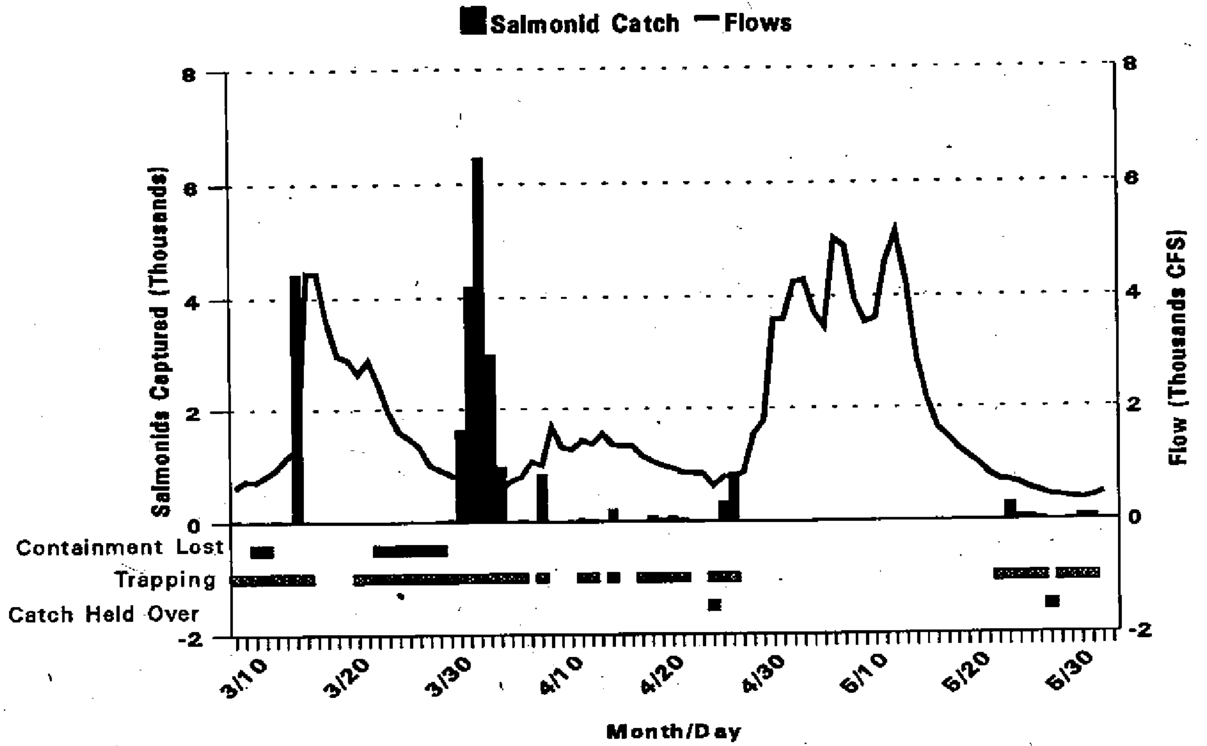


Figure H-5. Barnhart Trap (RM 42.2) from March 5, 1995 to June 1, 1995, Total Salmonid Catch, River Discharge (1000 CFS), Days When Most or All of the Catch Escaped, Days Trap Operated, Days When Trap was Checked but Catch was Held Over to the Next Day (TB945TFC.CH3).

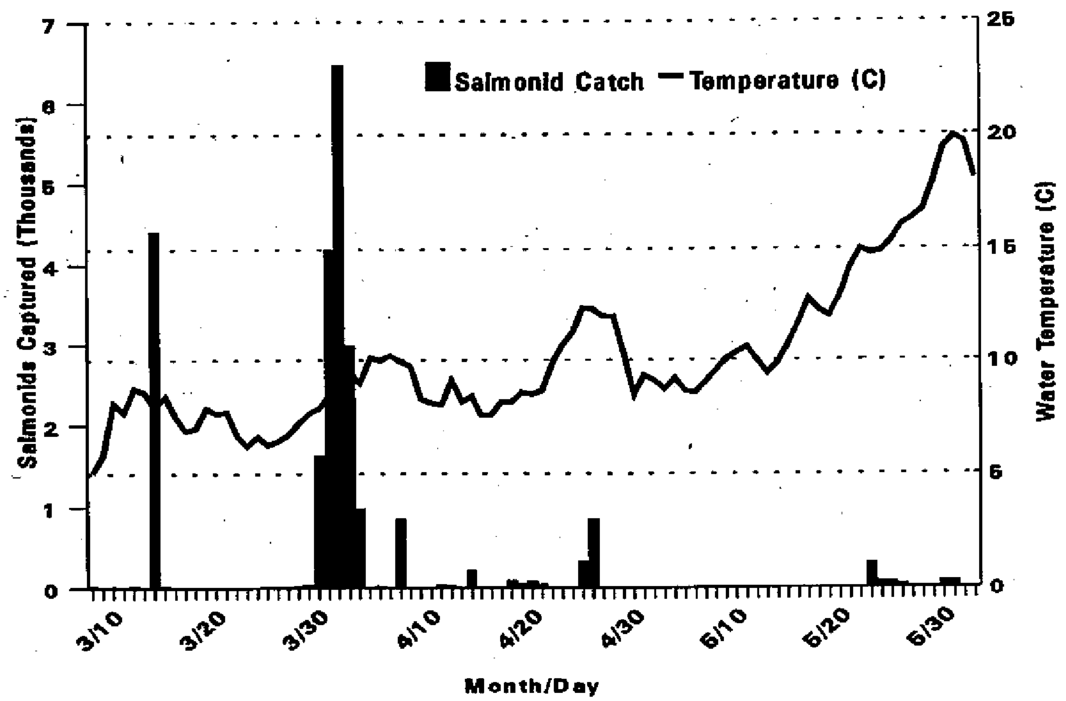


Figure H-6. Barnhart Trap (RM 42.2) from March 5, 1995 to June 1, 1995, Total Salmonid Catch and Water Temperatures (C), (TB945TC2.CH3).

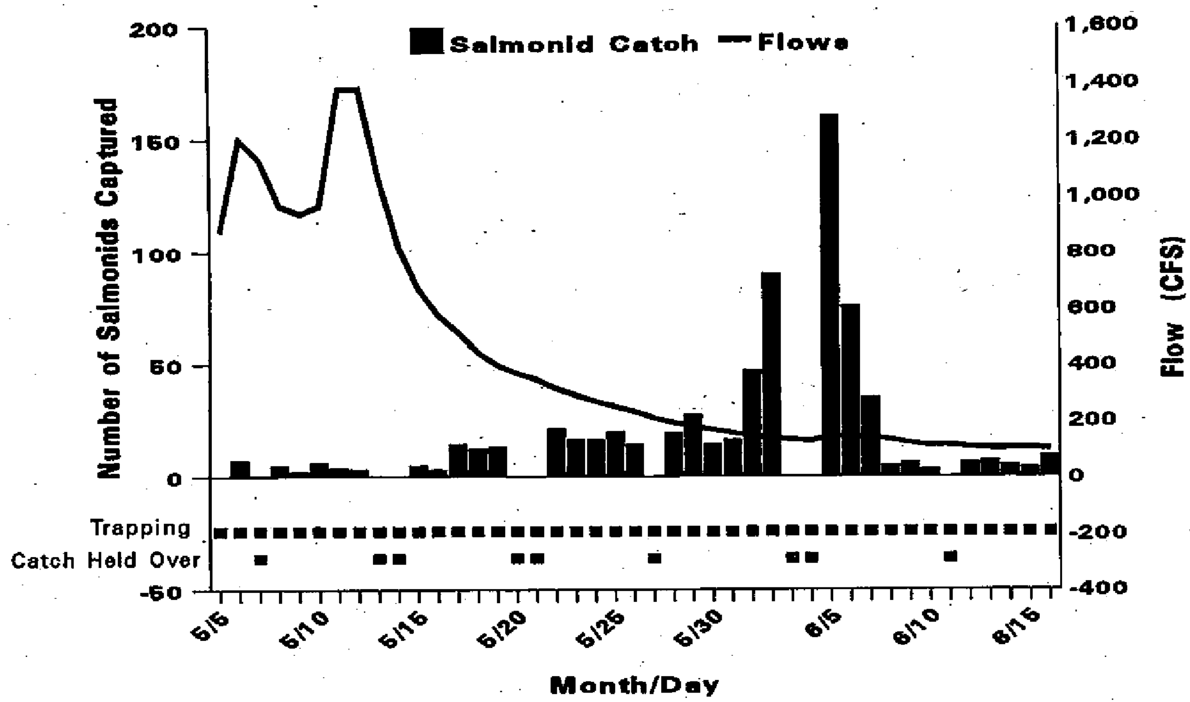


Figure H-7. Imeques Trap (RM 79.5) from May 5, 1995 to June 16, 1995, Total Salmonid Catch, River Discharge (1000 CFS), Days Trap Operated, Days When Trap was Checked but Catch was Held Over to the Next Day (TI945TFC.CH3).

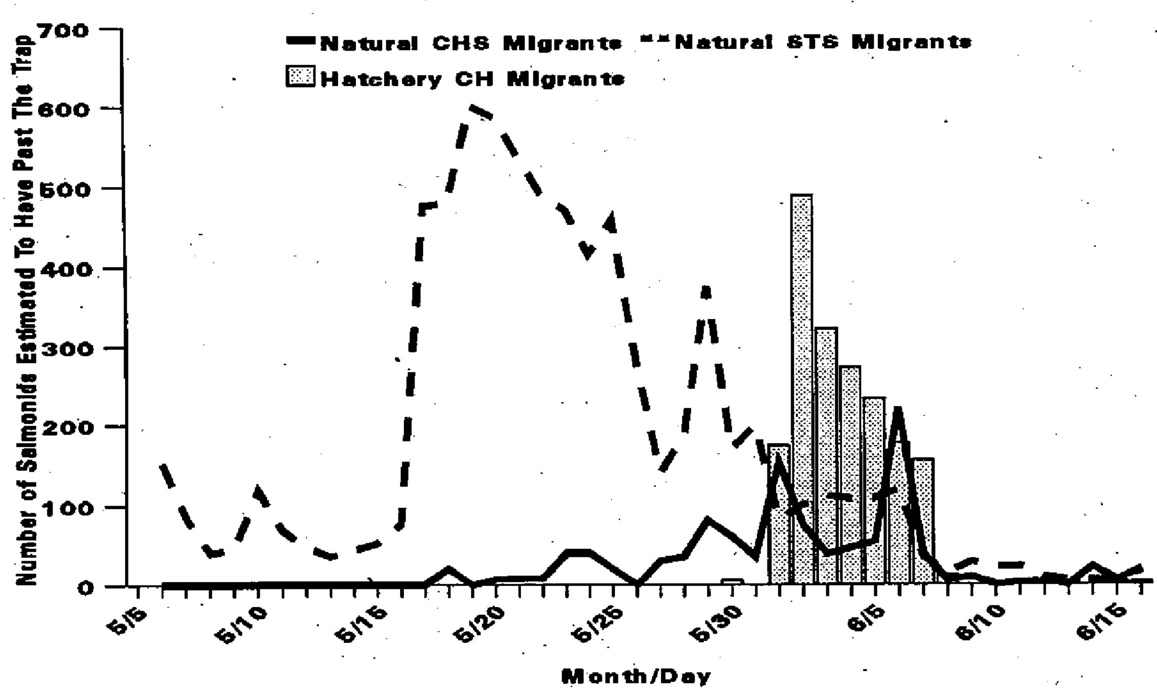


Figure H-8. Imeques Trap (RM 79.5) from May 5, 1995 to June 16, 1995, Estimated Number of Salmonids Migrating Past Trap (CHS = spring chinook; STS = summer steelhead; CH = hatchery spring and/or fall chinook), (TI945EC2.CH3).

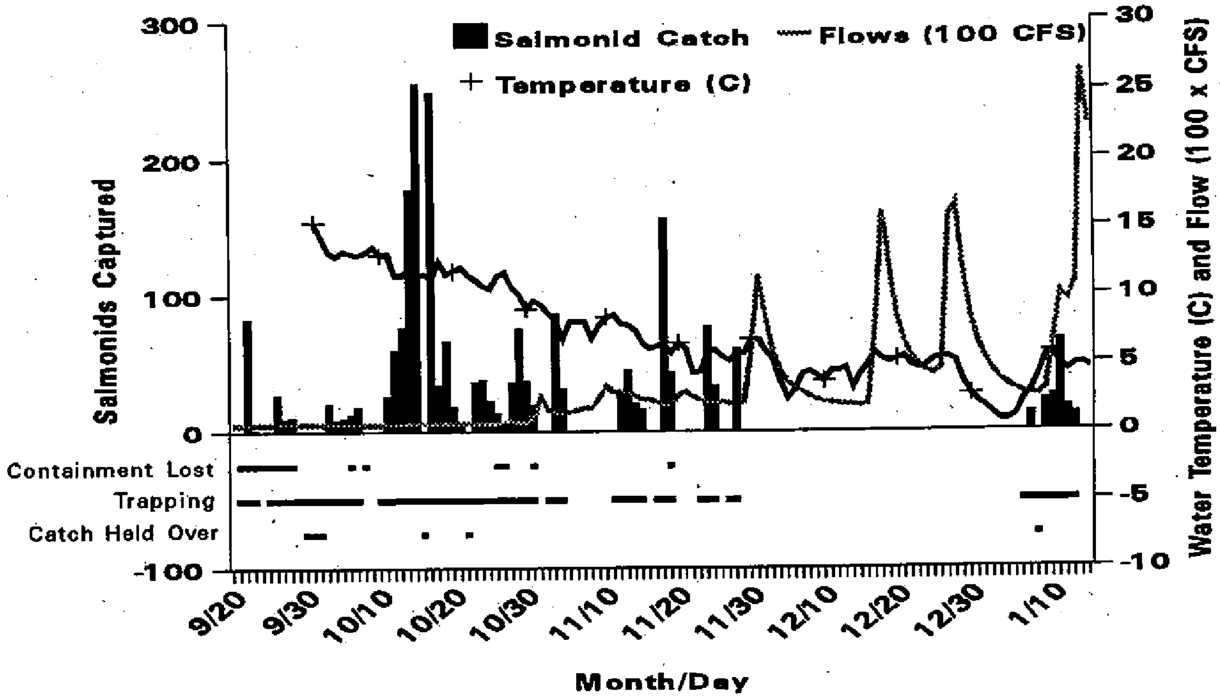


Figure H-9. Tumla Trap (RM 76) from September 22, 1994 to January 13, 1995, Total Salmonid Catch, River Discharge (100 CFS), Water Temperature (C), Days When Most or All of the Catch Escaped, Days Trap Operated, Days When Trap was Checked but Catch was Held Over to the Next Day (TT945TFC.CH3).

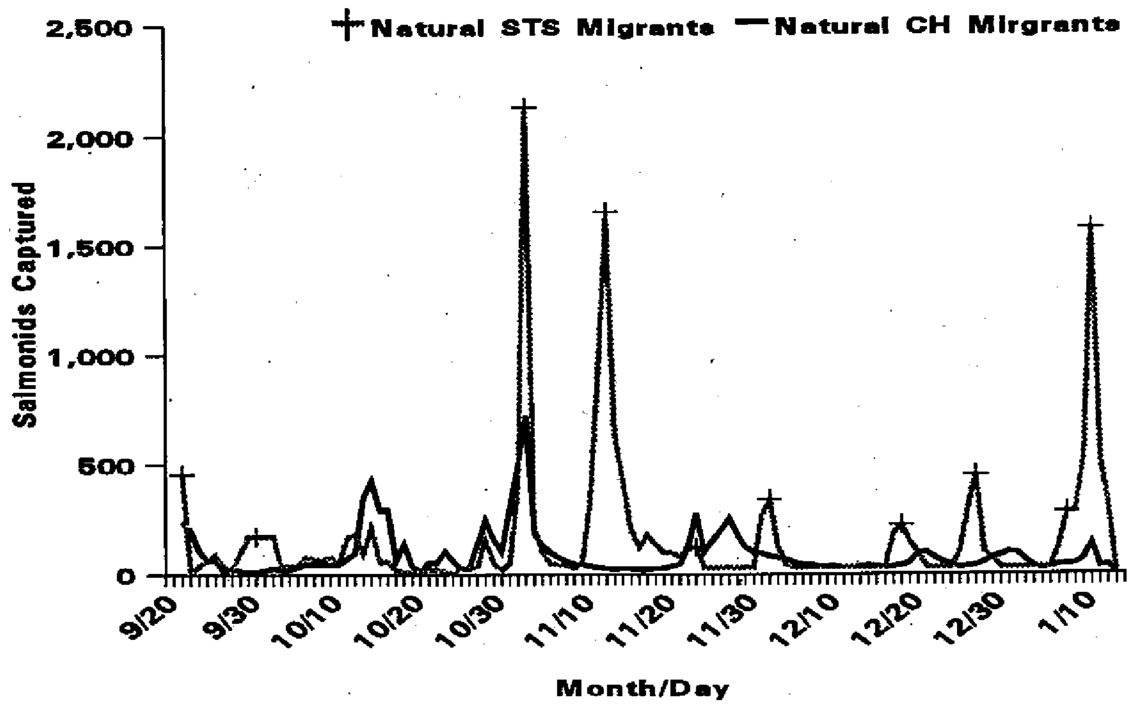


Figure H-10. Tumla Trap (RM 76) from September 22, 1994 to January 13, 1995, Estimated Number of Salmonids Migrating Past Trap (CH = natural chinook; STS = natural summer steelhead; TT945TF2.CH3).

APPENDIX I

Age and Growth Tables

Table I-1. Age Summary by Sex of the Umatilla River Wild Summer Steelhead Escapement in the Umatilla River, 1995.

AGE		1.1	1.2	2.1	2.2	3.1	3.2	Total
FEMALE	n =	0	0	11	9	6	7	33
	% =	0	0	33.3	27.2	18.2	21.2	100
MALE	n =	0	0	8	8	3	4	23
	% =	0	0	34.8	34.8	13.0	17.4	100
TOTAL	n =	0	0	19	17	9	11	56
	% =	0	0	33.9	30.4	16.1	19.6	100

Table I-2. Brood Year of the 1995 Umatilla River Wild Summer Steelhead Escapement.

BROOD YEAR		1991	1990	1989	Total
FEMALE	n =	11	15	7	33
	% =	33.3	45.5	21.2	100
MALE	n =	8	11	4	23
	% =	34.8	47.8	17.4	100
TOTAL	n =	19	26	11	56
	% =	33.9	46.4	19.6	100

Table I-3. Freshwater Age Data of the 1995 Wild Summer Steelhead Escapement in the Umatilla River.

AGE		1	2	3	Total
FEMALE	n =	0	20	13	33
	% =	0	60.6	39.4	100
MALE	n =	0	16	7	23
	% =	0	69.6	30.4	100
TOTAL	n =	0	36	20	56
	% =	0	64.3	35.7	100

Table I-4. Ages Based on Scale Analysis and Expansions Based on Comparisons of Age Versus Fork Length of Juvenile Rainbow/Steelhead Sampled in Various Tributaries of the Umatilla River, 1995.

UMATILLA RIVER, AUGUST 8 - 25, 1995

Age	n=	Range(mm)	Mean(mm)	S.D.	L/F-Age Expansion	Percent
0+	76	36-95	63.6	14.0	1291	68.0
1+	82	92-182	123.7	22.4	509	26.8
2+	30	132-258	186.9	26.8	93	4.9
3+	3	190-240	215.7	20.4	5	.3

MISSION CREEK, SEPTEMBER 5-13, 1995

Age	n=	Range(mm)	Mean(mm)	S.D.	L/F-Age Expansion	Percent
0+	25	56-111	85.1	13.8	116	57.4
1+	25	89-242	178.8	38.0	63	31.2
2+	13	160-290	224.2	34.8	23	11.4

COTTONWOOD CREEK, JULY-6 AUGUST 1,1995

Age	n=	Range(mm)	Mean(mm)	S.D.	L/F-Age Expansion	Percent
0+	12	51-100	70.5	13.5	87	50.9
1+	18	100-188	143.3	21.1	63	36.8
2+	9	140-222	181.2	22.8	20	11.7
3+	1	216			1	.6

MOONSHINE CREEK, SEPTEMBER 18-21, 1995

Age	n=	Range(mm)	Mean(mm)	S.D.	L/F-Age Expansion	Percent
0+	36	48-120	86.7	14.8	258	69.9
1+	33	118-194	158.3	21.1	97	26.3
2+	6	212-240	226.2	8.5	14	3.8

MOONSHINE CREEK, SEPTEMBER 18-21, 1995

Age	n=	Range(mm)	Mean(mm)	S.D.	L/F-Age Expansion	Percent
0+	11	42-65	55.1	7.7	83	26.8
1+	56	83-182	120.9	23.1	195	62.9
2+	11	118-243	175.5	35.7	31	10.0
3+	0					
4+	1	327			1	.3

Table I-5. Bull Trout Biological Data, 1994-1995.

FORK LENGTH	AGE	SEX	AREA CAPTURED	DATE	REMARKS
165	2+	-	RM 79.5-Rotary Screw Trap-(RST)	05/16/95	Live
170	2+	-	RM 88.4-Biological Survey	08/23/95	Live
220	2+	-	RM 89.2-Biological Survey	08/25/95	Live
222	2+	-	RM 79.5 (RST)	09/27/95	Live
233	2+	-	RM 89.2-Biological Survey	08/25/95	Live
245	2+	-	RM 79.5 (RST)	11/02/95	Live
254	2+	-	RM 79.5 (RST)	09/23/95	Live
258	2+	-	RM 79.5 (RST)	11/13/95	Live
268	2+	-	RM 79.5 (RST)	11/10/95	Live
270	2+	Male	RM 2.0-North Fork Umatilla	08/15/94	Hooking Mortality-Spawner
225	3+	-	RM 88.4-Biological Survey	08/25/95	Live
265	3+	-	RM 87.7-Biological Survey	08/22/95	Live
285	3+	-	RM 79.5 (RST)	11/10/95	Live
288	3+	-	RM 79.5 (RST)	10/05/95	Live
290	3+	-	RM 79.5 (RST)	10/23/95	Live
320	3+	-	RM 79.5 (RST)	10/23/95	Live
390	4+	Female	RM 79.5- 25 feet above RST	06/01/94	Lure in throat

APPENDIX J

Table J-1. Summary of Landmarks and their Associated River Miles, Umatilla River Basin.

Location / Landmark	RM	Location / Landmark	RM
Three Mile Falls Dam	3.7	Gibbon Railroad Yard	78.4
Horse Ranch	5	Mouth Of Meacham Creek	79.0
Tree Farm	5.5	Imeques C-mem-ini-kem	79.5
House on Bluff	7.4	Fred Gray's Bridge	80.0
South Park Bridge	8.8	Emmit Williams Place	81.1
Boyd's Return	9	London Bridge	81.4
Boyd's Dam	10.2	Reservation Boundary--Ryan Creek	81.8
Lookinglass Road	11.3	Larson's Driveway	83.1
Maxwell Dam	15.2	Stage Coach Stop House	84.8
Simplot	17	Bar M Driveway	85.9
Stanfield Bridge	23	Bear Creek	86.8
I-84 Bridge	24.2	Old Silver Building	87.1
Dillon Dam	24.6	Corporation Hole	88.5
Echo Bridge	26.3	Umatilla Mainstem Forks	89.5
Westland Dam	27.2	North Fork Umatilla River	0-10
Coldsprings Dam	28.2	Coyote Creek	2.5
Stanfield Dam	32.4	Woodward Creek	5.7
Yoakum	37	South Fork Umatilla River	0-10
Barnhart Bridge	42.2	Buck Creek	0.5
Forth's Diversion	46.9	Thomas Creek	3.3
Mouth of Birch Creek	48.3	Shimmiehorn Creek	4.6
PGG Building	51	Meacham Creek	0-36
ODFW, Receiver Site #4	56	Boston Canyon Creek	2.2
Pendleton Ready Mix	57	Bonifer Acclimation Site	2.3
Mission Bridge	59.5	Line Creek	5.0
Minthorn Springs	64.5	Camp Creek	10.9
Cayuse Railroad Bridge	67.0	Duncan	12.0
Cayuse Highway Bridge	67.5	North Fork Meacham Creek	15.0
Louie Dick's Fence	70.0	East Meacham Creek	18.5
Thornhollow Railroad Bridge	71.0	Butcher Creek	21.5
Badger Corner	71.8	Meacham	30.0
Thornhollow Highway Bridge	73.5	North Fork Meacham Creek	0-9.5
Weathers's Place	74.5	Bear Creek	3.0
Mouth of Squaw Creek	76.7	Pot Creek	5.2

Table J-2. Abbreviations Used in this Paper.

BOR	US Bureau of Reclamation
BPA	Bonneville Power Administration
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CWT	Coded Wire Tags
DEQ	Department of Environmental Quality
MEHP	Mid-eye to Hypural Plate
ODFW	Oregon Department of Fish and Wildlife
RM	River Mile
TMD	Three Mile Dam
UBNPME	Umatilla Basin Natural Production Monitoring and Evaluation Project
UMEOC	Umatilla Monitoring Evaluation and Oversight Committee
USFS	US Forest Service
USGS	US Geological Survey

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