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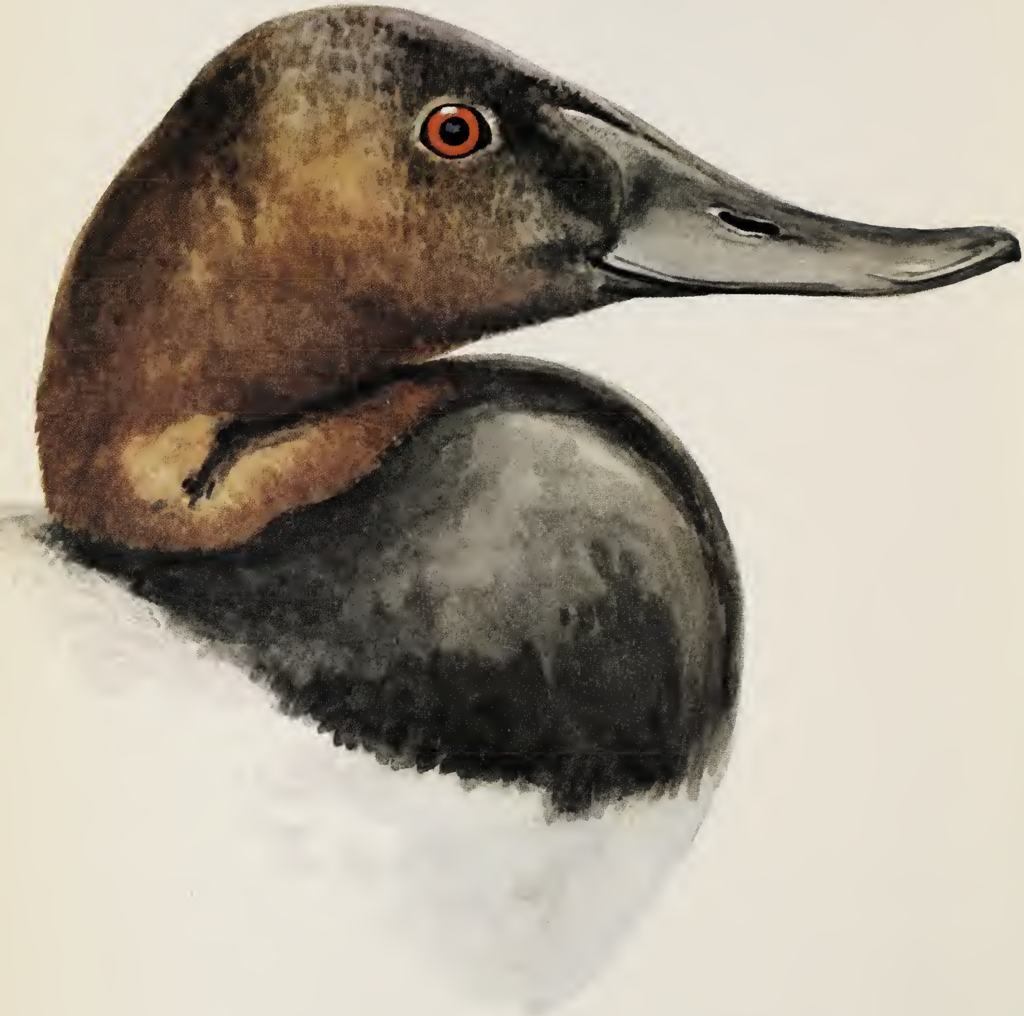

CANVASBACK *(Aythya valisineria)* male.
Watercolor direct from life by George Miksch Sutton.
Ithaca, New York, February 18, 1939.

ALEXANDER WILSON'S "*ANAS VALISINERIA*"

GEORGE MIKSCH SUTTON

GEORGE Ord, in the first new edition of Alexander Wilson's "American Ornithology," an edition published in three volumes in 1828–29 by Collins and Company of New York and by Harrison Hall of Philadelphia, and frequently referred to as "Ord's reprint," has this to say of the Canvasback (*Aythya valisineria*), the handsome North American anatid Wilson had described in 1814: "It is a circumstance calculated to excite our surprise, that the canvas-back, one of the commonest species of our country, a duck which frequents the waters of the Chesapeake in flocks of countless thousands, should yet have been either overlooked by the naturalists of Europe, or confounded with the pochard [Aythya ferina], a species whose characters are so obviously different. But that this is the fact the editor feels well assured, since he has carefully examined every author of repute to which he has had access, and has not been enabled to find any description which will correspond to the subject before us. The species, then, we hope, will stand as Wilson's own; and it is no small addition to the fame of the 'American Ornithology' that it contains the first scientific account of the finest duck that any country can boast of."

I have copied the above from the third volume (p. 33) of the only complete Wilson I have in my library—the Cassell Petter and Galpin printing of Sir William Jardine's edition of "American Ornithology," an edition published in 1832. Ord's resounding—and, I may add, amusingly American—praise may sound effusive to persons who do not know the Canvasback. But to those who have gone after the bird; to those who, half-frozen in a wild snow storm, have matched sharpness of eyesight and wits with it along the east shore of Lake Cayuga, it is, indeed, among the "finest" of waterfowl. With memory's eye I can half-see a flock of "cannies" now as, whirling in with the snow, they inspect the shore, swing out into the storm, disappear momentarily, then, as if convinced that what they had seen was inanimate and safe, whirl in again and alight.

I cannot recall how I happened to obtain the handsome drake whose direct-from-life portrait I painted in water color in my room on the third floor of Fernow Hall, on the Cornell campus, on 18 February 1939. I recall that my model was surprisingly well-behaved. He did not, for all his strength and fierce wildness, even try to bite me. I recall how amazed, how almost stunned, I was by the fiery brilliance of his eye.

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF OKLAHOMA, NORMAN, OKLAHOMA, 5 MARCH 1963

SELECTIVE FEEDING BY WILD DUCKLINGS OF DIFFERENT SPECIES

Nicholas E. Collias and Elsie C. Collias

At the Delta Waterfowl Research Station at the south end of Lake Manitoba, where this work was done, conditions are very favorable for the study of young ducklings. Eggs of various species are collected from the surrounding marshes and hatched in the laboratory incubator. Thus, newly hatched young of wild heritage were available to us for further study. We studied the diet and feeding behavior of Mallard (*Anas platyrhynchos*), Pintail (*A. acuta*), Blue-winged Teal (*A. discors*), American Widgeon (*Mareca americana*), Gadwall (*A. strepera*), Shoveler (*Spatula clypeata*), Wood Duck (*Aix sponsa*), Redhead (*Aythya americana*), Lesser Scaup (*A. affinis*), and Ruddy Duck (*Oxyura jamaicensis*), both in the laboratory and in the field, and attempted to concentrate our effort on the behavior of downy ducklings during their first week after hatching. An abstract of some of our results and conclusions has been published (Collias and Collias, 1958). The general ecology of the Delta area, with special reference to waterfowl, has been described by Hochbaum (1944). For identification of invertebrates in the marsh we relied mainly on the book by Pennak (1953).

Evidence for selective feeding in the field.—We managed to make some general observations on the mode of feeding in the marsh of from two to six broods each, of several of the above-mentioned species of ducklings in their first week. Ruddy Duck and Lesser Scaup broods of this age fed mostly by diving and straining, Blue-winged Teal by pecking and surface-straining, while Redheads and Mallards quite often used all of these methods.

Differences in feeding methods are associated with differences in bill structure, the extremes being represented by the Ruddy Duck and by the Blue-winged Teal and Wood Duck. Ducklings of the first-named species have very broad flat bills with many well-developed ridges for straining, while in the latter two species the bill is relatively narrow, with poorly developed internal ridges. In ducklings that are more general feeders, such as the Mallard, the bill conformation and structure show an intermediate condition from that seen in the specialists for straining or pecking.

Cottam (1939) and Mendall (1949) examined stomach contents of certain species of ducks, and found that the percentage of animal matter eaten is greatest in the young, and that a much greater proportion of vegetable matter is eaten as the duck grows older. Our examinations of stomach contents (we included proventriculus as well as gizzard in our observations), combined with those of others, suggest possible species differences in diet during the first week, post-hatching. Seven Blue-winged Teal from three different broods and localities had all eaten mainly small snails (*Physa* and *Lymnaea*). Four Ruddy Duck ducklings each had the stomach packed with midge (Tendipedidae) larvae. Cottam had also found that six of ten juvenile Ruddy Ducks had made midge larvae the main item of their meal. Water-boatmen (Corixidae) and amphipods were next in importance. Three Lesser Scaup ducklings we examined had eaten mainly *Chaoborus* larvae. Five Redhead ducklings, one week old, had eaten mainly seeds of the sago pondweed (*Potamogeton pectinatus*). Cottam reported that of three downy young Redheads, two had fed entirely on seeds and other plant material, while one had 93 per cent of animal matter in its stomach, mainly corixids. We found that a Mallard duckling, 10–12 days old, had 43 caddice-fly larvae in the proventriculus, while the gizzard contained many remains of Odonata, including wings of adult dragonflies.

These stomach content analyses help explain the diversity in feeding methods observed. Presumably, midge larvae are frequently secured by diving; snails, amphipods, and most adult and some larval insects, by surface feeding.

Laboratory evidence for selective feeding.—Evidence for different species of ducklings was secured by the following procedure. Ducklings were taken directly from the incubator on hatching, and were trained to follow the human observer (Collias and Collias, 1956). The ducklings became so tame that we could observe their feeding responses as closely as we wished without provoking alarm in them. Usually, from one to three individuals, each one to seven days old, and of different species, were placed in a flat-bottomed, white enamel pan partly filled with water. Into the pan we introduced various invertebrate animals from the surrounding marsh. Between test periods, the ducklings were kept together in a small, indoor pool, where they were fed a mixture of invertebrates, supplemented in some cases by the standard poultry-pellet diet used for raising ducks in the hatchery.

We also conducted some tests in an insect light trap, into which we introduced swarms of midges and other small flies, along with ducklings of different species. This structure was a small boxlike affair with sides and roof of flyscreen, and containing a lamp at one end.

In general, the laboratory observations on ducklings in their first week agreed with the field observations both on the importance of animal food and on selective feeding, but were more precise and extended the results. Thus, hand-raised ducklings of Mallard, Pintail, Blue-winged Teal, American Widgeon, Gadwall, Shoveler, Wood Duck, Redhead, Lesser Scaup, and Ruddy Duck, during their first week after hatching, ate little or no duckweed, but all readily captured and ate many daphnids, amphipods, and various aquatic insects.

There seemed to be two principal modes of securing food: straining and pecking. In straining, water is drawn into the bill near the tip and exits by way of the gape and sides of the bill farther back. In pecking, a duckling abruptly jabs at some object, seizing it in the partly opened bill at the same time, in one well-coordinated movement.

Different species of ducklings, at the age levels tested, used one or both methods of securing food in widely differing degree. For example, Ruddy Duck young fed entirely by straining food organisms from the water, downy Wood Ducks very largely fed by pecking at small invertebrates, and only rarely by straining. Other species were more or less intermediate between these two extremes.

The Ruddy Ducks captured all food organisms in water by straining, including even small fishes; and when placed in a dry cage swarming with midges or other small flies, they proved to be relatively helpless, and did little or no pecking. Once or twice a duckling would jab its bill sideways at the floor in a clumsy fashion but never caught anything. One duckling even tried briefly to strain midges up from the floor of the cage.

In contrast to the ruddies, the ducklings of all other species tested were adept at catching flies. Mallard and Blue-winged Teal were very interested and skillful. The other species were also skillful, but seemed less interested in the flies. It seemed to take a great deal of effort for the Redheads and Shovelers that were tested to swallow an insect once caught, but the Mallards swallowed the flies easily.

Not all aquatic invertebrates were equally available to the various species of ducklings. Good strainers like ruddies or Shovelers could remove zooplankton of smaller size than could most other kinds of ducklings. For example, when a Shoveler, American Widgeon, and Gadwall were placed together in a pan with hundreds of young *Daphnia* which were only ⅕ the size of adult *Daphnia,* the Shoveler soon cleaned up almost all of them alone. The other ducklings scarcely tried to feed, although the Gadwall pecked occasionally at some of the large *Daphnia* and at two or three flies that happened to alight on the edge of the pan. But when offered larger invertebrates, the Gadwall and American Widgeon readily fed on them. On the other hand there is a lower limit to the size of the zooplankton that even good strainers can readily obtain. Microscopic examination of the water after a three-day-old Ruddy Duck had finished feeding revealed the presence of much of the smaller zooplankton, including many ostracods, copepods, bosminid cladocerans, water mites, and recently hatched notonectid bugs. But the duckling did secure some of these animals.

An example of a particular test series may help clarify the nature of selective feeding behavior among ducklings. A Ruddy Duck was placed in a white

TABLE 1

COUNTS OF COMMON AQUATIC INVERTEBRATES, OTHER THAN SNAILS, ASSOCIATED WITH PLANTS AT THE DELTA WATERFOWL RESEARCH STATION (SUMMER, 1955)

Plants	Collecting time (min) in field	Number of collecting stations	Amphipods	Insects		Other inverte-brates
				Corixidae	Tendipedidae (larvae)	
Fluminia	15	4	2	24	487	3
Phragmites	75	5	130	10	100	19
Typha	30	6	784	52	92	7
Lemna	50	5	5,581	157	60	62
Utricularia	55	7	3,271	149	56	293*
Ceratophyllum	15	3	90	301	10	15
Scirpus	190	4	259	7	50	21
Potamogeton pectinatus	35	2	100	116	3	13

* Various dipterous larvae, other than Tendipedidae.

enamel pan partly filled with water and containing hundreds of red *Daphnia* and amphipods. However, this duckling would not feed but gave distress calls until it was given the company of another duckling, a Redhead. Then both ducklings promptly began straining out the *Daphnia,* which were all eaten in about 20 minutes. Precisely with the disappearance of the *Daphnia,* the Redhead stopped straining and began to give distress calls, continuing these for the next 20 minutes. Nevertheless, when this duckling stopped feeding most of the amphipods were still present, having concentrated at the bottom of the pan. Since the Redhead had strained at the surface, the amphipods escaped its attention. But the Ruddy Duck duckling put its bill down into the water more deeply, continued to strain, and caught all the amphipods.

By the end of the first 40 minutes of this test, two large notonectid bugs, present from the start, still eluded both the Ruddy Duck and the Redhead. These two ducklings were now removed, and a Blue-winged Teal duckling was placed in the pan. It actively pursued the notonectids and caught both of them within two minutes. It then jumped out of the pan, walked across the laboratory table to a jar containing two other notonectids and pecked at them through the glass.

Definite species preferences for given food organisms also helped determine selective feeding. We repeatedly observed that Blue-winged Teal ducklings placed in a pan with water fleas and snails, generally ate the snails first. Ruddy Ducks and Redheads under similar conditions ignored the snails and first strained out the water fleas.

Ecological distribution of invertebrate food organisms.—The next step in working out differences in feeding behavior was to see how such differences correlated with the ecological distribution of the principal invertebrate food

Table 2
Counts of Common Snails Associated with Plants at the Delta Waterfowl Research Station (Summer, 1955)

Plants	*Lymnaea*	*Physa*	*Helisoma*	*Menetes*	*Valvata*
Fluminia	425	268	1	27	0
Phragmites	69	61	96	0	0
Typha	12	63	0	0	0
Lemna	320	116	7	328	0
Utricularia	2,469	657	19	73	0
Ceratophyllum	13	18	0	0	0
Scirpus	34	21	7	0	0
Potamogeton pectinatus	136	1,163	3	0	102

organisms in the Delta Marsh. Most important of these organisms were the snails, *Physa* and *Lymnaea*, amphipods of the genera *Hyallela* and *Gammarus*, and various insects, particularly corixids and midge or chironomid (Tendipedidae) larvae. These are all predominantly scavengers and their abundance at Delta is correlated with the abundance of organic detritus in the marsh.

Tables 1 and 2 show the distribution of these invertebrates in relation to the principal angiosperm plants of the marsh. The time we spent in collecting necessarily varied greatly with the type of plant being collected, but comparisons of the relative numbers of invertebrates associated with each kind of plant are generally reliable. We tried to collect in places with relatively pure growths of each species of plant, insofar as this was possible.

Whitetop grass (*Fluminia*) was good for snails and midge larvae. Flooded areas of whitetop and ponds with whitetop and sedge margins have been found to be particularly good places for rearing of broods of such ducks as Blue-winged Teal and Ruddy Duck (Sowls, 1955). It seems apparent that the snails particularly attract the teal broods, and the midge larvae the Ruddy Ducks.

Phragmites or reed grass, as Lyle Sowls has remarked, may form dense growths that attract very few nesting ducks, and we found relatively few invertebrates in such dense growths. However, a bottom sample taken with an Ekman dredge in an opening near a *Phragmites* margin, at a place where a brood of downy Ruddy Ducks had been feeding, contained many midge larvae. Cattails (*Typha*) were also relatively poor in their invertebrate life, except that large amphipods were often quite numerous on the dead or decaying roots of cattails that had been flooded out.

It is in small open places within patches of whitetop grass, *Phragmites*, or cattails, that one often finds broods of downy ducklings of various species and it is here that duckweed (*Lemna*) and bladderwort (*Utricularia*) often abound and teem with invertebrate life. Snails, especially *Lymnaea* and *Physa*, as well as amphipods, were most abundant on these plants. Small amphipods would often cling to the roots of duckweed, and it was common to see downy ducklings of Blue-winged Teal and Mallard straining through the duckweed, with the tip of their bills just beneath the surface at the proper depth for capturing amphipods.

Coontail (*Ceratophyllum*) and bulrush (*Scirpus*) in the Delta Marsh appeared to be relatively poor in numbers of invertebrates. Patches of sago pondweed often grow well out in the lake, and despite their exposed situations are favorite feeding places for certain ducks, like the Canvasback (*Aythya valisineria*). Besides the seeds of the sago, there are various invertebrates, of which we observed the snail, *Physa*, to be abundant. One of the brood of Blue-winged Teal collected was feeding on snails in a patch of sago at the time, while a brood of five Redheads that were collected, one week old, had been eating seeds of the sago.

All of the plants listed in Tables 1 and 2 were frequently more or less covered with algae below the water, and patches of algae were often floating near them. Midge larvae were usually numerous in such masses of blue-green algae. Patches of a green alga (*Cladophora*) in duckweed, contained many small *Physa*, immature amphipods and some rotifers, while the algal filaments were studded with diatoms of several species.

Probably the most common invertebrate of a size visible to the unaided eye, in the Delta Marsh in the summer of 1955, was a red form of *Daphnia magna*, which swarmed in all the small openings as well as in the open bays, often feeding on a blue-green alga (*Microcystis*) that at times occurred in immense blooms, coloring the water a continuous green against which could be seen the red streaks and clouds of *Daphnia*. These red *Daphnia* often clustered about submerged vegetation such as bladderwort, and could be picked up by the thousands in one sweep of the dip net.

The density of *Daphnia* was sampled by dipping up with a pail 100 liters of water, over a random course once a week, from the open water of a small bay near the research station. A count was made of the 10 August sample, using the methods described by Welch (1948:285–288). From this sample we computed a density of 129 individual *Daphnia* per liter of water. In comparison, the largest density of *Daphnia*, sampled on 13 July, amounted to more than 1,000 individuals per liter. The daphnids on this day were even more abundant than in the preceding week, when the plankton net had become clogged with water fleas after being dragged behind the boat only 50 yards.

Daphnia appeared to us to be one of the most general foods available and acceptable to downy waterfowl. All of the ten species of incubator-hatched ducklings that we tested readily ate the water fleas. The average peak of hatch

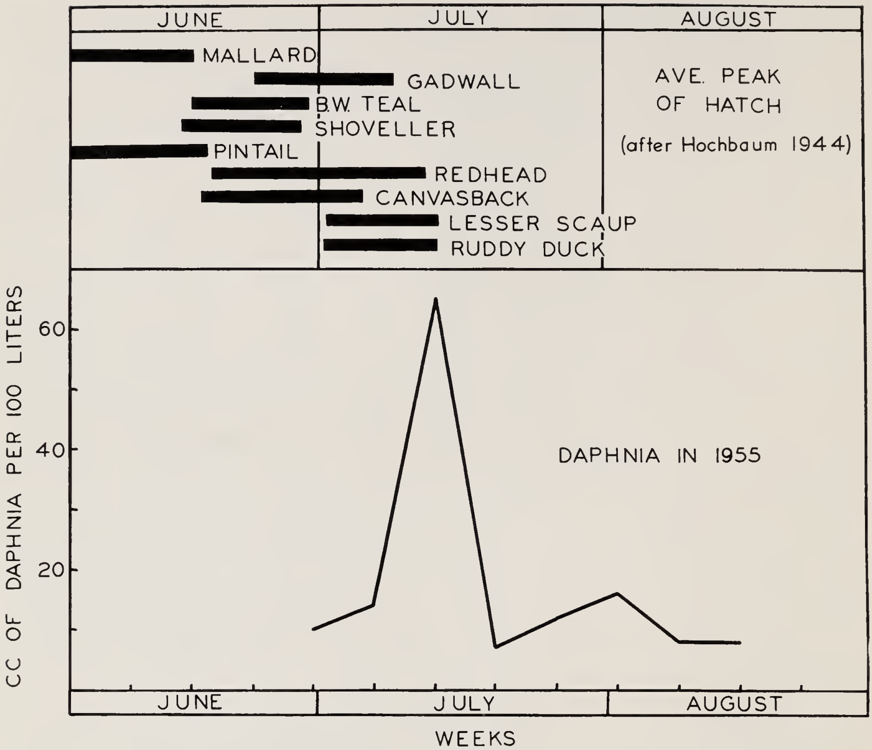

Fig. 1. Comparison of time of duckling hatch and population sizes of *Daphnia*.

of most species of ducks at the Delta Marsh comes shortly before the peak of *Daphnia* numbers (Fig. 1), as we observed the latter in sampling one part of the Delta Marsh in the summer of 1955. This was a late season with extreme floods, and the coincidence of broods with *Daphnia* in 1955 was closer than depicted by this diagram. The significance of the correspondence of the peak of cladoceran populations with peak abundance of downy ducklings is evident. Soon after most of the ducklings hatch, there is available to them this important and general food supply.

Caddice-flies, of the families Phryganeidae and Leptoceridae, were also very common. Invertebrates common in various parts of the marsh, but apparently utilized as food by the ducklings very little or not at all, included sponges, hydra, rhabdocoel flatworms (*Microdalyella, Mesostoma, Typhloplana, Stenostomum*), rotifers, gastrotrichs, clams, oligochaetes (*Stylaria*), leeches (*Helobdella, Glossiphonia, Placobdella, Dina, Theromyzon*), and various water mites. Some of the smaller crustaceans of the zooplankton were numerous but were so small that apparently they were not much utilized by the ducklings, including such crustaceans as copepods, ostracods, and various tiny cladocerans (*Bosmina, Kurzia, Pleuroxus, Chydorus*).

Invertebrates in the water were not the only potentially very rich source of food for young ducklings. During the summer of 1955, the biggest flight and emergence of midges that we observed came on 30 July, at which time 900 midges, or 30 cc, were collected in two minutes just by waving an insect net in the air. Spectacular aggregations of various other Diptera as well as dragon-flies (*Aeshna, Sympetrum*), and damsel-flies (*Lestes, Coenogrion, Enallagma, Nehalennia*) were also frequent during the summer.

Although red daphnids were often abundant in large bays in the Delta Marsh, such as Cadham Bay, the larger invertebrates generally associated with plant life were scarce or absent in the open water. Also, a bottom sample from the middle of Cadham Bay in the summertime contained merely old shells and no midge larvae. Downy ducklings do not ordinarily venture out into the open bay far from cover—the food scarcity provides another reason, besides the absence of cover.

In marked contrast to the great abundance of invertebrate food organisms for ducklings in the Delta Marsh, was the relative scarcity of such invertebrates in the waters of Lake Manitoba itself, on the other side of the sandy ridge that separates the lake from the marsh. The paucity of the lake fauna was in large part due to the virtual absence of duckweed and bladderwort with their rich invertebrate fauna. In addition, the *Phragmites* along the lake shore were much poorer in food organisms for ducklings. In 35 minutes of collecting, only 14 snails, 55 amphipods and 8 insects were secured from two *Phragmites* stations in Lake Manitoba; while in 35 minutes of collecting in *Phragmites* at two stations in the marsh, we secured 212 snails, 175 amphipods, and 13 insects. In the open water of the lake there were no red *Daphnia magna*, and the zooplankton consisted largely of copepods with some *Daphnia pulex* and rotifers. Broods of small downy ducklings are ordinarily not to be seen on the waters of Lake Manitoba.

SUMMARY

Downy ducklings, whether hatched in an incubator or in the field, readily eat invertebrate animals, and there is evidence that different species of ducklings tend to specialize on different kinds of invertebrates, despite considerable overlap in diet. These diet differences are related to differences in feeding behavior and in bill structure.

Duckweed and bladderwort contained the greatest number of invertebrate food organisms. The distribution of broods of ducklings is roughly correlated with the abundance of the invertebrates that apparently comprise the main food of many species of ducklings in their first week after hatching.

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BEHAVIORAL ASPECTS OF HABITAT SELECTION: THE ROLE OF EARLY EXPERIENCE

PETER KLOPFER

If we walk through a Piedmont (North Carolina) meadow in the month of June, it will not surprise us to find meadowlarks or bluebirds. We would not expect to find Pine Warblers, however, or other species that we might easily encounter were we to turn from the meadow into the surrounding loblolly pine. For each species of bird we recognize a characteristic habitat. The question on which we want to focus our attention is, "What determines a preference for a particular habitat?" That is to say, what factors assure that the young of a particular species will develop the same preferences as those of its parents?

The importance of being able to answer this question relates, in turn, to a hypothesis formulated by Klopfer and MacArthur (1961. *Amer. Nat.*, 95:223–226) that seeks to explain the enhanced avifaunal diversity of tropical regions in terms of an increase in the stereotypy of the behavior of tropical birds. The present study represents the first of a series on habitat selection in temperate zone and tropical birds.

METHODS

The purpose of the techniques described below was to measure the effect of certain kinds of early experience on the preference for particular perch sites of a north temperate zone passerine, the Chipping Sparrow (*Spizella passerina*).

Birds were obtained from mixed stands of loblolly pine and hardwood (in which the loblolly pine predominated) throughout various regions of Durham and Orange counties of the North Carolina Piedmont. Four groups of Chipping Sparrows were established as well as one additional group of White-throated Sparrows (*Zonotrichia albicollis*) trapped in the same area. These groups were as follows:

Group 1: wild-trapped adults (Chipping and White-throated Sparrows).—Ten birds of each species. These birds were captured in a funnel trap and held in large outdoor aviaries for from three to ten weeks prior to testing.

Group 2: wild-trapped adults (Chipping Sparrows).—These ten birds were obtained and treated as those in Group 1; for these the number of perches and amount of foliage in the pine-decorated half of the test chamber was reduced by one half.

Group 3: hand-reared nestlings (Chipping Sparrows).—This group of six birds, removed from the nest within 24 hours after the eyes opened, or, in most cases, before the eyes had opened, was reared in a cloth-covered cage kept within a house. They at no time in their lives saw any natural foliage, their vision being restricted to the sight of the experimenter who did the feeding, the cloth-covered interior of their cage and, occasionally, the furniture in the room where they were kept.

Group 4: hand-reared nestlings (Chipping Sparrows).—this group of eight birds, also collected either before their eyes had opened or within 24 hours after the opening of the eyes, was also reared by hand in a cloth-covered aviary which was decorated with a supply of freshly picked oak leaves. The leaves were from trees of various oak species native to the Piedmont, primarily red oak (*Quercus rubra*) and members of the white oak group. Both the hand-reared groups (Groups 3, 4) remained within the confines of their cloth-covered aviaries until the time of their tests. These tests began one to three months after the nestlings were fully fledged and feeding independently.

The experimental chamber within which the tests were conducted consisted of a room 12 feet long, 8 feet wide, and 8 feet high. Along the length of this room a light gradient was established by means of a series of six 40-watt daylight fluorescent bulbs which varied from a maximum intensity (at the perches) of 500 foot-candles to a minimum at the opposite end of the room of $< .8$ foot-candles. The placement of one of the lamps, midway along the length of the room caused the light intensity to fall off fairly abruptly halfway along the main axis, so that the room could be conveniently divided into a bright half and a dim half. In the center of the ceiling, just above the dividing light fixture, was a small exhaust fan that assured uniform circulation of air.

Along two opposite sides of the room were arrayed steel racks consisting of two parallel sets of bars stacked about 10 inches above one another and running the length of the room. These provided an abundance of perches of uniform position and size along the length of both sides of the room. To these racks were tied twigs from loblolly pines or, alternatively, from the various oaks. The purpose of tying the twigs to the racks was to assure that equal perch opportunities would be provided by both foliage types, a fact which is of course not the case in nature, where the difference in the perch opportunities afforded by a broadleaf tree and a pine tree is rather great. The significance of this feature will be apparent later. The position of the oak and pine (i.e., right or left of the chamber) was reversed for one-half of the birds.

The entrance to the room was closed by a panel on which was fastened a double layer of gauze painted with military camouflage pattern. Behind this was a darkened blind. Thus, it was possible for an observer to sit in the blind and watch the activities of the birds confined within the room without being seen. From the behavior of the birds, which frequently clung to the gauze directly in front of the observer, it was quite clear that the observer's presence was not detected by the birds. The observer had in his lap, in addition to note paper, a series of micro-switches, each of which was attached to a separate counter and timer. Thus, it was possible to record both the number of visits that a bird made to any particular section of the room as well as the duration of that visit. Food was available ad lib. near the center of the room.

Finally, additional observations were made of ten other wild-trapped, adult individuals of Chipping and White-throated Sparrows separately confined in outdoor aviaries measuring 20 × 8 × 8 feet (Groups 5 and 6). Within each of these aviaries there was available a coniferous tree, a broad-leaved tree, and a small pile of tangled vines and brush as well as some open unshaded grass.

Each bird was separately observed for a total of ten hours. Observations commenced only after the bird had been allowed to habituate to the test chamber or aviary for a period of 72 hours. No more than three hours of observation were made in any one day, and generally the observations were spread over four to five days. Whenever a bird failed to move for 45 consecutive minutes it was assumed to be asleep and the record for that period was rejected and replaced by another hour's observation made later in the day or the following day. Observations were made at all hours of the day which began at 6 AM and lasted until 10 PM (for the indoor trials) ; These 16 hours of light were provided by an automatic time clock. The aviary birds, of course, were subjected to the normal diurnal rhythm.

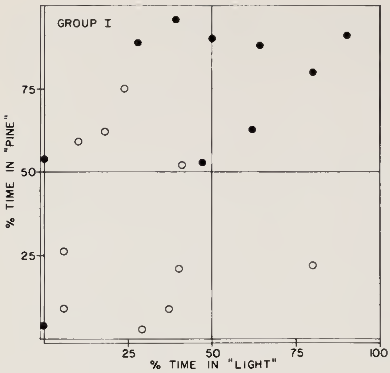
The data recorded on the graphs represent the percentage of the time spent in one or the other of the foliage types or light intensity areas, as calculated from the ratio of the number of seconds spent in portion A of the cage to the number of seconds spent in portions A plus B.

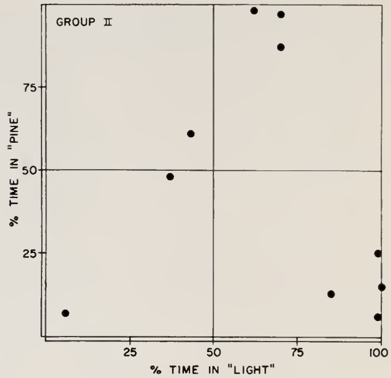
RESULTS

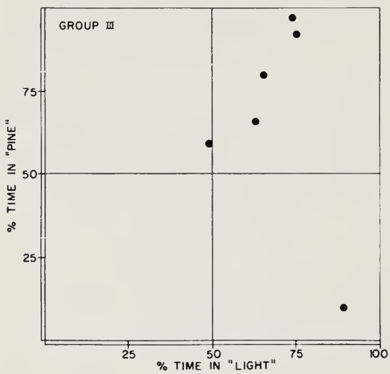
Group 1.—The preferences of adult Chipping and White-throated Sparrows are depicted in Fig. 1. The Chipping Sparrow group, it will be noted, was divided almost equally between birds favoring the light half of the chamber and birds favoring the dark half. All of the white-throats but one spent more than 50 per cent of their time in the darker half of the chamber. With respect to foliage preferences, the Chipping Sparrows clearly spent most of their time in the pine—only one bird spent less than 50 per cent of the recorded observation period in the pine foliage. The white-throats, on the other hand, were fairly evenly divided between pine and oak, four birds being predominately in the pine and six in the oak.

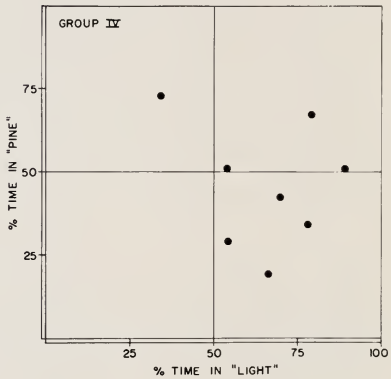
Group 2.—This group of birds was tested in a chamber with twice the volume of oak foliage as pine and twice the number of perches in oak as in pine and showed much the same distribution (Fig. 2) for light preferences as did those of Group 1. Their foliage preferences, however, are clearly distinct. Six birds of the ten spent more than 50 per cent of their observation period in the oak.

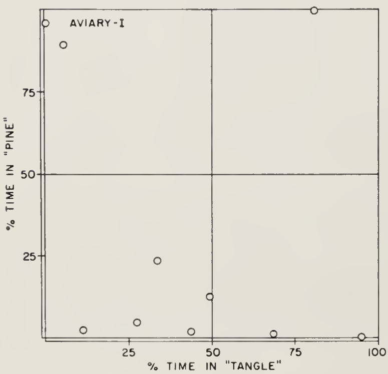
Group 3.—These six birds had never seen foliage of any sort prior to their introduction into the test chamber. All but one spent most of the observation period in the lighter half of the room (Fig. 3), and all but one preferred the pine. In this last respect, at least, these birds resembled the Group 1 controls.











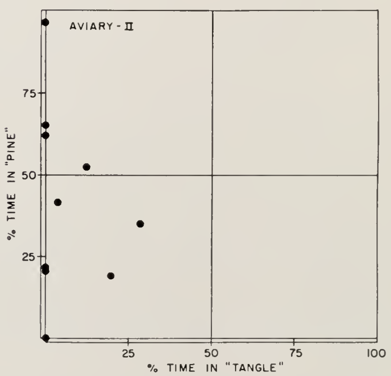


FIG. 1 (UPPER LEFT). Perch preference of Chipping (●) and White-throated Sparrows (o) in test chamber.

FIG. 2 (UPPER RIGHT). Perch preference of Chipping Sparrows in test chamber with one-half of the pine removed.

Table 1
Light Chamber Tests

Groups*	Group means % of time in:		Individuals with 50% or more of their time spent in:	
	Pine	Light	Pine	Light
Group 1 (Chipping Sparrows)	71	46	90	50
Group 1 (White-throated Sparrows)	34	29	40	10
Group 2	46	67	40	70
Group 3	67	69	83	83
Group 4	46	66	50	70

* See text.

Group 4.—These eight birds had been exposed to oak leaves since the opening of their eyes. Four of them subsequently preferred the oak to the pine (Fig. 4). All but one preferred the light to the dark half of the chamber.

Groups 5 and 6.—Unlike the birds of Group 1, the Chipping Sparrows tested within the confines of the large test aviary (Aviary II) did not show a marked preference for pine. Only four of the ten birds spent more than half their perching time in the pine tree, which, it should be noted, had a much reduced volume per foot of height than the broadleafed tree. The white-throats were generally similar (Aviary I), though they spent more of the time when they were on the ground within a dense tangle (rather than open grass) than did the Chipping Sparrows.

DISCUSSION

Relevant measures and cues.—A fundamental stumbling block to many studies of animal behavior lies in the determination of the appropriate measure for a particular trait or preference. In this case, one must ask whether the amount of time spent in a particular side of the apparatus represents an accurate measure of the preference for the foliage of that side. Would the selection of sleeping perches or nesting sites as the preference criteria have led to different conclusions? We have no data that would allow a clear answer. One can but surmise that since perch opportunities, micro-climatic conditions, and food were uniformly distributed, the non-uniform nature of the movements of the birds probably reflects an effect of the different foliage or light intensities.

Fig. 3 (center left). Perch preference of hand-reared Chipping Sparrows in test chamber.

Fig. 4 (center right). Perch preference of hand-reared Chipping Sparrows (reared among oak leaves) in test chamber.

Fig. 5 (lower left). Perch preference of White-throated Sparrows in outdoor aviary.

Fig. 6 (lower right). Perch preference of Chipping Sparrows in outdoor aviary.

Table 2
Aviary Tests

Groups*	Group means % of time in:		Individuals with 50% or more of their time spent in:	
	Pine	Tangle	Pine	Tangle
Group 1 (White-throated Sparrows)	33	41	30	40
Group 2	41	6	40	0

* See text.

The fact that the foliage was lighted on two sides to reduce shadows, further suggests that it is an attribute of leaf size or shape that is the relevant cue and not merely the shadow pattern cast by the leaves.

Effect of rearing conditions.—If we wish to compare the choices made by two groups of birds we may consider the group means, or, as is preferable in the case of small samples, the intragroup differences. Considering the means first, it can be seen (Table 1) that the wild-trapped Chipping Sparrows, on the average, chose the pine foliage over the oak 71 per cent of the time, contrasting with the white-throats, which selected pine 34 per cent of the time. Nine of the ten Chipping Sparrows spent half or more of the total observation period in the oak, while this was true for only five of the ten white-throats. An interspecific difference is thus apparent, though a statistical evaluation of the degree of difference is rendered difficult by the small size of the samples.

When the number of pine-decorated perches is reduced by one-half, the apparent preferences of Chipping Sparrows shift, too. The percentage of time spent in pine drops from 71 to 46, and the proportion of individuals spending more than 50 per cent of their time in pine drops from 9/10 to 4/10. This suggests these birds have an opportunistic nature, a suggestion corroborated by the aviary tests. Under aviary conditions, in which the number of perches provided by the oak tree was considerably greater than that provided by the less intensely branched pine, the Chipping Sparrows (Table 2) spent 41 per cent of their perching time in the pine (four of ten individuals chose pine more often than oak). In this test, the Chipping Sparrows were scarcely to be differentiated from the white-throats (Table 1), although the two species can be sharply differentiated by the amount of time spent in dense, dark tangles of vegetation as opposed to the open, grass areas. Thus, the first consideration in the selection of a suitable perch site is apparently the physical structure and quantity of the perches. Only where these conditions are equal do the foliage preferences become decisive.

The Chipping Sparrows that were reared without sight of any foliage can not be distinguished from their wild-trapped counterparts except in their greater preference for the higher of the light intensities proffered. This is probably due to their having been exposed to rather similar wave lengths and intensities of artificial light during rearing.

The group of Chipping Sparrows hand reared with oak foliage, however, shifted their preferences in the direction of the oak. Their mean time in the pine was only 46 per cent (compared to 71 per cent for the wild birds), with but five of ten individuals selecting pine more than 50 per cent of the time. It would seem, therefore, that Chipping Sparrows are, first of all, rather opportunistic in their selection of perch sites, choosing them for their availability and, perhaps, density and size. Second, their preferences for particular foliage types, manifested only when other conditions are equal, can be altered through exposure to a different foliage type during the first two to three months of their life. We do not know, at present, how stable these artificially created preferences will prove to be.

Intra-clutch differences.—The eight hand-reared Chipping Sparrows were taken from a total of three nests located (a) about 1.5 meters up in a *Ligustrum* hedge, (b) 5–6 meters up in a *Thuja*, and about 3 meters up in a *Juniperus virginiana.* All three sites were in fairly open country, among rows of other trees and shrubs, but not in deep woods. No systematic differences between birds from different clutches were apparent.

Thus, the variability in behavior found among a small population of Chipping Sparrows, at least insofar as foliage preferences are concerned, does not appear to be merely a consequence of the locus of the parental home or nest. A genetically determined variability seems considerably more likely.

General considerations.—Obviously, preferences for a particular shape of leaf represent but a small fraction of the preferences that totally determine the choice of habitat. Nonetheless, the behavior of the Chipping Sparrows used in these experiments accords well with what one would expect of a bird that must be equipped to deal with a varied and varying environment. The temporal changes in the stimulus fields of temperate zone birds would favor a fair degree of opportunism over absolutely rigid preferences for particular stimulus objects, and a fair degree of genetically imposed variability in preferences as well. It will be recalled that these are just the reverse of the characteristics postulated for the birds of tropical areas (Klopfer and MacArthur, ibid.). These, it is assumed, are less opportunistic, and thus, while highly adapted to a stable environment, are quite incapable of meeting the demands of changing seasons. A repetition of these tests described above, using representative tropical species should allow a closer scrutiny of this hypothesis.

SUMMARY

The foliage preferences of Chipping Sparrows were measured under conditions that sought to minimize the effects of other variables such as perching opportunities, food,

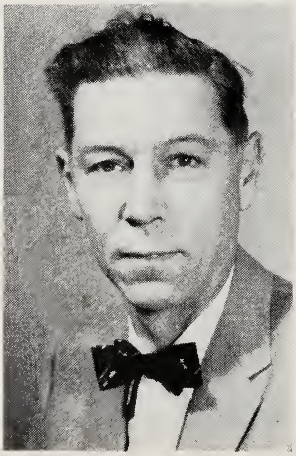
and light intensity. Wild-trapped adults indicated a preference for pine over oak leaves, as did the two- to four-month-old *Kaspar Hauser* birds that were reared without sight of any foliage. Isolates that were reared in the presence of oak foliage showed a decreased preference for pine. Studies of the stability of this shifted preference are in progress.

ACKNOWLEDGMENTS

Support for this study came from NIH Grants M 4453 and M 2850. I am much indebted, as always, to Dr. R. H. MacArthur. For their patient and conscientious assistance, I also wish to thank Miss Torrie Lowenbach, Miss Trudie Lowenbach, C. Hamilton, and C. M. Barnard.

ZOOLOGY DEPARTMENT, DUKE UNIVERSITY, DURHAM, NORTH CAROLINA, 1 MAY 1962

NEW LIFE MEMBER



C. Brooke Worth, a staff member with the Rockefeller Foundation in Port of Spain, Trinidad, West Indies, is a new Life Member of the Wilson Ornithological Society. He received his baccalaureate degree from Swarthmore College, and his M.D. degree from the University of Pennsylvania. Dr. Worth's publications include "A Manual of Tropical Medicine," with Mackie and Hunter, and "The Nature of Living Things," with Enders, as well as numerous papers.

His principal interests in ornithology are bird banding and the relationships of birds to human disease; other allied interests include entomology, mammalogy, parasitology, and popular nature writing. He is also a member of the AOU, Bombay Natural History Society, South African Ornithological Society, etc., and was president of the Eastern Bird Banding Association, and editor of the journal of the Delaware Valley Ornithological Club.

A RUSSIAN CONTRIBUTION TO ANTING AND FEATHER MITES

Leon Kelso and Margaret M. Nice

For over a century anting by birds has intrigued and mystified observers, and many theories have been broached as to its function. In her thorough review of the subject, Whitaker (1957:260) points out that "No report of an autopsy of an anting bird could be found," and states (p. 195) that despite a bibliography of some 250 titles, "the purpose of the behavior remains unexplained." Simmons (1957:419) in his review writes, "The most popular theory is that anting is of some use 'in the destruction or discouragement of ecto-parasites' (Goodwin, 1955b), though there is still no positive evidence for or against." Papers published in the last five years have not changed the situation.

Yet autopsies had been made and experimental light shed on the function of anting in 1943 by the Russian parasitologist, Dr. V. B. Dubinin. His three large volumes on "Feather Mites" were published in 1951, 1953, and 1956. They were recently discovered by one of us (L. K.) and translations of pertinent passages shared with the other (M. M. N.). This monumental work appears to be unknown in America as well as in Great Britain, where Hughes (1959) regrets throughout his book the lack of information on the habits and life history of these creatures.

Vsevolod Borisovich Dubinin (11 January 1913–8 June 1958) was apparently built on the scale of a major biological scientist (Novikov, 1959). Besides the fields of invertebrate zoology, he was occupied with conservation, field exploration, teaching, and administrative work. He published 136 titles in which he described as new 10 families and subfamilies, 40 genera, and 150 species of parasites. More remarkable still, his research on the life cycles, physiology, and evolution of feather mites as detailed in the 1951 volume is apparently the most advanced extant.

Feather mites (Analgesoidea) lack mouth parts strong enough to chew feather substance and in some cases even lack anal openings to the alimentary tract. The suggestion, dating as far back as Trouessart (1884, cited by Dubinin) and more recently by Kelso (1952) that they feed on feather lipids (oils, fats) involves a crucial point in the physiology of both the feathers and their mite parasites. The existence on feathers of lipids other than those of the preen gland is now well established (Bolliger and Varga, 1961). Dubinin dealt with the food problem directly and thoroughly by microscopic examination of over 20,000 stomachs of 26 species of feather mites: he determined that the principal food of these parasites is lipid substance from the feathers.

Under the subject "Food of feather mites as an ecological factor," Dubinin

(1951:297–303) describes how he collected at different times of the year 33 Sky Larks (*Alauda arvensis*), 27 Carrion Crows (*Corvus corone*), and 28 Garganeys (*Anas querquedula*); counting the feather mites and extracting with ether the lipid substance from the primaries, secondaries, and greater wing coverts. He found this substance at its lowest point during the molt and in winter, at its highest after the molt and during the nesting season. The numbers of feather mites fluctuated in correspondence with the amount of lipid substance in the feathers.

In this connection, Mrs. Whitaker informs us that Starks (1951) found in Oklahoma that infestation of Red-winged Blackbirds (*Agelaius phoeniceus*) and Brown-headed Cowbirds (*Molothrus ater*) by both feather mites and lice was highest from May through July and lowest from December through February.

In the section, "Effects of avian anting on feather mites," Dubinin (1951: 205–210) gives a brief review of the literature on the subject. No Russian authors were listed, however, for nothing had been recorded in Russian. Dubinin, with his profound knowledge of feather mites, determined to try to find the function of this behavior. In June and July 1943, in Transbaical, four Transbaical Steppe Pipits (*Anthus pratensis godlewskii*) were watched on ant hills persistently seizing wood ants (*Formica rufa*) and smearing them on the wing feathers. After 20 to 40 minutes these birds were collected, as were four others not anting at the time.

"In the central area of five feathers of the birds, 12 interspaces between the barbs of the webs were filled with a whitish liquid with bits of chitin hanging on it. Located in these barbs were 54 mites, *Pterodectes bilobatus* Rob., which were found to be dead. Furthermore, separate drops of liquid (69 drops) were situated in other interspaces between barbs. In 33 of these 36 dead mites were found. The feathers had a noticeable odor of formic acid, retained in part for as long as 12 hours after the birds were collected. In the stomachs of all specimens and in the mouths of two were found remains of ants recently swallowed, in numbers almost coinciding to the number of insects smeared (84 individuals)."

The rest of the mites on the four pipits which had anted were crawling over the feather surfaces at random. On the four non-anting pipits, the mites remained undisturbed in rows in spaces between the barbs. "Of 642 live feather mites taken from the four anting pipits, 163 died within 12 hours, and 8 more within 24 hours. Simultaneously from the four control pipits taken at the same time from near their nests, 758 live *P. lobatus* were collected, of which only five died within 12 hours and two more within 24 hours."

These experiments constitute the first evidence that anting may destroy feather mites.

In northern Tadzhikstan on 25 September 1944, Dubinin watched two Hoopoes (*Upupa epops*) anting. "Seizing an ant the Hoopoe several times anointed one, then the other wing and, thrusting the head under the wing remained in this pose for one and a half to two minutes. Only once did I happen to see the bird after a minute of posing as above draw the bill with abrupt movements five times along the inner side of the wing feathers. A similar method of anting, not drawing the insect along the feathers but only holding the ant against them was noted by Groskin (1943:57) for the Scarlet Tanager (*Piranga erythromelas*). For 60 minutes I observed one Hoopoe perform such an action 32 times, and another, 19 times during 45 minutes." After collecting the birds, "Most of the feather mites (*Pterolichus cuculi*) found in motion were crawling over the web and the shaft of the feathers to the basal part covered by the under wing coverts. Collected in a container the mites showed no noticeably great decline; in 12 hours 1.7% of the individuals died; of the controls the total percent dying was 0.9 to 1.2."

This method of anting apparently disturbed the parasites but did not destroy them. We have quoted Dubinin's description in detail because it appears to be the first record of anting for the Hoopoe and for the Coraciiformes.

"The same method of anting" was seen in the Jay (*Garrulus glandarius glandarius*) and Rusty-headed Jay (*G. g. brandtii*). "For 12 to 20 minutes the jays, with half-drooping wings sat on paths where ants (*Formica rufa*) were crawling and in turns seizing and holding the insect against the inner side of the primaries." The feather mites on these birds were *Proctophyllodes glandarius.*

In his 1956 volume (pp. 79–82), Dubinin writes that in years with early spring thaws certain grouse experience a pronounced increase in mites while still carrying their dense winter plumage. The birds then seek relief from the irritation by the mites through scratching, dust bathing, and anting. He quotes field notes of A. N. Formozov on Black Grouse (*Lyrurus tetrix*) in April 1951, and Hazel Hens (*Tetrastes bonasia*) in April 1953 "bathing" in anthills of *Formica rufa,* the materials of which were too coarse and too moist for "dusting," but overrun with ants. He regards these as instances of anting.

Dubinin called for more observations and careful experiments. His opinion is divided between the effect of anting on parasites and its effect as a special treatment, "cultivating" or "nursing" of those feathers most necessary for birds' flight. He also suggests that it might counteract or clean the oxidizing lipid film from the feathers.

As to the fact that so many anting birds have been reported as free of mites, it may well be that these parasites were at times present but were overlooked, since they are scarcely to be seen without careful examination with a strong hand lens.

We suggest that anting is an instinctive action present in many birds, perhaps aimed at defense against feather mites. It appears to be "triggered" by the acid or burning taste of ants and other substances and apparently may be performed *in vacuo,* i.e., in the absence of mite infestation.

SUMMARY

V. B. Dubinin collected nine birds of three species which he had watched anting. All were infested with feather mites. Of the 732 mites on the four anting Steppe Pipits, 90 were dead and 163 others died within 12 hours; of the 758 taken from four non-anting pipits only five died within the same period. These experiments apparently provide the first autopsies performed on anting birds, as well as the first evidence that anting sometimes destroys feather mites. They also give what appears to be the first record of anting in the Hoopoe and in the Coraciiformes.

Translations of the two sections on anting, of those on "Food of feather mites" and "Methods of collecting, counting and examination for feather mites," and of the three-page table of contents of Dubinin's 1951 volume have been donated to the Van Tyne Memorial Library at The University of Michigan at Ann Arbor.

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BREEDING AND THE ANNUAL CYCLE IN THREE TRINIDAD THRUSHES

D. W. Snow and B. K. Snow

Five species of the Turdidae breed in Trinidad. One species of *Catharus* and one of *Platycichla* are highland birds, breeding in montane forest mainly above 2,000 feet. The other three are typical members of the genus *Turdus*, they are widely distributed over the island and all occur from sea level to 2,000 feet, where the habitat is suitable. It is with the three *Turdus* species that this paper is concerned.

Their habitat preferences are different but overlapping. *T. albicollis* is rather strictly confined to forest. *T. fumigatus* occurs in forest, well-timbered plantations, and even in gardens if they have large trees and are close to forest. *T. nudigenis* occurs in more open habitats: orchards, gardens, and park-like savanna. Outside the breeding season it also feeds to some extent in secondary forest. Thus in the breeding season *T. albicollis* and *T. nudigenis* are completely isolated from each other by habitat, and *T. fumigatus* overlaps both of them. All three species feed on invertebrates obtained from the ground and on fruit, and no important differences were noted in their feeding habits, though the differences in their habitats must ensure that to some extent they take different foods.

They are medium-sized thrushes, all of much the same build. *T. albicollis*, the forest thrush, is the smallest (weighs mostly 50–60 grams): *T. fumigatus* and *T. nudigenis* are about the same size (weigh mostly 65–80 grams and 60–75 grams, respectively). All are plain-colored above, and their colors seem to some extent to be related to their habitats. Thus *T. albicollis* is dark olive-brown above, a similar color to some of the ground-living antbirds and furnariids, while *T. fumigatus* is a rich cinnamon color above, very like the woodhewers found in the same habitats. By contrast, *T. nudigenis*, inhabiting semi-open country, is a paler, greyer olive-brown, similar to the color of several other birds inhabiting this kind of country. *T. albicollis* is the only one with any contrasting feature in its plumage: it has a white throat patch which shows up conspicuously in the poor light of the forest. *T. nudigenis* has a broad ring of bare golden-yellow skin around the eye, lacking in the other two.

The quality of their songs too seems related to their habitats. The leisurely, rather simple and measured phrases of *T. albicollis*, and the vigorous, more varied and quickly repeated phrases of *T. fumigatus* are both far-carrying and suitable for the forest, where visibility may be only a few yards and sounds are muffled by the thick vegetation. They are much finer performances than the halting, feeble phrases of *T. nudigenis*, which probably relies more on visual contact than on song in intraspecific relations. All three species sing from cover, not from the exposed song-perches favored by northern thrushes.

Little information was obtained on territory, pair-formation, and the function of song in these species. In *T. fumigatus* at least, the only one whose behavior could regularly be observed, territorial behavior seemed to be weakly developed: birds were occasionally seen foraging close to the nest of another pair, and none of the displays associated with defense of territory in northern *Turdus* species was ever seen. Individual birds were, however, sedentary, and in two cases color-banded pairs remained together for successive years.

All three species build nests of typical thrush type, comparatively bulky cups strengthened with mud and with an inner lining of dry fibers. The two forest thrushes use much moss in the outer part of the nest: *T. nudigenis*, nesting in drier places, uses various plant materials, but usually not moss. *T. fumigatus* and *T. albicollis* usually place their nests on substantial supports such as crotches and recesses in tree trunks, stumps, tops of tree ferns and niches in banks. Many of the nests of *T. fumigatus* were found along roads and paths in cocoa plantations. As a consequence, more nests of this species were found in roadside banks than in any other site, but in forest, too, *T. fumigatus* was found to use banks more often than *T. albicollis*. *T. nudigenis* usually places its nest in a fork of the branches of a tree or large shrub: none was found in a crotch or recess in a tree trunk, on a stump, or in a niche in a bank, nest-sites which seem properly to belong to the forest habitat, though many such are now available in places where *T. nudigenis* breeds.

The data presented here were collected during 4½ years in the Northern Range of Trinidad, the range of forested mountains that runs along the north side of the island, at latitude 10° 45′ N, while one of us (D.W.S.) was Resident Naturalist at Simla, the New York Zoological Society's tropical field station. We are grateful to the following persons for help in the field work: Dr. W. G. Downs and Dr. T. H. G. Aitken of the Rockefeller Foundation, for nesting and trapping data obtained during the field studies of the Trinidad Regional Virus Laboratory; and Commander C. S. Bushe, Mr. John Dunston, and Dr. V. C. Quesnel, for nest records of *T. nudigenis*. H. Mayer-Gross and B. Nelson have kindly allowed us to quote unpublished information on the breeding success of *Turdus* species in England. This work, part of a wider program of studies on the biology of neotropical birds, was generously supported by National Science Foundation Grants G 4385 and G 21007.

BREEDING SEASONS

Information on the breeding seasons came from regular searching for nests in all months of the year. Altogether, 200 breeding records were obtained for *T. fumigatus*, 74 for *T. albicollis*, and 151 for *T. nudigenis*. Four hundred six of the total of 425 records were based on nests found, the remaining 19 on observations of recently fledged young birds.

Figure 1 shows the breeding seasons of the three species based on these records (see also Table 1). It will be seen that the breeding seasons of *T.*

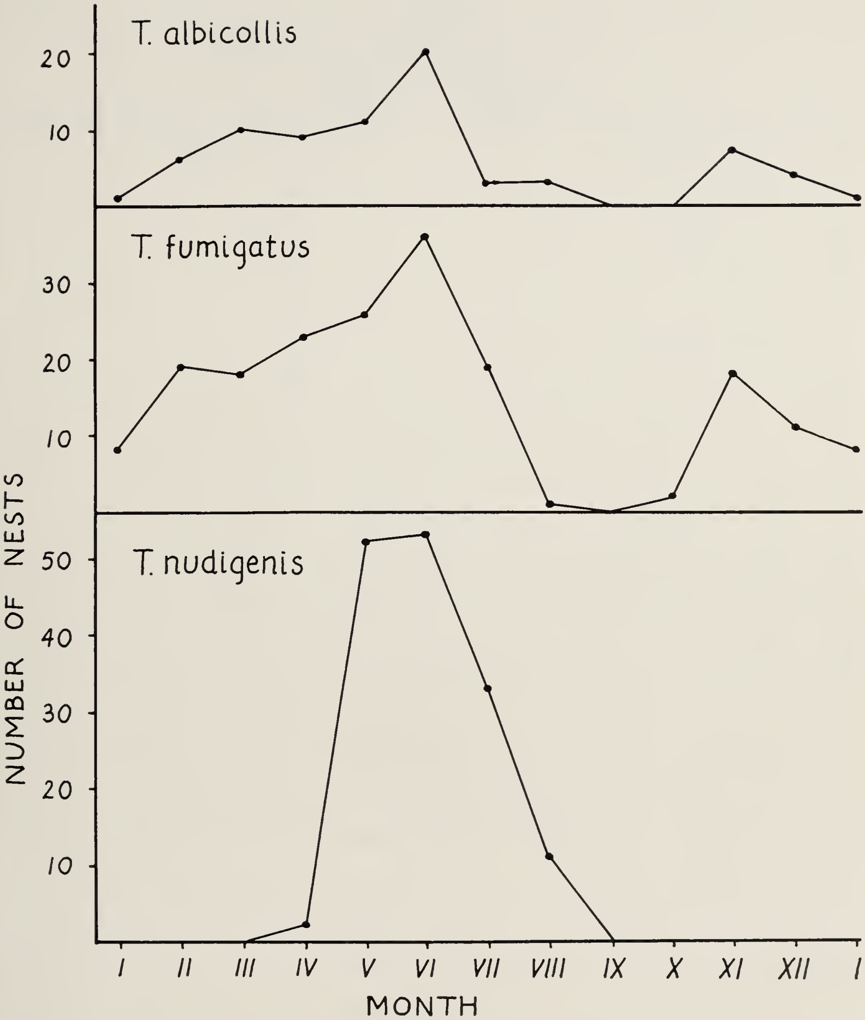

Fig. 1. Breeding seasons of *Turdus albicollis, Turdus fumigatus,* and *Turdus nudigenis* in Trinidad.

fumigatus and *T. albicollis* (the two species inhabiting forest) are long and very similar to each other, while that of the open-country *T. nudigenis* is far shorter. In the first two species, breeding starts usually in late October or early November; after a peak in November activity declines in December and January, and then rises again to a second, main peak in May and June. It continues until July or early August and then ceases. Only in September was there no record of breeding.

TABLE 1

BREEDING SEASONS, IN HALF-MONTHLY PERIODS

(number of nests started)

Dates	*T. fumigatus*	*T. albicollis*	*T. nudigenis*
October			
1	1		
2	1		
November			
1	10	3	
2	8	4	
December			
1	4	2	
2	7	2	
January			
1	2		
2	6	1	
February			
1	9	3	
2	9	3	
March			
1	9	3	
2	9	7	
April			
1	13	5	
2	10	4	2
May			
1	13	4	18
2	13	7	34
June			
1	26	11	35
2	10	9	18
July			
1	14	2	24
2	5	1	9
August			
1	1	2	9
2		1	2

In *T. nudigenis* breeding does not begin until late April. It quickly rises to a peak and ends at about the same time as in the other two species. It may be noted that only for this species is Belcher and Smooker's statement of the breeding season correct (Belcher and Smooker, 1937). For the other two they give far too short a season.

January–May are the dry months of the year. The wet season begins variably, usually in May, and continues until the end of the year, often with a minor interruption in September or October. The effect of the dry season is more severely felt in open country than in the forest, and this may be the environmental factor ultimately responsible for the short breeding season of *T. nudigenis*, which does not start to breed until the wet weather begins, compared with the other two, which breed right through the dry season.

Breeding activity is reduced in the two forest thrushes at the beginning of the dry season, but this decline is not directly related to weather. It seems to be inherent in the birds' physiological cycle. Thus breeding declines in December, before the dry season has begun, and increases again in February or March, while the dry season is at its height. This was especially clear in *T. fumigatus* in the 1960–61 breeding season. There was, as far as could be ascertained, no breeding in December and January, although the weather was rather wet. Breeding started again in February, when the weather was very dry, and continued through March, which was also dry. Song, which is very closely related to breeding, fluctuated in the same way. But if the weather is exceptionally dry in the latter half of the dry season breeding is eventually inhibited. In 1959, March and the first half of April were very dry, and there was an unusual gap in breeding in this period. In 1961, the drought was severe at the end of the dry season, and wet weather did not begin until 22 May. No nests were started from 9 April to 31 May, an exceptional gap not recorded in any other year. After the wet weather began there was a great outburst of breeding and more nests were recorded in the first half of June than in any other half-monthly period in the whole course of the study. It is probable that in other years, too, the varying numbers of nests recorded in the months March–May were correlated with the severity of the dry weather, but the numbers are too small for statistical significance.

The main song-period of each species coincides very closely with its breeding season. It was especially striking how in *T. albicollis* and *T. fumigatus* the reduction in breeding activity from December to March was exactly matched by the incidence of song, which varied in the different years as the breeding season varied. In *T. nudigenis* the period of regular, sustained song is short, like the breeding season, lasting from April to August, but a little song was heard in each year from February or March onwards; and in each year occasional song, which was usually subdued, was heard in November or early December.

NUMBER OF BROODS

Nests of *T. fumigatus* in sheltered sites, especially in roadside banks, are regularly reused. Usually they are reused only if the previous brood was successful. Of the 26 instances of reuse of a nest, the previous nesting was known or presumed to have been successful in 18 instances. In seven of the cases where the previous nesting had been unsuccessful, the nest was not reused until several months later; in only one case was a nest reused soon after a previous failure.

Two records were obtained of the same nest being used four times, and one of a nest being used three times, at intervals which suggested successive nestings by the same bird, and a record was obtained of four nestings, probably successive, by a color-banded bird. Nine other records were obtained of a nest being used twice at intervals suggesting successive nestings. The first-egg dates for the series of three or four successive nestings were as follows:

(1) 12 May, 8 July, 6 August (molt), 9 November;
(2) 17 May (molt), 14 November, 19 January, 21 April;
(3) 1 June (molt), 23 November, 1 May (molt), 11 November;
(4) 23 April, 7 June (molt), 14 October.

TABLE 2
INTERVALS BETWEEN SUCCESSIVE BROODS IN *TURDUS FUMIGATUS*

Month in which previous nesting attempt ended	Number of days before laying of first egg of next clutch
December	20, 33, 38, 52, (132)
January–February	9, 20, 33, 52, 63
April–May	13, 16, 18, 199
June–July	6, 10, 11, 27, 113, 152, 154
August	95

The presumed times of molt are based on trapping records (see below). It will be apparent from these records that three or four broods may be reared in the year.

Table 2 gives all the intervals between successive nesting attempts recorded for *T. fumigatus.* It will be seen that re-laying followed rather soon after the ending of a previous nesting attempt in the months April–July, or else there was a very long interval, doubtless due to the fact that the molt intervened. In December–February the intervals were mostly rather long, but variable, corresponding to the erratic and low incidence of breeding during these months.

For *T. albicollis* comparable data could not be collected, as the nests, being usually in more exposed positions, are rarely reused. There were only three cases of successive nestings in the same nest, the intervals being long (June, 38 days; December, 77 days; January, 87 days).

For *T. nudigenis* there were two records of successive nestings in the same nest, the intervals being 10 and 15 days. Thus two broods may be reared in their short breeding season, but only exceptionally could three be reared, if a pair started early and continued late.

CLUTCH SIZE

Clutch sizes of the three species are given in Tables 3–5, and family sizes in Table 6. Mean clutch size is highest in *T. nudigenis,* lowest in *T. albicollis,*

TABLE 3
CLUTCH SIZES OF *T. FUMIGATUS*, *T. ALBICOLLIS*, AND *T. NUDIGENIS*

	Numbers of clutches of			Mean clutch size
	2	3	4	
T. fumigatus	19	66	2	2.80
T. albicollis	47	2	1	2.08
T. nudigenis	9	41	7	2.96

Table 4
Clutch Size of *T. fumigatus*

Month	Numbers of clutches of		
	2	3	4
October		1	
November	3	5	
December	1	5	
January	1	3	
February	2	5	2
March	2	8	
April	3	6	
May	2	10	
June	4	14	
July	1	9	
All months	19	66	2

and intermediate in *T. fumigatus*. In view of their habitat distributions, this might suggest that food for young thrushes is more abundant in semi-open country than in the forest. There is no evidence on this point, but in open country, where the effect of the dry season is more severe, there may well be a greater flush of insect and other invertebrate life in the ground at the beginning of the wet season than in the more equable conditions of the forest. On the other hand, in *T. nudigenis*, with its short breeding season, selection for a large family may have an overriding effect, whereas in the two species with long breeding seasons there might be a greater selective advantage in the reduced strain entailed in feeding and attending a smaller family. Another factor could be suggested: the high rate of nest predation in forest might, as suggested by Skutch (1949), result in a reduction of clutch size in the two forest species. All, or none, of these factors may be operating, but as yet there is no information enabling them to be tested critically.

There was no evidence of any seasonal change in clutch size in *T. fumigatus* (Table 4) or *T. albicollis*, but in *T. nudigenis* (Table 5) there was a slight,

Table 5
Clutch Size of *T. nudigenis*

Month	Number of clutches of			Mean clutch size
	2	3	4	
May	1	19	3	3.1
June	6	13	4	2.9
July	2	9		2.8

TABLE 6
FAMILY SIZE
(Number of young in nests at 8 days or older)

	Numbers of families of				Mean family size
	1	2	3	4	
T. fumigatus	11	21	12		2.02
T. albicollis	4	10			1.72
T. nudigenis	2	18	20	2	2.52

but statistically insignificant, decrease in mean clutch size as the season advanced.

INCUBATION AND FLEDGING PERIODS

In all three species the eggs are laid daily. In *T. fumigatus* and *T. albicollis* the time of laying was ascertained for seven eggs, as follows:

T. fumigatus 0900–1215 (probably about 1100, when the bird was seen on the nest)
0715–0940
0945–1445 first and second eggs of the same clutch
0700–1100
before 1130 (probably about 1030, when the bird was sitting)

T. albicollis 1100–1215
0720–1145

In working out incubation periods (taken as the time from the laying of the last egg to the hatching of the last young), it has therefore been assumed that the last eggs were laid in the latter half of the morning.

According to the frequency of visits of inspection there was usually a period of from several hours to a day within which the last nestling might have hatched. This accounts for the varying accuracy of the incubation periods which follow. Two were found with almost complete accuracy:

T. fumigatus 12½ (±½), 13, 13 (±1), 13 (±1), 13½ (±¼), 14½ (±¼), 17
T. albicollis 12½ (±¼), 12½ (±½)

In the nest with a 14½-day incubation period, one of the three eggs did not hatch. In the nest with a 17-day incubation period, one of the three did not hatch, and of the other two one hatched two days after the other. In the seven other nests all the eggs hatched. The two long incubation periods were therefore probably caused by the inefficient incubation behavior of the female.

Fledging periods were obtained only for *T. fumigatus.* At one nest, two young flew at 13 or 14 days; at another, two young flew at 14 days, and at the third, two young flew at 15 days. These latter were the two young mentioned above, which hatched at an interval of two days, and they left the nest at the same interval.

In *T. fumigatus,* information on the length of time the young are attended by the parents after leaving the nest was obtained for three families. In one case, a single young bird was seen to be attended by a parent up to 32 days after fledging; in another, a young bird was seen to be fed by the male (color-banded) 28 days after fledging; and in the third case the young bird was still being attended by the male (color-banded) 22 days after leaving the nest. This last young bird was trapped and was found to have started its post-juvenal body molt.

BREEDING SUCCESS

In calculating breeding success, only those nests have been used that were found before the clutch was complete. If nests found during incubation are included, the sample is biased, as the nests found during incubation should be balanced by those that failed at an early stage and so were not found (Snow, 1955*b*). This is especially important when the rate of nest loss is high in the early stages, as in these tropical thrushes. Unfortunately for the present purpose, the majority of the nests of *T. nudigenis* were used by the Trinidad Regional Virus Laboratory for obtaining blood samples from nestlings, so their success cannot be analyzed.

For *T. fumigatus,* 57 nests can be used in the analysis of breeding success; 33 of them, and perhaps 4 more, reached the hatching stage, and young birds fledged from 19 of them (33%). Nests by roadsides and in plantations and gardens were more successful than those in forest: 14 (40%) of the 35 nests in the former habitats were successful, compared with only 5 (23%) of the 22 nests in forest. For *T. albicollis,* 35 nests can be used for analysis; 17 of them, and possibly 6 more, reached the hatching stage, and young fledged from 7 of them (20%). Only 21 nests of *T. nudigenis* can be used, and 7 of them (33%) resulted in fledged young. Predators appeared to be responsible for nearly all the nest losses, but in not a single case was the identity of the predator definitely known.

It is possible to make only a rough calculation of the annual reproductive rate of the three species, taken as the product of the number of nests started per pair per year, the percentages of nests that succeed, and the average family size at the time of fledging. This gives the average number of young reaching the fledging stage per pair per year; the effective reproductive rate—the number surviving to maturity—is of course unknown. The average number

TABLE 7
MOLTING SEASONS
(Numbers of individuals trapped in the three main molt-categories)

Month	*T. fumigatus*			*T. albicollis*			*T. nudigenis*		
	None	Body only	Wing	None	Body only	Wing	None	Body only	Wing
January	14		1	8			6		
February	8			1			3		
March	3			1			3		
April	4			2			5		
May	11						7		
June	15	1		1		2	10		
July	4	2	2	1			13		
August	3		4	3			11	2	5
September	2	1	2	4	2				3
October	2	3	3	3			1	1	1
November	8			6			3	2	3
December	11			9			20	1	

of nests started per pair per year is the least accurately known of these quantities, but it may be taken as three for *T. albicollis* and *T. fumigatus* and two for *T. nudigenis*. We may then make the following rough calculation of the reproductive rates:

T. albicollis 3 broods, 20% success, family size 1.72; reproductive rate 1.0.
T. fumigatus 3 broods, 33% success, family size 2.02; reproductive rate 2.0.
T. nudigenis 2 broods, 33% success, family size 2.52; reproductive rate 1.7.

These figures suggest that in spite of its short breeding season *T. nudigenis* may reproduce more efficiently than *T. albicollis* and not much less well than *T. fumigatus*.

THE MOLT

Data on the molt were obtained by examining birds caught in mist-nets. Each individual caught was noted as showing no molt, body molt (including head and coverts), or wing and tail molt. Several individuals were caught more than once. If they were caught more than once in the same month their state of molt at first trapping was used for analysis; if they were recaptured in a later month their state of molt could again be used. In this way, 131 records of molt were obtained for *T. fumigatus*, 106 for *T. nudigenis*, and 51 for *T. albicollis*, distributed in all months of the year (except May for *T. albicollis*). The results are tabulated in Table 7. For *T. fumigatus* the molting period was found to be July–October, and for *T. nudigenis* August–November. Only two specimens of *T. albicollis* were caught in wing molt, both in June, at the same time and in the same place. None of the 13 adults caught in July–

October were molting the wing. But the numbers for this species are rather few, and it may be that when molting they tend to skulk in the forest undergrowth and fly little. It would be surprising if, with its essentially similar breeding season, *T. albicollis* did not molt at the same season as *T. fumigatus.*

For *T. fumigatus,* limited information was obtained on the duration of molt in the individual. Three individuals were caught twice during the same molt. One which was just beginning to molt when first caught had very nearly finished 90 days later, the wing and tail being complete and the body still molting a little. Another bird accomplished about half of its molt in 50 days, and another was caught at too short an interval for calculation of the total period of molt. Table 2 shows that two of the five intervals between successive nestings that spanned the molt were as short as 95 and 113 days. These birds must have started to molt very soon after they had finished nesting and started to nest again very soon after their molt was finished.

The restricted molting season of a bird like *T. fumigatus,* which has a very long breeding season, raises a general problem. The young may hatch in any month from November to August; their postjuvenal molt probably normally follows soon after they leave the nest (as found in one juvenile banded as a nestling and trapped 22 days after leaving the nest), but their next, full molt comes in the same three months of the year for all of them. Clearly the timing of the annual physiological cycle must be regulated by some external factor, and it must be the action of this external factor in inducing the first full molt at the appropriate time that brings each individual in step with the population as a whole.

COMPARISON WITH NORTH-TEMPERATE *TURDUS* SPECIES

Annual cycle.—Except that its breeding season is a bit later, the annual cycle of *T. nudigenis* is very similar to that of a north-temperate thrush: it nests from late April to August, and molts from August to November. In *T. fumigatus,* and probably also in *T. albicollis,* the molt takes place at about the same time, but immediately after the molt they begin to breed, and breeding continues, at varying intensity, until July. The annual cycle of Trinidad birds is being dealt with in more detail in another paper. With respect to the thrushes, it is sufficient here to point out that the late October and November peak of breeding in *T. fumigatus* and *T. albicollis* seems at first sight to be homologous with the autumn recrudescence of gonads in resident northern thrushes, which in exceptionally mild autumns may culminate in breeding (Snow, 1955*a*). Such an interpretation, however, is questionable. For any sure conclusion one would need a series of observations on the breeding seasons of these and closely related species north through Central America on the one hand, and south across the Equator on the other hand; and supporting data on the season of molt would also be desirable. So far only Skutch's data

(Skutch, 1960) for *Turdus grayi* and *T. assimilis* at 10° N in Costa Rica provide a link with the north-temperate region, and they show no autumn breeding.

An alternative explanation is that the October–November peak is the homologue of the main October peak of breeding south of the Equator. This peak is very marked at Cantagalo, 4° 30′ S, still prominent at Belem, 1° 18′ S (Pinto, 1953), and probably persists as far north as coastal British Guiana, 6° N, where there is a secondary peak of breeding in September (Davis, 1953). There is not enough information on the breeding season of *Turdus* species in British Guiana for comparison with Trinidad, but in Surinam, also at 6° N, the breeding season of *Turdus leucomelas* begins in November and lasts until June (Haverschmidt, 1959), thus closely resembling that of *T. fumigatus* and *T. albicollis* in Trinidad.

Clutch size.—The Trinidad thrushes have smaller clutches than north-temperate species. This is part of a well-known phenomenon, that tropical birds lay smaller clutches than birds of temperate regions, but there is not yet general agreement as to its significance (Lack, 1949; Skutch, 1949). It is of interest that the two species with very long breeding seasons show no evidence of seasonal changes in clutch size, as are found in north-temperate thrushes. There is strong evidence that seasonal variation in clutch size is correlated with seasonal changes in the amount of food which the parents can collect for the young, which depends partly on the length of time for which they can search for it (day length) and partly on its abundance. At 10° N day length varies little, and no seasonal variation in clutch size would be expected for this reason. But there is a great contrast between conditions in the dry season and in the wet, in both of which *T. fumigatus* and *T. albicollis* breed. In the dry season the ground, even in the forest, is usually dry and more or less hard except immediately after rain; while in the wet season it usually remains moist. For thrushes, which obtain their animal food from the ground, such a difference would be expected to have a considerable effect on their ability to feed nestlings. If food for the young were the critical factor determining the upper limit of clutch size, it would be expected that clutch size would be adjusted according to the conditions, as is found in British thrushes (Snow, 1958). These considerations, while not conclusive, suggest that some other factors may be involved in determining clutch size.

Tempo of breeding.—The rate of development of Trinidad thrushes, as measured by their incubation and fledging periods, does not seem to be significantly different from that of their north-temperate congeners (e.g., Snow, 1958; Young, 1955). But in the rate at which successive broods follow one another, *T. fumigatus*, and probably also *T. albicollis*, differs markedly from the north-temperate species; while in *T. nudigenis*, with its short breeding

Table 8

Nesting Success of Trinidad and Some North-temperate Thrushes

Species	Country	Habitat	Number of nests	Number successful	% successful	Source
T. albicollis	Trinidad	Forest	35	7	20	This study
T. fumigatus	"	"	22	5	23	"
"	"	Plantation	35	14	40	"
T. nudigenis	"	"	21	7	33	"
T. merula	England	Woodland	107	15	14	Snow (1958)
"	"	"	63	14	22	Nelson (unpublished)
"	"	"	59	12	20	Mayer-Gross (unpublished)
T. ericetorum	"	"	32	4	13	"
"	"	Copses	73	22	30	"
T. merula	"	Gardens	169	84	50	Snow (1958)
T. migratorius	U.S.A.	Parkland	45	25	55	Howell (1942)
"	"	Parkland and cemetery	176	86	49	Young (1955)

season, the intervals between broods appear to be much as in the north. With their very long breeding seasons, very quick successions of broods would not be expected in *T. fumigatus* and *T. albicollis;* but the selective factors favoring long intervals are not altogether obvious. It may be that too quick a succession of nesting attempts would impose a strain on the parents that would offset the advantage gained from the higher reproductive rate, but we have no evidence that nesting activities in tropical conditions impose a sufficient strain for this effect to operate. When a nest has been successful, there might be a selective advantage in tending the fledged young for a longer period than in the north, and so increasing their chances of survival. Although we have little information on this point, two of the three periods for which fledged young of *T. fumigatus* were found to be attended by a parent (28 and 32 days) were longer than any of the 33 periods recorded for *T. merula* in England (Snow, 1958). Finally, it may be that a quicker succession of nests might result in an increase in the already high rate of nest predation, since it would be advantageous for predators to continue to hunt in an area where they had recently found a nest. With the data available the problem can only be raised, not answered.

Breeding success.—Information on breeding success for some northern thrushes is summarized in Table 8, together with the data for the three Trinidad species. It is evident that breeding success varies widely in the same species according to habitat, nests in man-made habitats being more successful than those in woodland. It is noteworthy that breeding success in forests in Trinidad is much the same as in temperate woodland. If further studies confirm that this is so (and comparisons must be limited to related species with similar nesting habits), it may be necessary to re-examine the generalization, often made, that nesting success in tropical forest is exceptionally low. It certainly is low, but this may be the rule rather than the exception. The real distinction may be, not between the tropics and temperate regions, but between relatively unaltered habitats, where predators abound, and man-made habitats, where predation is much reduced.

SUMMARY

Observations on the breeding of *Turdus albicollis*, *T. fumigatus*, and *T. nudigenis* were made in Trinidad over a period of 4½ years. *T. albicollis* breeds only in forests, *T. nudigenis* in semi-open country, and *T. fumigatus* overlaps them both, breeding both in forests and well-timbered plantations and gardens.

The two forest thrushes have very long breeding seasons lasting for nearly nine months, in contrast to *T. nudigenis*, which breeds at the beginning of the wet season, from late April to August. It is suggested that this difference is ultimately due to the more severe effect of the dry season outside the forest. The two forest thrushes breed right through the dry season, but breeding is inhibited if the drought is very severe at the end of the dry season.

T. fumigatus and probably also *T. albicollis* make three or four nesting attempts in the course of the breeding season; *T. nudigenis* not usually more than two.

Clutch size is highest in *T. nudigenis* (mean 2.96), lowest in *T. albicollis* (mean 2.08), and intermediate in *T. fumigatus* (mean 2.80). There was some evidence of a slight seasonal decline in clutch size in *T. nudigenis*, but no evidence of any seasonal variation in the two species with long breeding seasons.

Incubation periods of *T. fumigatus* ranged from 12½ to 13½ days, with two long periods of 14½ and 17 days which were probably due to inefficient attentive behavior by the female. Fledging periods were 13–15 days. Two incubation periods of *T. albicollis* were both 12½ days.

Nesting success (percentage of nests started which resulted in fledged young) was 33 per cent in *T. fumigatus*, 20 per cent in *T. albicollis*, and 33 per cent in *T. nudigenis*. In *T. fumigatus*, nests in forests were less successful than those in other habitats. It is shown that in spite of its short breeding season the reproductive rate of *T. nudigenis* is probably higher than that of *T. albicollis* and not much less than that of *T. fumigatus*. Data are presented on the season of molt in the three species. In *T. fumigatus* the duration of molt in the individual was found to be about 90 days.

On the basis of these data, a comparison is made between the breeding of Trinidad and north-temperate thrushes.

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WINTER POPULATIONS, BEHAVIOR, AND SEASONAL DISPERSAL OF BALD EAGLES IN NORTHWESTERN ILLINOIS

William E. Southern

As a result of efforts by Bent (1937), Broley (1952), Herrick (1924, 1932, and 1933), Imler (1955), and others, numerous data on the Bald Eagle (*Haliaeetus leucocephalus*) are available. Little of the published information, however, pertains to the winter habits of the species or to winter population dynamics and seasonal movements.

Between 27 November 1961 and 1 April 1962, at the Savanna Army Depot, Carroll and Jo Daviess counties, Illinois, my assistants and I spent 232 hours observing and attempting to trap eagles. Additional time was devoted to other aspects of the project (making and setting traps, securing bait, etc.). On several occasions we spent the entire daylight period in the area.

The study area extended for 14 miles along the Mississippi River and its backwaters and sloughs, which were proliferated with islands (Fig. 1). Most of the slightly rolling terrain bordering the river was covered by deciduous forest. The trees along a portion of the main channel had been thinned to the point that the area (between points 1 and 2, Fig. 1) resembled a park. The study area represented only a small part of the habitat suitable for eagles near Savanna; however, it probably had the greatest abundance of food and, therefore, eagles (we observed only four outside the Depot; three of these during spring dispersal). The concentrations reported during our study were larger than those reported elsewhere in the state.

My objectives were to record behavior, live-trap, color-mark, and determine the movements of Bald Eagles during the winter and early spring. As much additional information (e.g., weight, measurements, plumage, fecal and blood samples) as possible was also obtained prior to a bird's release.

Data presented in this paper are intended as a preliminary report. I hope bird-banders along the Mississippi Valley and in other areas having winter eagle concentrations will develop an interest in a similar project. A coordinated program could contribute significant data regarding seasonal movements of eagles and accordingly their conservation.

The study was supported by a grant from the Frank M. Chapman Memorial Fund. Northern Illinois University provided a research vehicle. Field assistance was given by James Tate, Jr., and Alfred Bjelland. Major Ira Meyers arranged for us to conduct our study on the United States Army Savanna Depot. Fish and Wildlife Service personnel, particularly Herbert Troester, aided the project by offering many valuable suggestions and by loaning equipment. Alexander Sprunt IV, of the National Audubon Society, assisted by placing articles in local newspapers to acquaint the public with the project and to request that color-marked birds be reported to the Society. Several commercial fishermen, including Richard Brown, aided us in various ways. Weather records were ob-

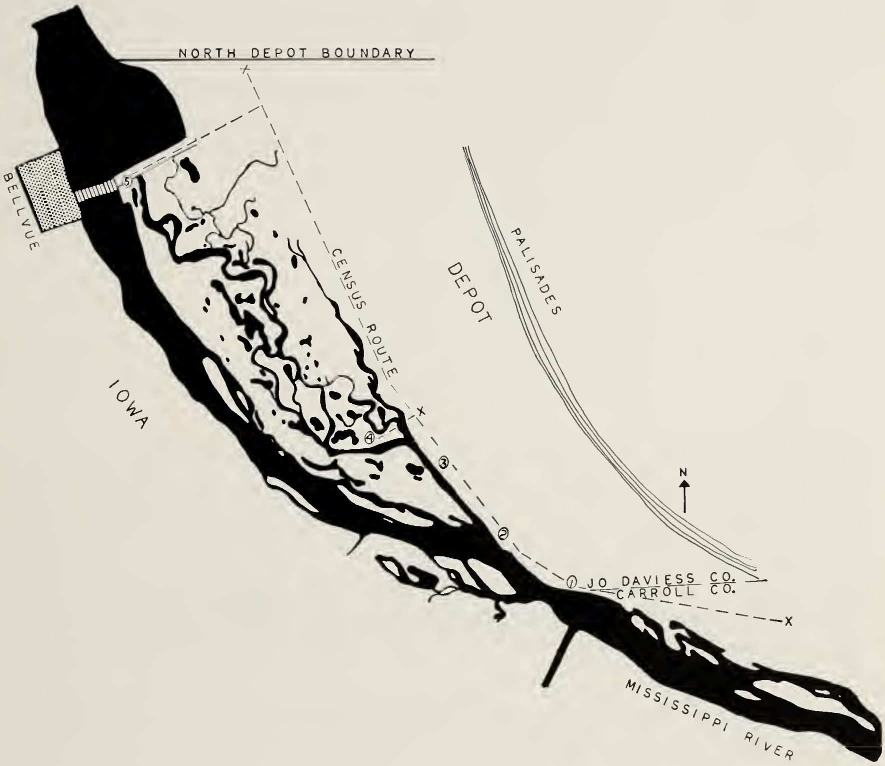

FIG. 1. Map of the study area. Plots marked 1, 2, 3, and 4 are four major feeding areas (see text). Area 5 is Lock and Dam 12.

tained from Raymond DePauw, Lockmaster at Lock and Dam 12. The success of this project was directly associated with the efforts of these individuals and organizations.

POPULATIONS AND FLUCTUATIONS

In recent years the populations of Bald Eagles wintering in the Central United States attracted the attention of ornithologists. Musselman (1949) was one of the first to publish comments regarding eagles wintering along the Mississippi River between Illinois and Iowa. The birds originally fed on offal from a packing plant, but later the abundance of fish at the new Keokuk dam attracted them. In the winter of 1947 and 1948, Musselman reported a total of 83 eagles, which was greater than concentrations previously observed in the area. He noted that the birds congregated along the river about 15 December and departed about 15 February.

More recent publications of Imler (1955), Robbins (1960), and Fawks (1961) indicated further the importance of the Mississippi Valley as a winter-

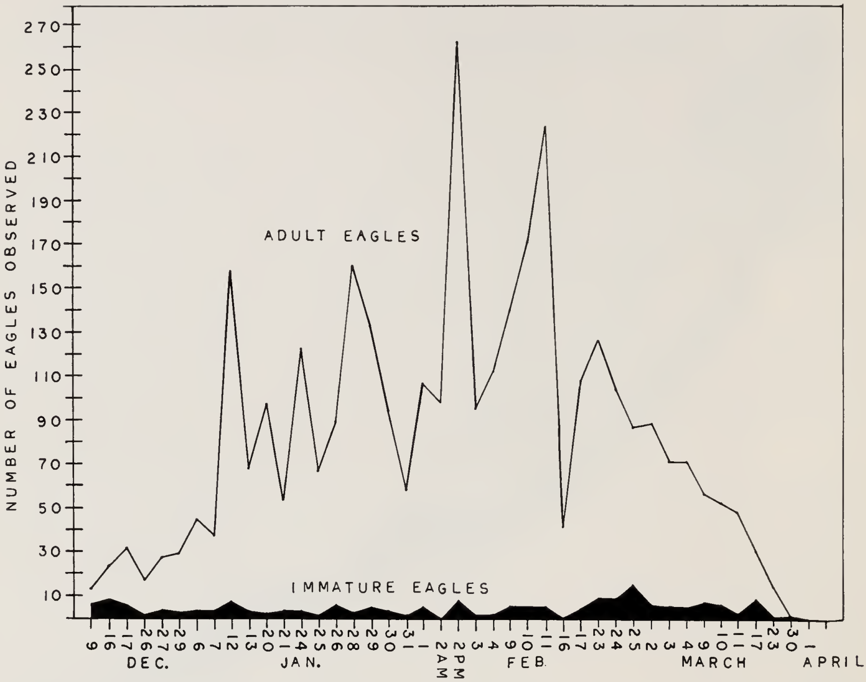

FIG. 2. Population fluctuations of adult and immature Bald Eagles as indicated by 41 counts during the winter of 1961–1962.

ing area for Bald Eagles. Data presented by Fawks (1961:56–57), however, are misleading, since the figures for some regions apparently include all birds observed during a period of several weeks or months.

Robbins (1960:4) analyzed the Bald Eagle records published in the Christmas Bird Counts sponsored by the National Audubon Society and noted a trend toward higher counts in the Mississippi Valley during the past 15 years. The counts, however, showed marked variation from year to year because of unequal coverage. He suggested the pools below dams caused eagles to concentrate near such localities.

My study indicated that daily variations in the eagle population were to be expected and that pools immediately below dams were of little importance in concentrating the birds. A single count by observers on the ground during any one day was an unsatisfactory indication of the eagle population for an extensive area. Observations over periods of several days were perhaps more indicative (Fig. 2). Censusing by airplane, as has been done by the Fish and Wildlife Service, appears to be a suitable method. Eagles were counted during the 1961 winter waterfowl survey and the number reported during mid-Febru-

Table 1
Major Winter and Spring Changes in Ice Conditions on the Mississippi River, Savanna Army Depot, 1961–1962

Date	Ice conditions within study area
9 December	First ice formed on sloughs
16 December	Backwaters and much of main channel frozen
26 December	Few open holes remain in main channel and sloughs
*29 December	Only four open holes (see text) remain open
10 March	Many open holes in main channel and sloughs
23 March	Main channel open; sloughs partially open
30 March	No ice; high water; sloughs flooding

* Periods of above-freezing temperatures caused these holes to enlarge.

ary at the Upper Mississippi Refuge was comparable to our high count (262) for a portion of the refuge (Savanna Depot) on 2 February.

Several guards at the Depot, employed there since the early 1940's, recalled that there were few, if any, Bald Eagles wintering on the Depot prior to 1942. This statement was substantiated somewhat by the trend indicated by Robbins (loc. cit.). Construction of Lock and Dam 12 (Fig. 1) was the only change recorded in recent years that might have affected eagle populations near Savanna. Provided the dam was responsible for maintaining the extensive sloughs, and thereby indirectly responsible for the open areas used by eagles when feeding, its influence was definite; otherwise it seemed of little importance. Once during the study we observed an eagle feeding at the open water below the dam and on several occasions one or two birds were observed in trees near the dam. Fish were not readily available near the dam.

Although eagles perched elsewhere (e.g., occasionally within the dense forest during early December), the concentrations always occurred near areas of open water on the frozen main channel or sloughs. Most sloughs appeared heavily populated by fish and this prey seemed more readily available to eagles feeding in these areas than to those feeding along the swifter main channel of the river. Certain groups of large dispersed trees were consistently used as loafing areas for one or more (occasionally 20 or 30) birds.

Four localities (Fig. 1) generally had large eagle concentrations after most of the river and its backwaters were blocked with ice (Table 1). Two of these were open areas about 1.5 miles apart on the main channel. In most instances eagles were observed perched in trees, but, with some regularity they were also seen standing on the ice or on the beach. The size of the open holes varied with the severity of the weather. One was closed completely during a brief but extremely frigid midwinter period. Increased water flow resulting from warmer weather upstream tended to enlarge the open holes. The result of very low temperatures, therefore, was not always a reduction in the amount of open water in the main channel.

Two other areas located near the center of the study area had sizable eagle concentrations. One was a slough with open water along the mainland bank. The open water was a result of seepage from small springs in the bank. The warmer water which entered the slough retarded freezing. Nearby Palisade outcroppings of Saint Peters Sandstone (approximately 900 feet above river) probably influenced spring flowage. The width of the open water varied from a few inches to 12 or 15 feet depending on the temperature, and the depth gradually increased to 30 inches. Occasionally open water occurred along a mile or more of shoreline although it was normally restricted to a series of distinct holes scattered along approximately 100 yards of beach.

The remaining area was near two culverts through which water from Crooked Slough flowed with enough force to maintain an open hole of some size throughout the study. During the winter the hole was as large as 100 by 30 yards and as small as 25 by 8 yards. This area was adjacent to the one described immediately above.

FOOD AND FEEDING HABITS

The extremely abundant Gizzard Shad (*Dorosoma cepedianum*), three to four inches in length, were the primary food of the eagles, but occasionally small carp (*Cyprinus carpio*) and buffalo (*Ictiobus* sp.) were taken. Throughout most of the winter the open holes along the shore were literally choked with shad probably as a result of the intolerance of the species to reduced amounts of oxygen or to decreased temperatures as was reported for the American Shad (*Alosa sapidissima*) by Tagatz (1961). Many were dead or dying and the live ones often swam near the surface or in very shallow water. The fish are relatively weak swimmers and were thus vulnerable when exposed to sudden changes in current. The result was an almost constant and readily available food supply for the eagles.

The eagles preferred live fish and attempted to catch them, even with quantities of dead ones available on the ice or in the water. In areas where the water flowed most swiftly the shad, on occasion, became helpless, turned on their silver sides, and approached the surface. This was apparently when the eagles caught them. Four methods were used by Bald Eagles to capture live shad or other fish.

1) Swooping from a perch and striking at fish with the talons. This method provided success no more than 25 per cent of the time. If a bird caught a fish it flew to the ice or nearby tree and consumed its catch. Often other adults or immatures attempted to steal the fish. In fact, immatures seemed more eager to take fish from adults than to capture their own.

2) Flying back and forth or circling over open water, and then swooping down and striking with the talons. This method was no more, and possibly less, successful than Method 1.

3) Standing on the edge of the ice and reaching into the water with talons or beak. Although this method seemed somewhat successful, very few eagles used it.

4) Wading in shallow water and catching fish with the beak. This method was used along the shore of the main channel, its backwaters, and the running water of Crooked Slough. It was the most successful manner of feeding. Adult eagles, and occasionally immatures, waded up to their bellies in water and characteristically submerged their heads when capturing fish. I watched one adult capture and swallow at least 10 shad, head end first, in two minutes. The eagles were most wary while in this situation. Sometimes the body and flight feathers were so wet that the bird had difficulty taking flight.

Even though Methods 1, 2, and 3 provided fewer fish during a specific amount of time than Method 4, each was successful enough to satisfy the requirements of the birds. Each method seemed to be particularly suited for, although not always used during, certain feeding conditions (e.g., depth of water, size of open area, etc.).

Another source of eagle food was supplied by the activity of commercial fishermen, who discarded quantities of rough fish during their operations, these being placed in piles or scattered on the ice. On 7 January, we saw 10 eagles feeding on one pile of fish and three on another. Although the commercial fishermen related that eagles swooped down and removed fish from their ice-boats and fed on piles of fresh fish while they were still nearby, we found the birds too wary to approach such piles until several days had elapsed. It is possible that food was more plentiful this winter than it had been during previous years and, therefore, the birds did not have to rely upon this food source.

Common Crows (*Corvus brachyrhynchos*) fed on our bait and more commonly on the dead shad at the open holes. It was not unusual to see as many as 150 Crows in such feeding places. Often eagles fed simultaneously.

About 300 Common Mergansers (*Mergus merganser*) and a few Common Goldeneyes (*Bucephala clangula*) wintered in the area. Their presence seemed to have little influence on the eagles. We observed eagles make several unsuccessful attempts to capture mergansers. The ducks, appearing to sense an eagle's attack, dived quickly as it approached. The ability to dive quickly apparently permitted mergansers and eagles to use the same food supply but prevented mergansers from supplementing the eagles' diet. That eagles will take birds of this size is evidenced by my observation on 26 December 1956, near Charlevoix (Charlevoix County), Michigan. An adult Bald Eagle swooped down, struck, and carried off an adult Herring Gull (*Larus argentatus*) that was one of several standing on the ice of Lake Charlevoix.

During our trapping attempts bait of various types was used. The eagles preferred rough fish (carp, buffalo, etc.) to frozen shad. Several hundred pounds of frozen carp were used during the project. Several days always elapsed before our bait was eaten. Often one or more eagles remained perched in trees near a pile of fish for most of the day and seemed to watch the bait. Although we could not be certain, it seemed that the same group of birds watched the fish for the period prior to feeding.

Two dead deer that we used for bait were completely devoured. Almost two weeks elapsed between the time the bait was put out and the time when the first eagle fed on it. Immatures fed most actively on this bait and scattered hair over an area of several feet. Rib cartilages and the distal bony portion of ribs were also consumed. On one occasion I observed two deer leave the woods and start across the main channel of the river. An immature eagle that was flying past detoured and slowly circled low over the second deer. The eagle followed the animal halfway across the river and at times was no more than 6–8 feet above it. On several occasions during this period the bird's behavior suggested, to me, that it might attack the deer.

There appeared to be a definite correlation between the degree of eagle concentration and the availability of shad. However, large numbers (more than 25) of birds did not seem to feed in one area for a long period of time. This was probably due to the aggressiveness shown by some adults and most immatures. Conflicts and pursuits were common within large congregations even though food was plentiful.

CENSUS METHODS AND RESULTS

An improved Army road paralleled the study area (Fig. 1) and several side roads ended at the river (total distance of roads, 19 miles). The distance from the River Road to the Mississippi River varied from about 25 yards to almost two miles. The river, sloughs, or backwaters bordered the west side of the road for all but about two miles of its length. Eagles were censused along this route by the direct count method from an automobile, thereby reducing the chances of flushing birds and duplicating our count at another site. Censusing was aided by use of 8×30 binoculars and a $20\times$ scope mounted on the auto. Eagles visible on both sides of the river (Iowa and Illinois) were recorded. Possibly on occasions we overlooked eagles because we did not walk into areas not readily observable from the road. Therefore, some of our census figures may have been slightly lower than the actual population. We were, however, confident that our count was not greater than the number of birds present.

We censused the population during 41 of the 53 days spent in the area between 27 November 1961, and 1 April 1962. On some days we did not count the birds because our work at trap sites had altered the number of birds present. The results of this census are presented in Fig. 2. No attempt was made to smooth the curve since the points represent the actual number of birds counted and since irregular periods elapsed between counts. This method provided an accurate indication of the population fluctuation and also permitted a comparison with our weather data.

Several factors obviously affected our counts. On clear sunny days when the temperature began to rise about noon and the thermals were optimum, many eagles were observed soaring over the river, woodlands, and bluffs. It was often noticeable on such days that the birds were more dispersed during the morning hours. Increased amounts of Army traffic along the River Road reduced the number of birds in the areas of disturbance. Also, the availability of food, at particular feeding sites, varied with the changing ice conditions (Table 1). We were unable to explain the somewhat sudden increase or decrease in numbers during a particular day. For example, on 2 February, at 1030 we recorded 98 adult Bald Eagles, but when we made a second count at 1230, to demonstrate our technique to Herbert Troester of the Fish and Wildlife Service, we recorded 262 Bald Eagles, eight of which were immatures. Three Golden Eagles (*Aquila chrysaëtos*) were also present. At the first open hole (Fig. 1) we counted 103 adult and eight immature Bald Eagles; at the second there were 95 adults; at the other two open areas there were 11 and 32 adults; and the remaining 12 birds were observed in trees along the road. For some reason the birds congregated in trees along the bank in larger groups than usual. Often there were eight or ten perched in one tree. I doubt that such an increase indicates a northward migration as Fawks (1961:54) suggested. Instead, it may represent the result of a particular set of climatic conditions which caused the eagles, previously dispersed throughout the extensive slough areas, to congregate at the open holes within the census area. On this occasion the sky was overcast and a light rain was falling, but these conditions were experienced on other occasions without noticeable effects on the density of eagles.

Evidence that may be purely coincidental but that cannot be ignored lends some validity to the idea of a northward migration on 2 February. On 29 January, ice was breaking up on the Mississippi near Cairo (Pulaski County), Illinois, and ice-breakers were in operation. These conditions may have caused wintering eagles in the area to move northward in search of more suitable feeding areas. It is possible for eagles to make the 400- to 500-mile trip in time to boost the Savanna census on 2 February. The presence of other feeding areas south of the Depot, however, makes this possibility highly improbable.

The peak population was reached by 12 January, approximately two weeks after maximum ice conditions (Table 1), and was maintained until 23 February, after which a steady decline was noticed until 1 April, when no eagles were seen. It is likely that the highest count (262) recorded on 2 February, approached the figure for the actual population of the area. Fluctuations during the peak period probably were the result of factors previously discussed. Although three- or four-day periods of warmer weather were occasionally followed by the observation of increased numbers of eagles, we were unable to definitely correlate weather conditions or the amount of open water, and thereby food, with the number of birds observed. Needless to say, these factors are important and undoubtedly influence the suitability of the area to wintering eagles but the daily changes did not appear extreme enough to account for the variation in census figures.

ROOSTS

Roosts were noted on two or three occasions, and birds were heard calling from these areas after dark. Each roost was in large deciduous trees and near feeding areas. Birds disturbed by one of us walking into a roosting area failed to return to that particular site. Several times at dusk we watched eagles flying in one by one to roost; but a massive flight, or an indication that all eagles in the area used one roost, was not evidenced. There was no indication that they left the study area to roost.

NUMBERS OF IMMATURES

The numbers of individuals in both age groups varied throughout the winter. During late winter and to some extent early winter (Fig. 2) a larger percentage of the total number of eagles were immatures. As winter progressed the overall proportion of immatures to adults decreased. Comparing the largest number of immatures (15 on 25 February) with the greatest number of adults (254 on 2 February) recorded at any time during the winter the proportion of immatures to adults was 1:17.

Observations of the eagles wintering at Horseshoe Lake (Alexander County) in southern Illinois indicated a much higher proportion of immatures. On 26 December 1961, we counted 15 adults, 19 immatures, and seven of unknown age. Similar figures were available for 1960; on 29 December, we counted 14 adults and 12 immatures (46 per cent immatures). These figures indicated a tendency for immatures to range farther south. Possibly this tendency coincided with the movements of, and wintering areas for, waterfowl. On several occasions at Horseshoe Lake we observed immatures feeding on Canada Geese (*Branta canadensis*). No kills were witnessed and the geese were not startled by the movements of the eagles.

As a result of our work I am of the opinion that the proportion of immature Bald Eagles to adults cannot be obtained by censusing birds wintering in the Mississippi Valley bordering Illinois because these areas are apparently not equally suitable for both age groups; nor can a realistic view of the reproductive success of the species be obtained by this method. Moreover, it is not possible to determine accurately the movements of birds having unusual plumage (e.g., white coverts) as suggested by Fawks (1961:59). Careful and prolonged observations of eagles in the Savanna area indicated such variations were more common than expected and might be related to age. During one morning we observed three immature eagles with white coverts and partially white underparts. Two were observed simultaneously. Had these birds been observed singly we might have assumed that they were the same individual. This particular type of plumage variation, with modifications (e.g., a white triangular patch on the back), was recorded several times during the winter.

TRAPPING METHODS AND RESULTS

During the winter we experimented with a variety of trapping techniques. Although eagles were caught in but one type of trap, I am confident that additional methods, described herein, will work satisfactorily under proper climatic conditions.

The trap in which we finally captured eagles was a modified Bal-Chatri which I called a platform snare. The platform was a two-foot-square section of hardware cloth (mesh ½″ × 1″) to which we attached approximately 75 nylon snares. The snares were constructed from 60-pound-test transparent monofilament fishing line. The knots were coated with Duco Cement at the point of attachment between snare and platform. This caused the snares to stand more erect, increasing the chances of a bird's foot entering the loop. The four- to five-inch-diameter loops were arranged so that they overlapped slightly.

Platforms were placed in areas of eagle concentrations: near piles of dead fish or deer used for bait; on river or slough edges where the birds landed or walked; and in the water where they waded in search of food.

The main disadvantage of this trap was noticeable when we used it on ice or on snow-covered beaches. Often the platform became embedded in ice or crystallized snow and made the loops inaccessible to walking birds, or prevented them from closing. Light snowfalls did not affect the operation of the snares.

Two adult eagles were caught in snares set in the water at Crooked Slough. This was one of the places where, during late winter, the eagles waded in search of fish. Several other birds were caught in the snares, but the banks of the slough and debris sometimes concealed trapped birds and they escaped before we reached them.

Platforms were placed on the bottom in three to six inches of water. The metal portion of the trap was slightly concealed with mud or sand, leaving the nooses protruding. While wading, the eagle entangled its toes in the nooses and its next step resulted in the noose being pulled tight. On each occasion the bird was caught by only one or two toes. Attached to the trap was a two- to three-foot piece of flexible wire which was, in turn, attached to a five- or six-pound weight. This permitted the bird to move the platform, reducing the chances of its pulling out of the trap or injuring itself.

Baits of various sorts (frozen fish, deer) were tried in attempts to lure eagles to trap sites; but, because the birds were hesitant to feed on our bait, none was captured at these sets. Usually the birds waited several days before feeding on our bait, and in the meantime it was necessary for us to close our traps and return to the University. When we returned to the area the bait was usually gone and had to be replaced. During previous winters extensive commercial fishing operations were conducted within our research area. According to fishermen and Depot guards the eagles fed on the trash fish (game fish or unmarketable species or sizes) thrown on the ice, often while the fishermen were still nearby. If these operations had continued this year our success at bait sets may have been better. On two occasions early in the winter before shad were numerous we observed 3–13 eagles grouped closely together feeding on piles of fish.

Because of our observation we decided to use a cannon net. We placed it on the ice where we had observed the eagles feeding and baited the area heavily with fish. The brown net contrasted with the white snow and ice and caused the birds to withdraw from the area, so we attempted to camouflage it by attaching white cloth to the lead edge. We also put canvas under the net to prevent it from freezing into the snow and ice. Inclement weather nevertheless harassed the use of this equipment. Later the net was placed along the shore of an open hole where the eagles were feeding. We also tried to use a mounted eagle and crows as decoys but each attempt failed. If food had been more scarce and if the eagles were required to feed in more specific areas, I believe that the net would have worked.

Steel traps were also used. That these proved unsatisfactory possibly meant that we used sizes (numbers 1 and 1½) too small for eagles. On several occasions traps were sprung at bait sites or water and beach sets but never did it appear that a bird was even momentarily caught. The springs of the traps were weakened and the jaws padded with friction tape. Larger traps were not used because of possible injury to the birds. Changing weather conditions

TABLE 2

CAPTURE, MARKING, AND REPORT DATA OF BALD EAGLES IN 1962

Date	Age	Sex	Band number	Locality captured	Color-markings	Reports
17 February	A	M	528-98106	Hampton, Illinois (Lock and Dam 14)	Rectrices and primaries orange	18 February; near Burlington, Iowa by Mr. Clark Archer.
25 February	A	F	No Band	Savanna, Illinois (Lock and Dam 12)	Rectrices yellow	None
4 March	A	F	509-52601	Savanna, Illinois (Lock and Dam 12)	Rectrices red	26 March; 8 miles south of Rapid City, South Dakota by Mr. Alfred Stein.

and an abundance of raccoons (*Procyon lotor*) hampered the use of this method.

Various modifications of nylon snares were also tried. Nooses were designed to encircle large (10- to 12-inch) shad in such a way that the foot of a bird striking the fish would penetrate the loop and cause it to close. The free end of the line was fastened to a weight on the river bottom. The fish were eviscerated and filled with styrofoam of a size and shape that made the fish float in a normal fashion or on its side as we desired. We placed the rigged fish in the open water of the main channel and Crooked Slough before daylight (the general practice for setting and servicing all of our traps). The eagles failed to show interest in bait so arranged.

During the project three Bald Eagles were caught and color-marked. Two were captured at the Savanna Army Depot and a third by the assistance of Peter Petersen, Jr., at Hampton, Illinois (Table 2).

After removal from the trap the eagles were hooded and placed in long knit cones for transit to the automobile. This method worked well, reducing the bird's struggling and thereby the risk of injury to it and to the investigators.

At the car the bird was weighed, measured, sexed by cloacal examination, banded with Fish and Wildlife Service lock-on bands, and finally released. The entire operation required about one hour.

Dyes obtained from the National Analine Division of Allied Chemical Corporation were used for marking. Three of the colors (wool orange, fast crimson, fast light yellow) recommended by Allen Duvall, Patuxent Wildlife Research Center, were used. The recommended mixture was one ounce of dye and one-half ounce of detergent (Lestoil) diluted in one quart of warm water. Application was with a synthetic sponge. Although we had worked out an elaborate color-code it was apparent, when we caught our first bird, that we would not be marking as many as originally planned; therefore, we discarded our code and marked the tail of each bird a solid color. Petersen also marked the primaries of the Hampton bird.

REPORTS OF MARKED BIRDS

Three individuals reported seeing marked eagles. One report from Moline, Illinois, was invalid because the exact pattern of the marking could not be reported. The two reports I considered valid appear in Table 2. The report from South Dakota is of special interest since it suggests a funneling of birds into the Mississippi Valley from a wider belt of the Northern United States and Canada than I previously suspected. To my knowledge, these are the first substantiated reports of the movements of marked live Bald Eagles.

SUMMARY

A study of eagle populations was conducted during the winter of 1961–1962, in northwestern Illinois.

The eagles concentrated near four areas of open water along the Mississippi River and its backwaters. These areas remained open throughout the winter and an abundance of food was present. The primary food was live Gizzard Shad. Four methods were used by eagles to capture fish. Frozen fish, deer, and ducks were also consumed by the eagles.

Eagles were censused during 41 of 53 days. The largest number recorded on a single day was 262. The population varied considerably, but the peak was reached by 12 January and was maintained until 23 February. All of the eagles had departed by 1 April.

Roosts were located, but only a few birds were there; the same area was not used by the eagles throughout the winter.

The number of immatures sighted on any one day was 15. The overall proportion of immatures to adults was 1:17. More immatures, in proportion to adults, were observed farther south in the state.

Several eagles with similar plumage variations were recorded; hence, such birds cannot be positively identified by observers.

A variety of techniques was used in attempts to capture eagles. Three adults were trapped and color-marked. Two of these were caught in platform snares.

Two validated reports of color-marked live eagles were received. One report was from South Dakota.

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FALL MIGRATION AND WEATHER, A RADAR STUDY

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Many ornithologists have found evidence of a relationship between changing weather and the timing and volume of bird migration. Recently, Lack (1960*b*) reviewed much of this work on the weather factors which appear to affect flights of nocturnal migrants. His review represents a real contribution and a service to students of migration, but certain of his generalizations and conclusions are so at variance with findings from our own studies that we feel called upon to discuss the subject further in detail.

Behavior patterns of migrants vary not only from species to species, but probably also from place to place. Lack's conclusion (p. 185) that low temperature in autumn is the dominant factor in stimulating flights of migrants may be true of migrants in some areas of North America and the old world, but this relationship, i.e., temperature change and migration, does not generally hold for nocturnal migrants in the Great Lakes area of the United States, at least in early and mid-fall. It is the purpose of this paper to consider the factors that do influence migration in this area.

Our data were acquired with the use of a 3-cm (APS-31) radar installed at the University of Illinois Airport south of Champaign, Illinois, specifically for the purpose of observing migration (see Graber and Hassler, 1962). In 1961–62, radar observations of migration were made by Graber across a three-state area (Iowa, Illinois, and Indiana) and we believe that the data presented here are generally representative of a large section of the midwest, not merely of our local area. The study, initiated in the spring of 1960, was supported by the National Science Foundation and the Illinois Natural History Survey.

METHODS

Drury, Nisbet, and Richardson (1961) presented an excellent review of the radar studies of migration. The equipment used in this investigation and the methods of collecting and recording data were described by Graber and Hassler (op. cit.).

We have utilized the relative flight densities and flight altitudes taken from our radar film record for the period 2 August 1960 through 30 October 1960. The number of bird targets detected by the radar during each 2-minute period of film exposure was counted. To determine whether flight densities of migrants varied from hour to hour during the night, we computed hourly densities for each night, and constructed a curve (Fig. 1) representing the typical hourly trend of the migration activity. This curve includes data (averaged) from 10 nights of migration between 5 August and 11 September. The

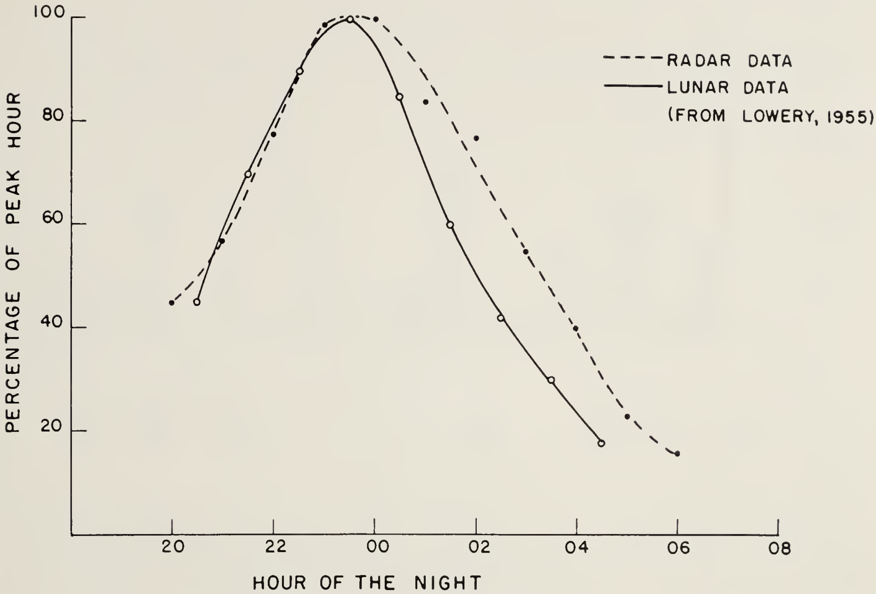

FIG. 1. Comparison of average temporal patterns of nocturnal migration obtained from lunar and radar data. Solid line is Lowery's curve "A" (1955:259). Broken line was plotted from radar data (averaged) for ten nights in autumn 1960. Nights included were clear, and without change in surface wind direction. Curves are based on hourly data plotted as percentage of the peak value.

seasonal variation in flight density was graphed (Figs. 2, 3, 4) from the average volume of flight per hour for each night, obtained by dividing the total nightly count by the number of hours of operation (usually sunset to 0500 CST). No attempt has been made to equate these relative densities to the true number of birds in flight. Because of technical trouble, radar data for the nights of 9 August, 2, 7, and 8 September, and 18 October are missing.

Meteorological information which we examined in order to obtain an accurate picture of the weather conditions during this 3-month period include the U.S. Weather Bureau daily surface maps; microfilm copies of the hourly surface observation made at Chanute Air Force Base, Rantoul, Illinois (about 25 miles north of the radar station); thermograph, barograph, and recording anemometer records supplied by Illinois State Water Survey stations in Champaign; and winds-aloft data from the nearest radiosonde station (Peoria, Illinois).

The daily surface map describes the location of surface weather phenomena (i.e., fronts, high and low pressure centers, areas of precipitation, etc.) at 0100 and 1300 EST, or 0000 and 1200 CST. The Rantoul surface data include

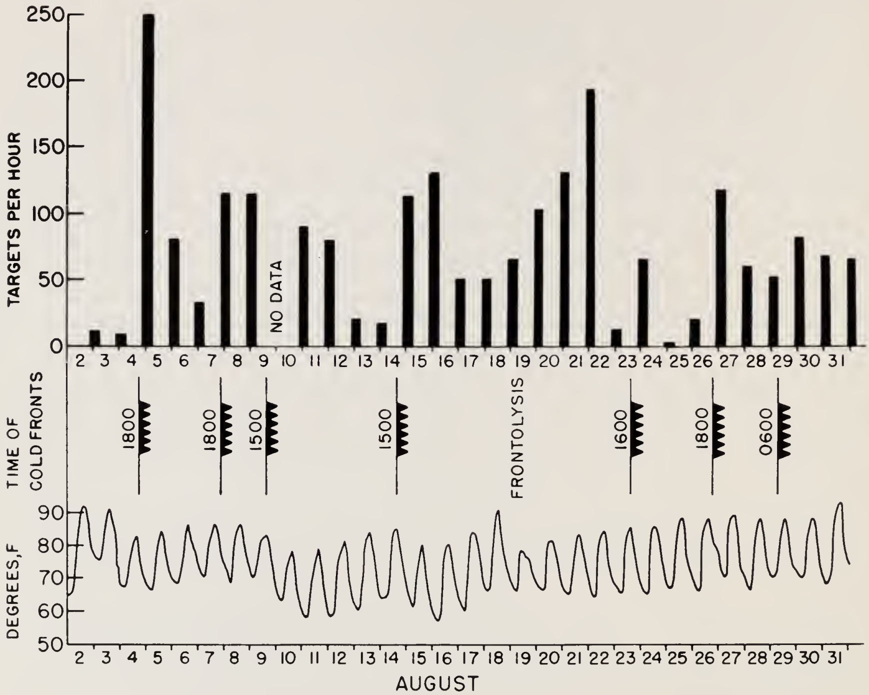

Fig. 2. Volume of nocturnal migration, cold front passages, and temperature at Champaign, Illinois, during August 1960. Bars represent the average number of bird targets per hour detected each night during the period from sunset until 0500 CST. Pips indicate midnight. Cold front symbols indicate to the nearest hour the time at which the pressure trough passed Champaign. The continuous daily temperature curve was constructed from thermograph charts, with values plotted for every three hours.

temperature, dew-point, barometric pressure, surface wind direction and velocity, sky cover and precipitation, recorded hourly, or more frequently when changing conditions warranted. The barograph, thermograph, and anemometer charts provided a continuous graphic picture of variations in pressure, temperature, and wind speed and direction.

Using the surface maps and the Rantoul observations, we determined the time of passage of each cold front through Champaign during August, September, and October 1960. Theoretically, a front is defined by the line of temperature discontinuity between the two air masses involved and this temperature discontinuity coincides with the pressure trough and wind-shift line. Actually, however, a frontal "line" is an area of considerable width in which the temperature, pressure, and wind may all be changing at different rates, locations, and intensities. The pressure trough is used to plot the position of the front on

Table 1

Temperature on First and Successive Nights of Migration Waves, Autumn 1960

Temperature	Dates		
	August	September	October
Lower			
Initial night of wave	4, 10, 19	9, 19, 25, 30	6, 19
Successive nights of migration	15	16, 20, 28	3, 7, 15, 23
No change			
Initial night of wave	7, 14, 23	17, 27	2, 14
Successive nights of migration	8, 11, 20, 21	26	
Higher			
Initial night of wave	26, 29	3, 11, 22	9, 22
Successive nights of migration	30, 31	1, 4	8, 10, 11, 20

the surface map. Since it is also the easiest of the various elements to localize in time, we shall, for convenience, define the time of occurrence of the pressure trough to be the time of cold front passage, and will discusss temperature and wind changes in relation to it. The barograph records enabled us to locate the time of this pressure fall and rise within approximately one hour.

To determine specifically how the elements of weather might influence migration, it was necessary to study both the daily weather conditions under which the birds were living, and the nature and magnitude of the changes which occurred with the passing of fronts. In preparing Tables 1 and 2 from this analysis we defined the "first night of a wave" to be a night on which an increase in migration volume occurred following one or more nights of decrease. An increase of less than 30 targets per hour was not considered significant, as this represents an increase of only one target per film frame and is within the possibility of error in film analysis. Nights included in the tables as having significant continuing migration after the initial night of a wave are those on which the density was approximately two-thirds or more of the density on the first night or which showed migration of 200 targets per hour or more.

The "average" temporal curve.—Lowery (1951) showed that the flight density of migrants was not constant but varied with the hour of the night. He pointed out several patterns of variation but found one particular pattern which occurred most frequently. In this pattern the flight density of migrants increased sharply after sundown, reached a peak around midnight, and fell off steeply thereafter. In fall at Champaign the common temporal pattern shown by our radar observations was very similar to that presented by Lowery based on lunar data (Fig. 1). Lowery also discussed various factors which could

TABLE 2
SURFACE WIND DIRECTION ON EACH NIGHT OF AUTUMN 1960

	Wind direction				
	NW–NE (310–060)	Calm	E (070–110)	SE–SW (120–240)	W (250–290)
Initial night of wave					
August	4, 10, 14, 23, 26	29 (360°)		19	7
September	9, 11, 17, 19, 22, 25, 27, 30			3	
October	2, 6, 9, 14, 19			22	
Successive nights of migration					
August	11, 15, 21			8, 20, 30, 31	
September	26, 28	1 (360°)		20	4
October	3, 7, 8, 10, 15, 23	11 (090°)			16, 20
Nights of little or no migration					
August	22	3 (variable) 12 (180°)	5, 16	2, 6, 13, 17, 18, 24, 25, 27, 28	
September	12, 29	14 (220°)	5, 10, 13, 15	6, 16, 18, 21, 23, 24	
October	17		24	1, 4, 5, 12, 13, 21, 25	

affect the pattern including the method of observation itself, species differences among the migrants, and topography of the land.

In our entire fall record (85 nights) we found few exceptions to the "average" temporal pattern, but these exceptions are important in showing the influence of weather on the flight density of migrants. In the ensuing discussions it will be necessary to refer to the average temporal pattern and the exceptions.

TIMING OF FALL MIGRATION WITH COLD FRONTS

Many investigators have observed that waves of migration followed the passing of a front. Graber and Cochran (1960) presented information on the precise time relationship between migration and fronts, but their audio data were subject to special behavioral interpretation, and the radar data presented here are superior for analyzing the timing of migration with various environmental factors. Some migration was detected by radar at Champaign on every night recorded but one (21 October) between 1 August and 25 October 1960. It is nonetheless true that migrants pass through this area in definite waves or rushes (Figs. 2, 3, 4) of which there were eight in August, nine in September, and six in October. Marked increase in migration followed 19 of the 20 frontal

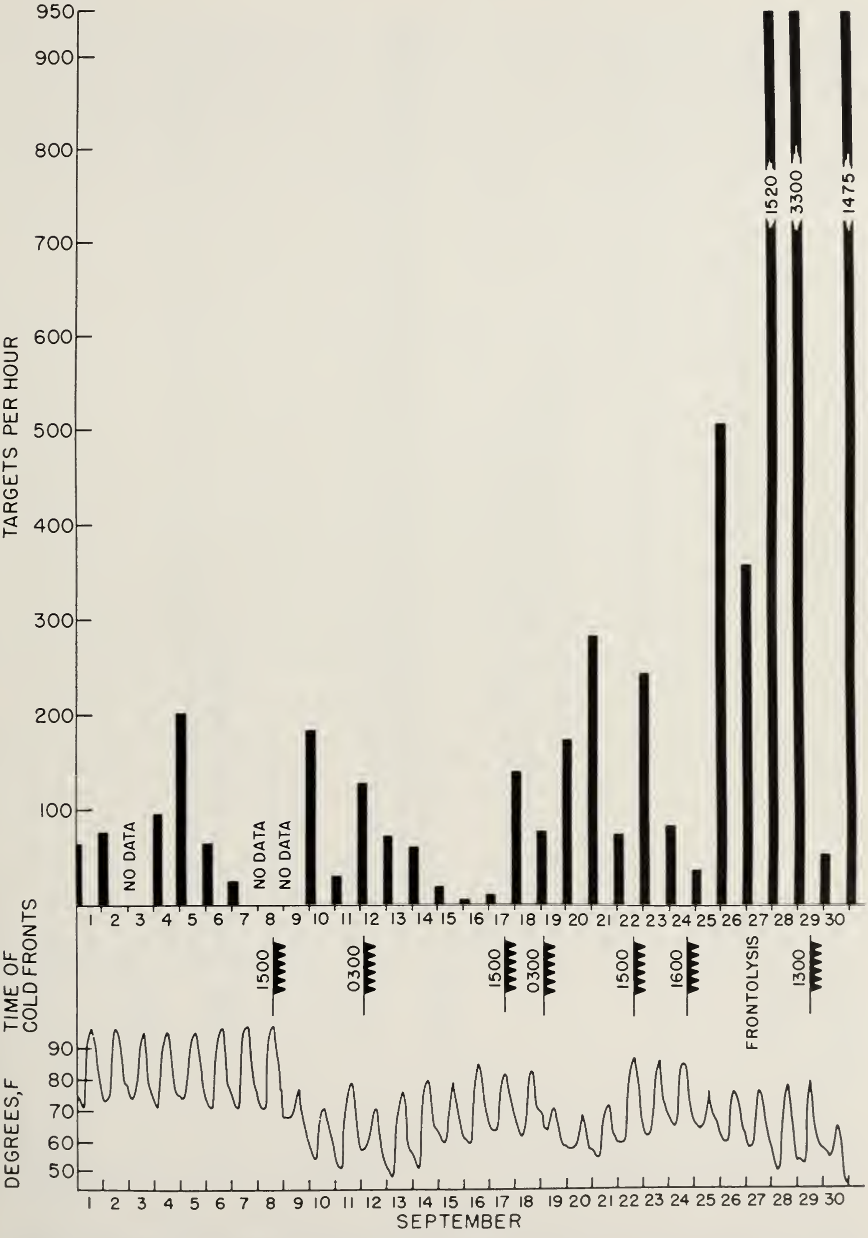

FIG. 3. Volume of nocturnal migration, cold front passages, and temperature at Champaign, Illinois, during September 1960. Bars represent the average number of bird targets per hour detected each night during the period from sunset until 0500 CST. Pips indicate midnight. Cold front symbols indicate to the nearest hour the time at which the pressure trough passed Champaign. The continuous daily temperature curve was constructed from thermograph charts, with values plotted for every three hours.

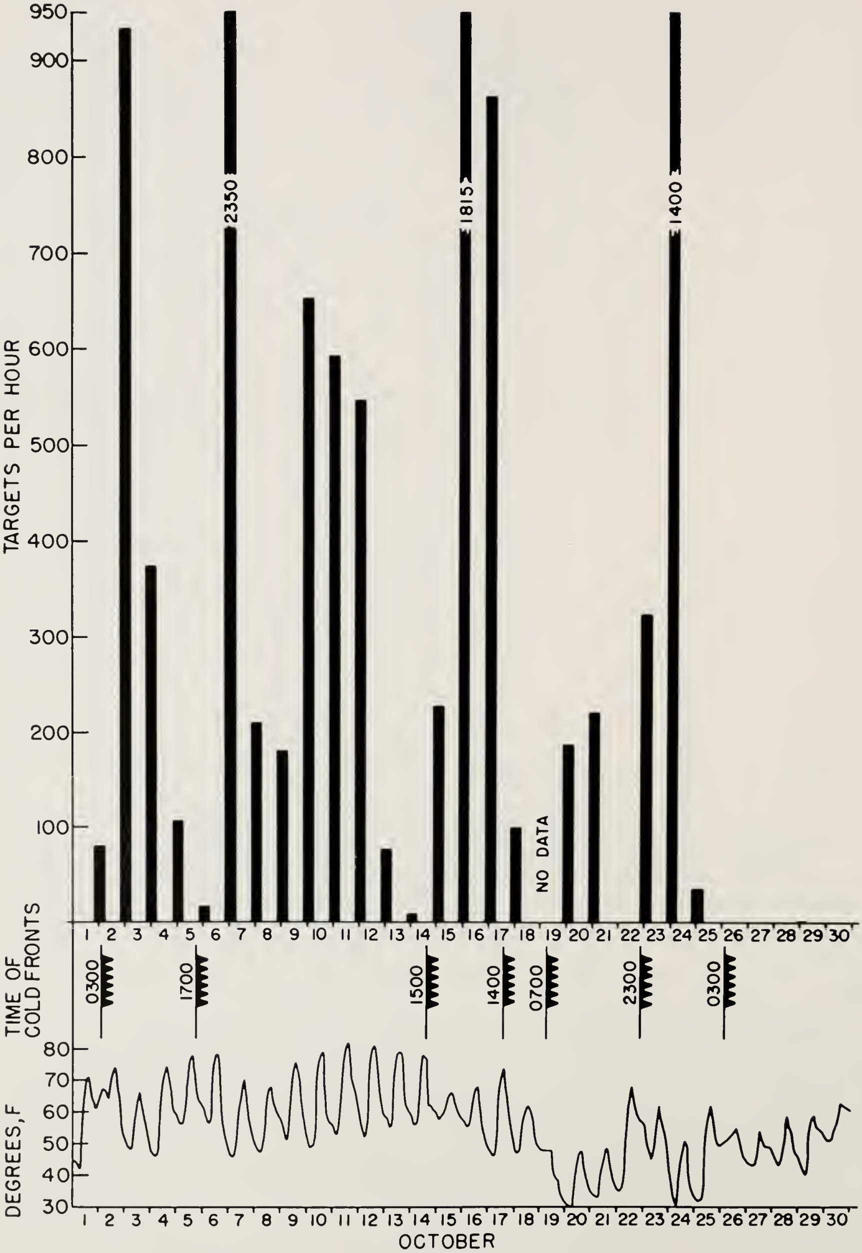

FIG. 4. Volume of nocturnal migration, cold front passages, and temperature at Champaign, Illinois, during October 1960. Bars represent the average number of bird targets per hour detected each night during the period from sunset until 0500 CST. Pips indicate

passages before 24 October. The exception (night of 17 October) will be discussed later. In addition, migration volume increased following the frontolyses (dissipating frontal systems) which took place during 19 August and 27 September, and on two occasions (3 September and 9 October) without the presence of any notable meteorological activity. The precise timing of fall migration with cold fronts is shown by the following examples.

On 4, 7, and 27 August, fronts passed through Champaign about 1800 CST, less than two hours before sunset (Fig. 2). On each of these nights a wave of migration began, with numerous echoes appearing on the radar indicator immediately after dark, by migrants which must have departed from near the radar station. On 14 and 23 August, 17 and 22 September, and 14 October (Figs. 2, 3, 4), frontal passages occurred a little earlier, about 1500 CST. Still only three to five hours had elapsed between the time of these frontal passages and darkness, when the first migrants of the waves were detected by the radar.

These examples indicate that migrants located very close to Champaign were responding directly and immediately to some element(s) of the weather situation which had developed with the recent passage of a front across the Champaign area on which they were situated. During the entire fall, migration waves initiated **prior** to cold front passage on only two nights, 11 September and 22 October. These exceptions to the general rule will be discussed later.

In general, the volume of migration fluctuates according to a fairly typical pattern, increasing sharply on the night following frontal passage, then decreasing each successive night until conditions again occur which stimulate flight. Typical of this pattern are the nights of 11 through 16 September (Fig. 3).

When conditions suitable for migration develop much after midnight, birds do not usually depart until the following evening. Thus, the passage of a front late in the night (0300) on (18)–19 September and (1)–2 October brought no migration wave until the subsequent evening (Figs. 3, 4). Under certain circumstances, to be discussed, migration waves will develop after midnight.

Accompanying the passage of a cold front are changes in pressure, temperature, and surface wind. Although these meteorological elements are generally interrelated (all parts of the same phenomenon—the boundary between adjacent air masses) we found that we could study the effects of each individual factor upon the observed hourly and daily changes in the migration pattern.

Pressure.—We first examined the possibility that the migrants might be responding to the decreasing barometric pressure which invariably accompanies

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midnight. Cold front symbols indicate to the nearest hour the time at which the pressure trough passed Champaign. The continuous daily temperature curve was constructed from thermograph charts, with values plotted for every three hours.

cold fronts. That this falling pressure might be a factor in stimulating migration was suggested to us by the work of Bagg, et al. (1950), a study of the relationship between spring migration and northern hemisphere pressure patterns. An examination of several barograph traces has caused us to believe that pressure change alone as a positive "trigger" of migration is improbable.

For example: During the period from 23 to 30 September, three distinct waves of migration were recorded; one on 25 September following a cold front, another on 27 September following a frontolysis, and a third on 30 September following a front. During these seven days the total variation in pressure from highest to lowest was 0.32 inch of mercury. Pressure change with the front of 24 September was 0.10 inch, with the frontolysis was negligible, and with the front of 30 September was 0.06 inch. It is easy, when looking at the barograph trace, to see the pressure trends, but it is also evident that pressure fluctuations unrelated to frontal activity are present. Diurnal variations in pressure (0.04–0.10 inch) which are related to the daily rise and fall of temperature also occur.

It is difficult to attribute to an animal the possession of an internal barometer sensitive enough to detect a 0.10-inch change in pressure such as that produced by the front of 24 September, and the discrimination to know which pressure change is due to a cold front and which is not. Convective showers, for example, although they may cause pressure fluctuations of 0.05–0.08 inch, apparently do not induce migration.

Temperature.—In considering a possible relation between the prevailing temperatures and migration activity, we had to decide what sort of temperature change the birds might respond to. Abruptly decreasing temperature (8–12 degress within an hour or two) would be a likely cue. Such a change occurred at Champaign only six times during the 3-month period of our study, usually as a result of thundershower activity. These changes showed no correlation in timing with the migration.

Another possibility would be for the birds to react to temperatures (during the day of departure) which were noticeably lower than those of the day before. How large a decrease would be required before a bird would respond is problematical. Weise (1956), in a study of the activity of caged migratory sparrows, considered a decrease of less than 5 F in the temperature at civil twilight to be no significant change.

Referring to Figs. 2, 3, and 4, one can compare changes in migration activity with temperature changes. In August there were eight mass flights. For two of these (4–5 and 19–20 August) one can see a possible correlation in timing between the flight and a notable temperature change. The flight of 4–5 August followed a drop in both maximum and minimum daily temperature of about 8 F during the preceding 24 hours. In the period 18–21 August, there was no change in the minimum temperature but the maximum dropped 10° coinciding with frontolysis and mass migration. Temperature declines **followed** mass flights on 10 and 14 August. As for the other August flights (7, 23, 27, and 30 August) there was either no change in temperature or a slight temperature increase in these periods. Temperature could not have been the primary stimulus in initiating these early fall mass flights of nocturnal migrants.

In September there were nine known mass flights (data for three nights missing). Sharp drops (10–20°) in maximum and minimum daily temperature preceded flights on 19, 25, and 30 September, but no temperature change accompanied the flights of 3, 17, and 27 September. Slight temperature increase was noted on 11 and 22 September. In October there were six mass flights. Sharp temperature declines preceded the mass flight on 19 October and **followed** flights on 2, 6, and 14 October, while the flights of 9 and 22 October occurred in a period of warming temperatures.

In further analyzing the temperature pattern at Champaign (Table 1) we made hour by hour comparisons of the temperatures of the first day of a migration wave with the temperatures of the day before the wave. For purposes of analysis, in Table 1 we have defined as being "cooler" any day on which temperatures were 2 F (or more) lower than the previous day (the same hours) for four or more hours. The same comparison was made for successive nights of migration following the initial night of a wave. In summary, we found that migration occurred on nights that were cooler, warmer, or without change in temperature in nearly equal proportion (Table 1). Of the 44 days (nights) on which significant migration was recorded, 17 (39 per cent) had cooler temperatures than the previous day, 12 (27 per cent) showed no temperature change, and 15 (34 per cent) were warmer.

We are dealing in this kind of study with a large number of species, and it is probable that some species respond to temperature change and others do not. It is also possible that changing temperature may be a secondary factor in stimulating flights and affects migration only when coupled with one or more other factors.

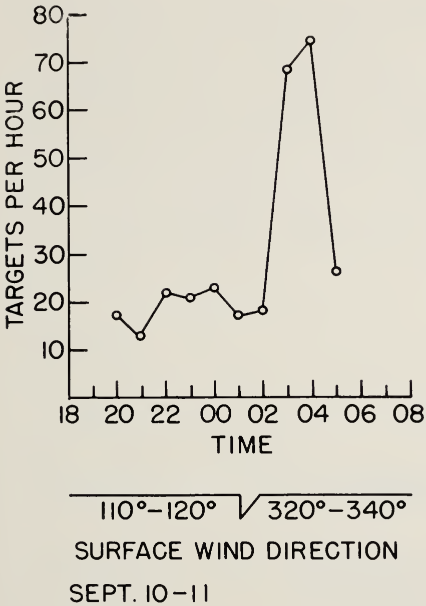
Surface wind.—We have already indicated that neither pressure nor temperature changes correlate well in time with the onset of nocturnal flights of migrants. Associated with the passage of a cold front there is a definite change in wind direction. This change is usually clockwise from a southerly direction to west, northwest, or northeast. It is possible that birds might recognize and respond to this wind shift.

From the Rantoul and Champaign, Illinois, weather records, we learned the surface wind directions for all of the nights of migration (Table 2). On 32 (73 per cent) of the 44 nights of significant migration, surface winds were northerly (300° to 60°), and on 12 (27 per cent) of the migration nights, winds were from other directions ranging from southeast (clockwise) to west-southwest.

It should be pointed out here that while in general migration waves are associated with cold fronts, and that in general cold fronts induce the wind shift described above, the method of analysis of wind direction versus migration (Table 2) did not presuppose the presence of a front. The analysis merely showed what surface wind prevailed on each night during the hours of flight without considering what affected the wind direction. Wind shifts may occur without frontal association, and wind shifts which are associated with frontal passage are not invariably of the classic type. For convenience, we have defined the time of frontal passage in terms of the passage of the trough. Related to this passing low pressure, the wind shift (to north) may come later or even, though rarely, earlier. The change in wind direction may also be erratic, shifting northward, backing and shifting again. In the case of a frontolysis, there is no distinct wind shift but northerly winds may develop over the area where the front dissipated.

We found that the wind shift associated with 14 of the 20 cold fronts of the fall of 1960 occurred within five hours after the passage of the trough. These were: 7 (2300) August, 9 (1900) August, 14 (1800) August, 26 (1800) August, 29 (0900) August, 8 (2000) September, 17 (1500) September, 19 (0700) September, 22 (1700) September, 29 (1400) September, 2 (0600) October, 14 (1600) October, 17 (1800) October, and 23 (0300) October. Of the remaining six cold fronts: on 4 August, wind shift preceded the front (trough) by about one hour; on 23 August, a distinct shift was not evident with the weak front; on 12 September, wind shift preceded the front by over 24 hours (if the two events can be truly associated); on 24 September, the wind shift was erratic, with the final shift occurring 10 hours after the frontal passage; on 9 October, the wind shift came nine hours after the front; and on 19 October, it preceded the front by about four hours.

How well did the migrations coincide with these wind-change patterns? Of the 21 migration waves for which we have complete data, 14 (4, 14, 26, 29 August; 11, 17, 19, 22, 25, 30 September; 2, 6, 14, 19 October) were initiated on nights following a wind change from southerly to northerly within the previous 12 hours. For three additional waves (23 August, 27 September, 9 October), winds were northerly but no wind shift (from the south) was involved. Two other flights (7 August, 22 October) actually *preceded* by several hours a wind shift (north), though the shift occurred on the same night as the migration. In two cases (19 August, 3 September), migration was initiated into *southerly* winds. We have already discussed the close relationship in timing between cold-front passage and migration. There were two instances (24



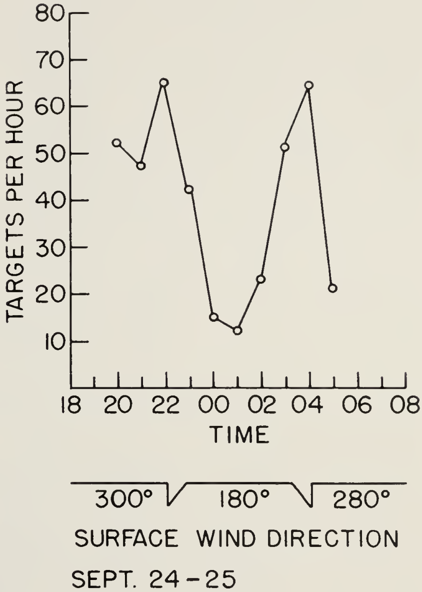


Fig. 5 (left). Hourly flight density and surface wind direction at Champaign, Illinois, on the night of 10–11 September 1960. Wind shift occurred at 0100 cst.

Fig. 6 (right). Hourly flight density and surface wind direction at Champaign, Illinois, on the night of 24–25 September 1960. Wind shifts occurred at 2200 and 0300 cst.

September, 6 October) during the fall when the frontal troughs passed Champaign in the evening but the wind shift lagged and did not occur until the following morning. In both cases, migration was initiated on the following evening; i.e., late in relation to the trough as though in response to the lagging wind change. Conversely, on 11 September, the wind shift to north preceded the trough and so did the migration—again as though migrants were responding to the wind shift.

We have some positive evidence that migrants respond very rapidly to the wind. The "average" temporal pattern of migration has already been discussed. On the nights of 10–11 and 24–25 September, the pattern varied considerably from this average (Figs. 5, 6). We examined our weather data for these nights to see if any meteorological factors could account for the irregularity of the temporal patterns. There was a remarkable correlation in timing between changes in flight densities and changes in direction of the surface wind, as though migrants were responding immediately to the wind shift. Frontal systems were associated with both these flights. On 24 September, the frontal trough passed Champaign at 1600 cst, a wind shift (to 300°) occurred about 1800, and, as might be expected, flight density of migrants rose sharply after sundown. On this night, as occasionally happens, there was vacillation in the frontal wind shift and at 2200 the wind swung back to south (180°). This change coincided with an abrupt reduction in the flight density. After midnight, flight density increased again, coincidentally with a wind shift back to WNW. On 10–11 September, a wind shift (to NW) occurred at about 0100, preceding the frontal trough by about 24 hours. Migrants appeared to respond to this shift and the flight density rose sharply after 0200 (Fig. 6).

Overcast.—The influence of an overcast sky upon the activity of the night migrants is pertinent both to the study of the timing of departure of mass flights and to the investigation of celestial orientation in birds. Here, study of the two problems overlaps, insofar as the ability of a bird to navigate satisfactorily will surely influence its "decision" to fly on a particular night. A forthcoming paper by Bellrose and Graber will discuss in detail navigation and orientation data obtained from the radar study. However, it is pertinent here to present briefly some observations which we have made on migration activity during conditions of overcast.

We found high cirrus overcasts present on several nights of no significant migration activity when southerly surface winds prevailed. On 14 August, 19 and 29 September, and 14 and 15 October, migration coincided with extensive overcasts that covered broad areas of the midwest. We have estimated that a bird which averaged 50 mph ground-speed or less (optimum for most passerines), and which arrived at Champaign near midnight on any of these nights must have departed under overcast conditions. On three of these nights, 14 August, 19 September, and 14 October, migration waves began. On 15 October, a considerable increase was recorded over the activity of 14 October. Only on 29 September did migration remain low, even in the presence of surface winds usually favored by the migrants.

We compared the flight altitudes of the migrants detected on nights of overcast with the height of the cloud bases, and could find no definite tendency on the part of the migrants for flying above or below a solid cloud layer. On 14 August, however, when the height of the overcast changed rapidly during the peak hours of migration, a definite change in the altitude distribution of the migrants occurred (Fig. 7). A 5,000-foot overcast was present on this night from well before sunset until after 2200 CST, when stratus clouds began to develop rapidly at 1,200 feet. This layer, which was probably about 500 feet thick, rose gradually to about 2,000 feet by 0600 CST. Our radar data show that virtually all of the migrants which were aloft prior to midnight were flying well below the overcast, with the maximum concentration at about 2,800 feet. After midnight, when the stratus layer had become established, the birds

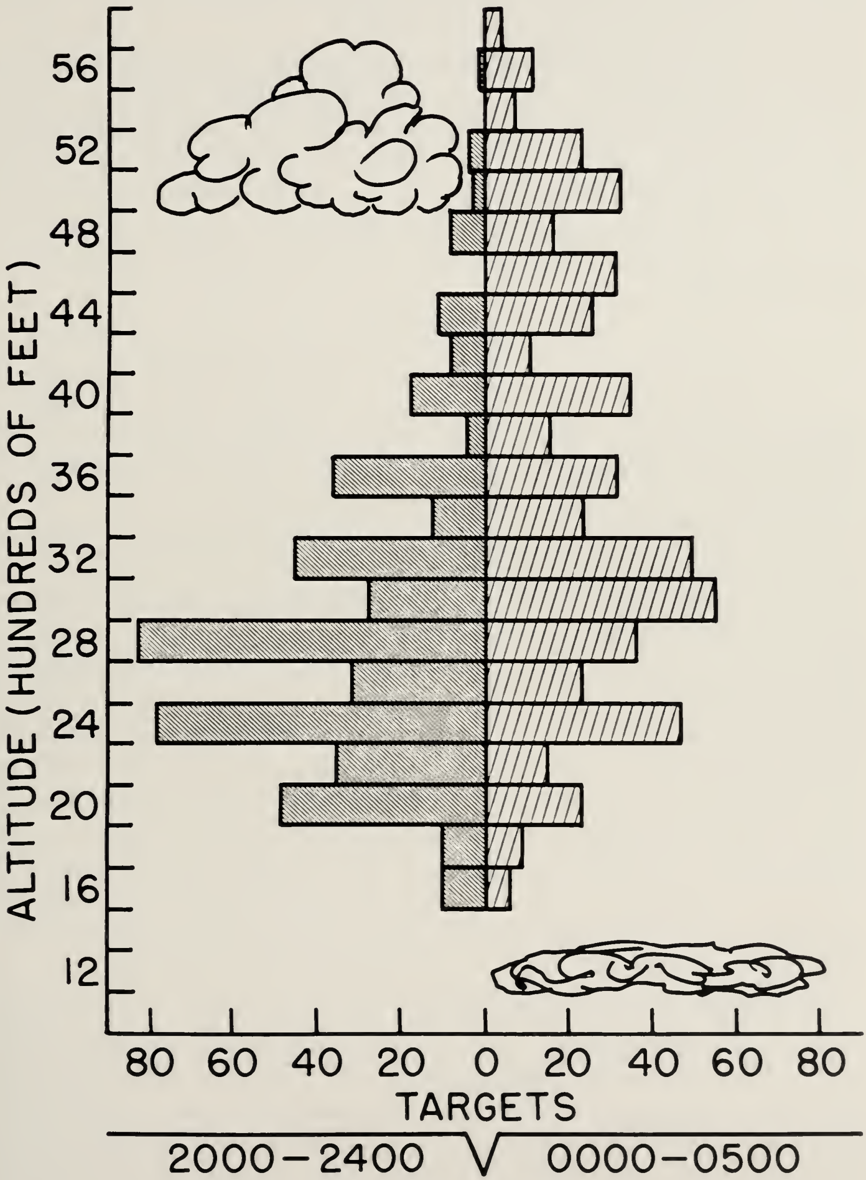


Fig. 7. Altitude distribution of nocturnal migrants on the overcast night of 14–15 August 1960. Cloud base was 5,000 feet until near midnight and about 1,200 feet thereafter.

were more numerous at about 3,200 feet and targets frequently appeared above 4,400 feet where few had been detected earlier.

A close examination of the migration record (Figs. 2, 3, 4) shows that while there was migration activity on the overcast nights, further increases occurred on the night following each of the first four dates. These observations suggest (1) some migration does occur on nights of complete overcast, (2) not all birds in the migratory state will depart under overcast skies, and (3) the radar may fail to detect some of the smaller or more distant targets present on the overcast nights because of attenuation of the radar energy by moisture particles in the clouds.

DISCUSSION

The relationship which exists between autumn departures of nocturnal migrants and weather is not a simple one. Investigations of this relationship by different methods have produced contradictory results, as have studies conducted in various localities, and many questions remain to be answered on what might be called the natural history of migration.

It is probable that different migratory behavior patterns have developed in different species, and in response to different environmental situations.

The migration of western Europe and that of the east coast of North America have certain features in common that do not apply to the migration through the continental interior of North America. This is to be expected, for the environmental characteristics of the first two areas, while certainly not identical, are nevertheless quite similar. These coastal situations have a distinctive topography and a marine-influenced climate. By contrast, the interior of North America is a flat, nearly featureless plain which experiences a distinctly continental climate. Clear nights prevail. Persistent overcast, fog, and precipitation are relatively rare. The pattern of the frontal systems which occurs is not complicated by orographic or marine influences which produce the rather complex weather systems typical of western Europe and the east coast of North America.

To illustrate the geographical influence upon migration, both Drury, et al. (op. cit.), in Massachusetts and Lack (1960*a*) in Norfolk, England, have in the course of their radar studies, examined the effect of coastlines on the direction of migratory movements, an effect which is, of course, absent in the midwest. Another migration problem which varies with geographical region is "reverse migration" (Baird and Nisbet, 1960). Drury (op. cit.) has witnessed this phenomenon on radar, and many field observations of this "wrong-way flight" have been recorded both in the eastern United States and in Europe. In contrast, observations of reverse flights in the midwestern United States during autumn are extremely rare, and in three seasons of radar observations we have seldom observed even a single target proceeding in a "wrong" direction.

As we have previously suggested, species differences in migratory behavior may also exist. For example, Baird, et al. (1959) showed that northward movements of Yellow-breasted Chats (*Icteria virens*) into New England in fall were associated with southwest winds. Again, the fall migration into southerly winds which we have found to be exceptional to the usual pattern may prove ultimately to represent the behavior of a few particular species.

Ironically, the lunar and radar techniques of migration study which provide the best direct quantitative record tell us little of the species involved, and there is a real need for detailed information on the migration habits of particular species such as that obtained from banding studies (Baird, et al., 1958, 1959).

Lacking species information it is still worthwhile to explore the subject in more general terms as we must when working with radar data. Because we are dealing with 200 or more species of migrants, the possibilities for different kinds of behavior patterns are numerous, and it is remarkable that the patterns of migration which we have observed on radar are as consistent as they are.

The variation in flight density of migrants from hour to hour during the night is a matter that requires further study. Our radar data on this temporal pattern coincide very closely (Fig. 1) with those obtained with the lunar technique of study (Lowery, op. cit.). From his radar data, obtained in Zurich, Switzerland, Sutter (1957) described a temporal pattern similar to our own, concluding that his data were in complete agreement with those of Lowery. Lack (1960*a*) also discussed the temporal variations in the volume of nocturnal migration. He found the pattern in Norfolk in spring to be essentially the same as that of Sutter, with peak density usually occurring from 2100 to 2200 (somewhat earlier than the peak hour in other locations).

The temporal pattern described from direct quantitative observation roughly parallels the hour-to-hour variation in nightly unrest of some captive migrants (Eyster, 1954; Farner, 1955). This suggests an internal timing of activity which may explain why mass flights are not usually released in central Illinois by cold fronts which pass much after midnight.

Audio records, however, indicate a very different pattern, in which maximum activity (i.e., flight calling) occurs in the pre-dawn hours (Graber and Cochran, 1959). The pattern has been observed so many times by both visual and aural methods that there can be no question about the validity of the observations, but their meaning is still obscure. Cochran and Graber (1958) observed a fairly constant flight density of migrants throughout the night around a television tower, but these tower observations represent a definitely abnormal situation wherein birds continued to fly in confusion when they might otherwise have landed.

To compromise the lunar-radar observations on temporal pattern with the aural observations, we can hypothesize that migrants reduce altitude after midnight and fly close to the ground where they would go undetected by radar and lunar observations. The aural data indicate that at least some migrants continue to fly, but many may land. Even supposing this to be true, we must account for the timing of the nightly flight and particularly its duration. Odum, Connell, and Stoddard (1961) calculated potential flight ranges of migrants based on energy reserves in the migrant. Their specimen data indicated that long-distance migrants (tanagers, thrushes, and warblers) could fly 600–1,500 miles nonstop, or 12–30 hours even at a speed of 50 mph. Swainson's Thrushes (*Hylocichla ustulata*) killed at 0100 CST near Champaign in September 1959 (Graber and Graber, 1962) still carried a calculated (from fat-free weights, Connell, Odum, and Kale, 1960) fat deposit of about 15 per cent of gross weight, the equivalent of an estimated flight range of 240–400 miles (Odum, et al., op. cit.). This would amount to a minimum of nearly five hours more of potential flying time, or, for the example cited, a flight lasting until 0600, i.e., 10–11 hours total. The flight range potential appears to greatly exceed the actual flight time during one night, judging from the radar temporal curve. Fatigue (accumulation of lactic acid) and/or dehydration of the migrants may be the primary factors in delimiting the flight span, but more basic data are needed on the physiology of individual birds before these factors can be evaluated.

Farner (op. cit.) discussed factors which bring the bird into a state of readiness to migrate, and though we are primarily concerned with the extrinsic factors which appear to stimulate *en masse* flights of nocturnal migrants, the two phenomena, i.e., the condition of the individual bird and the mass flights, are obviously intimately related.

The classic wave pattern of migration has been well documented. It is typically seen by the field observer as an influx of migrants into an area on a given day, several days of static or declining activity, then another conspicuous arrival. Our radar data confirm the reality of these waves in the midwestern United States. Lack (1960*a*) found that the spring emigration from Norfolk proceeded steadily, but with fluctuations in volume, on every night during the season except those few with extremely unfavorable weather, and he did not describe a pattern for this activity. The wave type of migration which occurs in the midwestern United States depends not only on a supply of (physiologically) ready migrants but on secondary extrinsic factors to "release" the flight.

The duration of a migration wave is usually two or three days (example: 4–6 August), and typically the migration volume falls off progressively after the first night. The wave is followed by a period of low migration activity which rarely lasts more than three nights; usually two or less (examples: 3–4, 13–14 August). This periodicity, i.e., duration of wave and lull, is fairly consistent and its significance is still not entirely clear. We have already indicated that the periodicity depends to some extent on the presence of one or more meteorological factors usually associated with a cold front. Yet when the interval between fronts is extended, a migration wave may occur without any apparent meteorological releaser (examples: 4 September and 9 October), and in such instances the wave shows the "usual" periodicity.

Intervals of low migration activity may in some cases represent "stopover periods" for migrants. King (1961) analyzed data from several authors to show that stopover periods for migrant White-throated Sparrows (*Zonotrichia albicollis*) averaged three to five days, which is about the time required for fat deposition in this species prior to flight (Wolfson, 1954). Fat deposition in migrants has been correlated with the onset of *Zugunruhe*, and Weise (op. cit.) showed that *Zugunruhe* in migrant sparrows varied with weather conditions apparently even when the fat condition of the birds remained unchanged. These data and the radar observation showing correlation of mass flights with cold front passage indicate that migrants may wait for an environmental stimulus before taking flight even though they are in (physiological) condition to migrate. The waves of 4 September and 9 October show that migrants will not always wait more than a day or two for the releaser.

Just what extrinsic factors act as stimuli for mass flights is a subject of some controversy. Lack (1960*b*) emphasized the importance of temperature as the meteorological phenomenon most likely to stimulate migration. He concluded, after citing numerous field and laboratory studies, that warmth in spring and cold in autumn are the primary factors in stimulating migration, dismissing wind direction as unimportant. He also stated that (p. 185), "In the United States, nocturnal movements in September normally occur with cold, northerly winds, especially with cold fronts (Bennett, 1952; Lowery and Newman, 1955), but the difficulty, as in spring, is to separate the possible influence of temperature from that of wind direction."

After careful consideration of the work of both Bennett, and Lowery and Newman, we do not believe that either of them intended to imply that they found cold the important factor in initiating autumn migration. Both cited an apparent correlation with cold front passages, but Bennett in particular believed wind direction was the more important factor in stimulating waves of migration; and Lowery and Newman did not discuss the problem in detail.

Some observers who recognize the stimulus of frontal passage upon autumn migration may tend to envision the cold front as being invariably followed by sharply reduced temperatures. In the midwestern United States during August and much of September, we have observed that such fronts as occur are often weak and slow-moving or stationary. Frontolyses are not uncommon. These nearly static fronts represent rather broad, indistinct boundaries between air masses which are very similar in temperature and humidity. Bennett (1952: 213), in discussing the early fall migration of warblers through Chicago, also observed that "most summer cyclones and anticyclones are not strongly developed circulations, and the summer cold fronts are ordinarily mild." This weather is typical over the midwestern United States from the Canadian border south at least to Kentucky. Half or less of the fronts which occur in this area at this season produce a significant (5 F or more) temperature decrease (Figs. 2, 3), and the decrease often requires 24 hours to become evident. Nevertheless, the radar record shows that these fronts are, indeed, promptly followed by increases in migration.

It is difficult to imagine that birds which are regularly experiencing diurnal temperature variations of 15 to 20 F would be stimulated to take flight by such a slow temperature decrease from one day to the next as is produced by the weak, early season fronts.

The greatest difficulty, when discussing the effects of temperature on migration, is not to separate the effects of temperature from those of wind, but to establish the degree of temperature change which might prove to have significant influence on the birds. Most laboratory studies on nocturnal migration have had as their primary objective something other than the correlation of *Zugunruhe* with temperature, and are not conclusive on this point.

The statistical evaluation made by Lack (1960*a*) of the relationships between spring departures of migrants from Norfolk and various weather elements illustrates one approach to the problem of what might constitute a significant temperature effect. He concluded that spring emigration from Norfolk was favored by a temperature (at 1800 hours) of 45–49° between 1 and 23 February and by a temperature of 40–44° from 24 February to 31 March. He also noted that temperature apparently had no influence on emigration in April.

Baird, et al. (1959) indicated that declining temperature was important in stimulating fall migration on the east coast of the United States, stating that a migration wave of 19–21 September 1958, was initiated under overcast skies "apparently influenced by a temperature drop a few days earlier." These authors correlated temperature drops and good catches of migrants at recovery netting stations. It is important to realize that diurnal observations do not always reflect the previous night's migration at a given locality (Drury, et al., op. cit.). Graber and Cochran (1960) found correlation poor between field observations and their audio record, and suggested several explanations for the discrepancies. Quantitative correlation between field observations of migration and the radar record is equally unsatisfactory. The pattern of continuing but decreasing activity on nights following the initial movement, and the existence of numerous small waves go virtually unnoticed in the field.

In 1958, the cold front which crossed Illinois on 15–16 September crossed New England on 16–17 September. In Illinois, heavy migration was recorded at night within two hours of the passing of this front (Graber and Cochran, 1960). In New England heavy mortality of night migrants occurred widely at ceiliometers and TV towers in the wake of the front on 16–17 September (Baird, et al., 1959), yet diurnal observations in New England showed no great influx of migrants until 19 and 20 September. The same frontal system released mass flights in Illinois and New England, but in Illinois temperature could not have affected the release because there was no temperature decrease associated with the front. In this example we can see an apparent and unaccountable lag between the night migration and what daytime observers found in the way of grounded migrants. At Champaign, heaviest flights occur typically on the same night or the first night after frontal passage. Baird, et al. (1959) stated that the **second** day after cold front passage often produced the greatest density of migrants, based on diurnal observations. Because temperature decline often lags behind both the trough and wind shift of the front, we can see why this factor correlated well with the flights detected by daytime observers. Furthermore, temperature decreases with frontal passage are probably more pronounced at coastal stations in New England than in Illinois, because the widespread precipitation which is more likely near the marine environment tends to hold down temperatures. In such cases the front is not the direct cause of the lower temperature.

Both Weise (op. cit.) and King (op. cit.) indicated that night restlessness in certain fringillids appeared to be correlated with temperature change. These fringillids were short-distance (Odum, et al., op. cit.), late fall migrants, and it is possible that the flights of these species are released by temperature change, since marked temperature declines are more often associated with late fall and winter fronts. By contrast, the flights of long-distance migrants which pass Champaign for the most part in early and mid-autumn (to 10 October) do not appear to be "triggered" by falling temperatures. It is not uncommon for mass flights in this season to depart from Champaign even with slightly rising temperatures. We do not deny that temperature change may release migration flights, but at least some mass flights are triggered by some other frontal characteristic than temperature change.

SUMMARY

The migration-weather relationship is complex. Among the factors contributing to this complexity may be differences in environmental situation, physiology, and specific behavior of the many species of migrants under investigation.

Radar and lunar data yield nocturnal temporal patterns which correspond closely with one another and with some observations of the activity of captive migrants but contradict the pattern obtained by aural methods. Potential flight range of migrants apparently exceeds actual flight time. Additional physiological data are needed to resolve these differences.

Our radar data indicate that mass departures of nocturnal migrants, particularly long-distance migrants in early and mid-fall, are "released" in the Champaign area by a change in wind direction from south to north. Such wind shifts almost always accompany cold fronts, but the migrants may react to the wind shift whether or not a cold front is involved. How rapidly migrants respond to the wind shift is indicated. A following wind would seem to be especially important to these long-distance passerine migrants. Recognition and response to such a wind condition would appear to have real survival value both from the standpoint of energy conservation in the migrant and the reduction of total migration time. On the other hand, it is difficult to see survival value in a response to the subtle temperature changes which accompany cold fronts in mid-fall.

Regardless of which factor triggers a mass departure, it is apparent that cloud cover can modify the response by deterring at least some of the migrants. Thus, while the heaviest concentration of migrants typically passes Champaign on the first night of a mass flight, overcast can postpone the heavy flight one or more nights.

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STATE NATURAL HISTORY SURVEY DIVISION, URBANA, ILLINOIS, 26 JUNE 1962

USE OF MINNESOTA PONDS AND PITS BY WATERFOWL

Hans G. Uhlig

In recent years there has been a significant increase in the construction of ponds and pits for livestock water in Minnesota. This increase was brought about by a need for water to better effect distribution of grazing, by the availability of funds for cost-sharing through the Agricultural Conservation Program, and by the availability of technical assistance through the Soil Conservation Service.

In Minnesota, stock-water pits (dugouts) are less than one-fourth acre in area and about 10 feet deep, but otherwise are similar to those described by Shearer (1960) for South Dakota. Farm ponds in Minnesota average one acre in area and are 12 feet or more deep. They are found in more rolling land where a fill can be constructed that will back up water to flood a draw, gully, or ravine.

In Minnesota, both ponds and pits may be fenced and the area seeded to grass and legumes. In some instances the protected area is partially planted to shrubs and trees. In the case of farm ponds the fence is a minimum of 40 feet from the edge of the water, but on the majority of pits the fence is only 12 feet out, although in some cases the fence may be as far away as 25 to 40 feet.

Minnesota farmers and ranchers constructed 1,902 ponds and pits during the 1962 fiscal year. These brought the total built with technical assistance from the Soil Conservation Service to 6,785. It is significant that many of these water areas were built in parts of the state low in permanent open water important to waterfowl (Mann, 1957).

Some reports received in 1956 showed that ponds and pits were being used heavily by ducks during the spring migration. Other reports from southwestern Minnesota indicated that farmers were able to hunt ducks on their own land for the first time due to the ponds and pits that had been built for livestock water. Because of these reports it was decided that observations should be undertaken to determine wildlife benefits derived by the application of these water conservation measures.

OBSERVATIONS

1957.—Three counts were made of 17 ponds and 7 pits in Lincoln and Pipestone counties in southwestern Minnesota. On 26 April and 16 and 29 May, when the observations were made, 13 (76%) of the 17 ponds and 3 (43%) of the 7 pits were utilized by ducks on at least one of the three visits.

1958.—Three observations were made during the spring migration period on 21 ponds and 36 pits in Lincoln, Pipestone, and Rock counties. The observations were taken on 23–25 April, and 5–6 and 22–23 May. During the three observations, 204 ducks were seen, 160 on the ponds and 44 on the pits, for an average of 7.6 ducks per pond and 1.2

per pit. Eighty per cent of the ponds and 28 per cent of the pits were utilized on at least one of the three visits.

While en route to these ponds and pits, observations were made of ducks on 343 natural wetland areas. Eighty-eight of these were one or more acres in size and ducks were seen on 78 per cent of them. There were 145 wetlands of less than one acre and ducks were observed on 31 per cent of them. In addition there were 110 areas that had gone dry. On 24 April, 25 per cent of the pits were being used by ducks, but only 18 per cent of the small wetland areas were being used. Seventy-eight per cent of the ponds were being used while 61 per cent of the wetland areas over one acre in size were in use. It was concluded, therefore, that ponds and pits compared favorably with the natural wetland areas during the spring migration period.

Blue-winged Teal (*Anas discors*) composed 43 per cent of the waterfowl observed using the ponds and pits. Lesser Scaup (*Aythya affinis*) made up 39 per cent. Other species were Pintail (*Anas acuta*), Mallard (*A. platyrhynchos*), Shoveler (*Spatula clypeata*), Ruddy Duck (*Oxyura jamaicensis*), and American Coot (*Fulica americana*).

Observation in August revealed four broods (three Blue-winged Teal, one Mallard) on four ponds and two broods (teal and Mallard) on two pits. The low utilization by broods is not surprising since all three counties are in an area of low value (Mann, 1955). The observations indicate that the utilization of these water areas by ducks is primarily confined to migrating birds, but that they are of some benefit to birds during the courting and breeding period.

1959 and 1960.—On 6 and 22 May, and 18 June 1959, observations were made of waterfowl use of 14 pits in Mahnomen County. This county is in an area of high waterfowl value in northwestern Minnesota. Nineteen waterfowl were observed on seven of the 14 pits.

On 26 May 1960, in a single check of 39 pits built in the fall of 1959 in Mahnomen County, 39 waterfowl were observed on 15 pits. Occupied pits averaged 2.6 ducks per pit. Blue-winged Teal and Mallards were the principal species.

FACTORS AFFECTING UTILIZATION

During the 1958 observations, data were recorded on age of the ponds and pits, their water levels, adjacent vegetation, and fencing (Table 1).

Age.—Ninety-four ducks were observed on the nine ponds that were over two years old for an average of 10.4 ducks per pond. Eleven newer ponds had 55 birds for an average of 5.0 ducks per pond. On nine ponds where waterfowl were observed on two out of three spring observations in 1958, only two ponds were less than two years old. The average was 4.2 years. On the 11 ponds where waterfowl were observed once or not at all, 10 ponds were less than two years old. The average was 2.6 years. These data would indicate that the utilization of ponds by ducks increases as the ponds become older. The age of one pond was not known.

Water levels.—Ponds in which the water level did not fall more than 3 feet below the full mark by 22 May 1958 had an average of 9.7 ducks during the observations. Ponds that dropped more than 3 feet from full averaged only 4.2 ducks.

Pits showed similar characteristics. In 21 pits in which the water level did

TABLE 1
FACTORS AFFECTING USE BY WATERFOWL OF PONDS AND PITS IN SOUTHWESTERN MINNESOTA*

	Ponds			Pits		
	No. of ponds	Ducks per pond	Utilization (%)	No. of pits	Ducks per pit	Utilization (%)
Utilization	21	7.6	81	36	1.2	28
Age + 2 years	9	10.4	100	8	1.0	37
– 2 years	11	5.0	64	28	1.3	25
Adjacent cover						
Well-grassed	15	7.2	87	12	2.2	50
Mud or mud-grass	5	0.6	33	24	0.7	17
Water levels						
Stable						
Less than 3′ below full	13	9.7	80	21	1.8	33
More than 3′ below full	8	4.2	73	15	0.4	20
Fencing						
Adequate	11	7.6	73	23	1.8	39
Inadequate or none	10	7.6	80	13	0.2	8

* April–May 1958. Three observations.

not fall more than 3 feet from full, an average of 1.8 ducks per pit was observed. One-third of the pits observed were being utilized. Of 15 pits in which the water level dropped to a greater extent, only three were used by ducks and these at the rate of only 0.8 birds per pit. Similar findings were reported by Shearer (1960). It was also observed in Mahnomen County in 1960 that pits located on the edge of a marsh and fed by seepage rather than by run-off water were used to a greater degree than pits supplied solely by surface run-off water. The combination of desirable adjacent cover (cattails, bulrush, etc.) and a dependable water level were probably the influencing factors.

Adjacent cover.—Six of the 21 ponds had mud or mud with very sparse grass cover within 40 feet of the water's edge. Thirty-six ducks were observed during the three observations. However, 33 of these ducks were on one eight-year-old pond.

Twenty-four of the pits had mud or mud with very sparse grass cover within the fenced area. Twenty-three ducks used four (17 per cent) of these pits for an average of nearly 0.7 duck per pit during the observations. Six (50 per cent) of the twelve well-grassed pits were utilized by 27 ducks for an average of 2.2 ducks during the observations. Good shore-line vegetation appears to be an important factor determining the use of an area by ducks.

Fencing.—Eleven ponds had stock-proof fences and averaged 7.6 ducks for the period of observation. Ten were not fenced or were poorly fenced, did not

Table 2

Wildlife Use of Ponds and Pits in Minnesota*

	Number	Per cent
Utilized by		
Ducks	311	90
Pheasants	257	82**
Deer	167	48
Geese	60	17
Mink	41	12
Muskrats	17	5
Others***	83	23
Non-utilized pits	5	1

* Landowner report.
** 82% of the ponds and pits were in pheasant range.
*** Raccoons, fox, rabbits, Mourning Doves, Gray Partridge, songbirds.

exclude livestock, and averaged 7.6 ducks for the period. It appears, therefore, that fencing around ponds is not necessary to maintain the quality or density of cover preferred by ducks. Bue, et al. (1952) reported that grazing within the carrying capacity was not detrimental to utilization by breeding birds.

Thirteen pits were not fenced or were grazed inside the fence. Only one was utilized for an average of 0.2 duck during the observations. Twenty-three pits were adequately fenced. Nine (39 per cent) were utilized by 42 ducks for an average of 1.8 ducks during the three observations. It appears that fencing is of value to waterfowl around pits if not around ponds. Logic indicates that pits being much smaller than ponds, grazing within the fenced area is much more apt to be above carrying capacity, thereby destroying the preferred cover.

Loafing sites as a means of increasing waterfowl use of pits.—Fourteen stock-water pits in Wright County, Minnesota, were observed for waterfowl utilization from 18 April through 17 July 1961. Loafing sites were placed on seven pits. The loafing sites consisted of rafts anchored in the middle of the pit and constructed of any material available on the farm. The minimum size of the rafts was 4 × 4 feet. Ten observations of these pits and seven pits without loafing sites were made by personnel of the Soil Conservation District. A total of 109 waterfowl was seen using the pits with loafing sites as compared to 26 on the pits without loafing sites. This amounted to 1.7 waterfowl per observation per pit with loafing site compared to 0.4 waterfowl per observation per pit without loafing site.

Waterfowl observed consisted of 88 Blue-winged Teal, 32 Mallards, 11 Wood Ducks, and 4 American Coot. Only teal were observed on the pits without loafing sites. One brood of eight teal was on a pit with a loafing site. Only three pits were not used; all three were without loafing sites.

These observations indicate that loafing sites in stock-water pits are attractive to waterfowl and should be highly recommended as an improvement measure. To prove fully the attractiveness of these sites, the plan for 1962 is to remove the existing loafing sites and to place them on the pits that did not have them in 1961. Observations in 1962 would eliminate the influence of the pit location.

REPORTED UTILIZATION OF PONDS AND PITS

During the summer of 1960, 666 postcard inquiries were mailed to owners of ponds and pits in 10 Soil Conservation Districts. A total of 347 (52 per cent) was returned. Twenty species of wildlife were reported by the landowners as using these areas. These ranged from Prairie Chickens to moose, but the more abundant were ducks, geese, deer, mink, and muskrat. Only five farmers reported non-utilization. Extent of use by the major species is given in Table 2. Farmers in Swift County reported 25 broods of ducks in 16 of the 31 ponds and pits.

These observations by the farmers show the value of ponds and pits to wildlife to be greater than determined by my observations.

SUMMARY

Many species of wildlife make use of ponds and pits. Ducks in particular utilize them during the migration period, and to some extent for courting, breeding, and brood rearing.

Apparently good grass shore-line vegetation has the most influence on degree of utilization of ponds and pits by ducks. Stable water levels and age of the area appear to be important secondary influences.

Ducks use ponds more frequently than pits, apparently due to the larger size and the irregular and shallow shore lines of the ponds. Trials indicate that waterfowl utilization of pits may be substantially improved by installing loafing sites.

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SOIL CONSERVATION SERVICE, 517 FEDERAL COURTS BUILDING, ST. PAUL 2, MINNESOTA, 9 MAY 1962

ON THE YELLOW-BILLED LOON

George Miksch Sutton

The Yellow-billed Loon or White-billed Northern Diver (*Gavia adamsii*) breeds in fair numbers in parts of Victoria Island, the largest island in the western part of the Canadian Arctic Archipelago. In the summer of 1962 one pair (perhaps two pairs) nested on a large lake near the eastern foot of Mt. Pelly, not far from our party's headquarters at the village of Cambridge Bay, and several pairs nested on large lakes north and northwest of Mt. Pelly.

The species arrived from the south on or about 9 June, when David F. Parmelee saw one flying over the lake-dotted area east of Cambridge Bay. On 13 June, at about 1 AM, while Dr. Parmelee and I were on Mt. Pelly, we heard a Yellow-billed Loon calling in the wild country off to the north. The cries were like those of the Common Loon (*G. immer*) in that they had a piercing, quavering, far-carrying quality. Later that day we watched a Yellow-billed Loon as it rose from the shore-lead of a big lake just south of Mt. Pelly.

On 17 June, J. G. Hunter, of the Fisheries Research Board of Canada, brought us a fine male Yellow-billed Loon he had found dead in a fish-net at the west end of Ferguson Lake, a very large lake not far north and west of Mt. Pelly. The bird weighed 11¾ lb; was 34⅜ inches long from bill-tip to tail-tip (39½ inches from bill-tip to toe-tip); and had a wingspread of 60½ inches. The bill was dull ivory white, faintly tinged with bluish olive-gray throughout the basal half of the mandible. The eyes were rich chocolate brown, not red, and the iris was encircled by a narrow, pale bluish-gray ring that did not show unless the eyelids were pushed back. The tarsi were very dark gray on the outer side and grayish-white, with a faint bluish-olive cast, on the inner side. The specimen was extremely fat, the stomach empty. The left testis measured 27 × 6 mm, the right testis 16 × 2 mm. I made a water-color sketch of the head before skinning. Since the bird had been taken from the net two days before, the colors of the fleshy parts may have changed slightly.

On 8 July, at a large, deep, irregularly shaped lake just south of the east end of Mt. Pelly, Dr. Parmelee and I had a never-to-be-forgotten look at a Yellow-billed Loon as it popped to the surface not far from a long, narrow, rocky island, whose low-lying, nearer end was about a hundred yards from shore. In 1960, a friend of Dr. Parmelee had found one pair of Yellow-billed Loons nesting on this island and another pair on a similar island in a wholly different part of the lake. We had a portable boat with us, but the wind was far too strong for safe use of so high-riding a craft. As we were watching the whitecaps, a vast sheet of ice broke free of the island and bore down upon us. The near edge hissed as it scraped against the shore and broke into hundreds of cubes so similar in size and shape they looked almost machine-made. The loon did not call, nor did it move closer to the island.

On 18 July, H. A. Stephens of our party and I put the portable boat to use. As we approached the island's low eastern tip, we realized that many birds were nesting there. Sabine's Gulls (*Xema sabini*) and Arctic Terns (*Sterna paradisaea*) began diving at us even before we touched shore and followed us wherever we walked. Presently we found two nests of the Oldsquaw (*Clangula hyemalis*) a few yards apart and not far from the scattered gulls' nests. The loon's nest was along the north shore, only a few rods from the island's tip and within a few yards of all the other nests mentioned. It was a shallow, moist, unlined depression in an 8-inch high turf-mound at the island's very edge. Near it the water was deep. In it were two eggs about an inch apart, one of them pipped, the hole up. We could see the bill of the chick moving. After a considerable search with our binoculars we located one of the parent birds in the water several hundred yards away.

I wanted to draw a newly hatched Yellow-billed Loon direct from life. Since paper and paints were several miles away in the village, we decided to take the eggs to the incubator we had at our tent and hatch them there. We rowed to shore, put the eggs in my collector's creel under two chick Parasitic Jaegers (*Stercorarius parasiticus*) we were taking back alive, and walked to the village as rapidly as possible. We knew that the pipped egg was in good order for we could hear the cheeping of the chick inside. Another cry, given infrequently by the unhatched chick, was a faint, high, long-drawn-out wail that was curiously like one of the cries of the adult.

The pipped egg hatched during the night. On the morning of 19 July, I helped the chick out of the shell, noting, as I did so, that a considerable mass of gelatinous "after-birth" remained in the shell. While replacing the incubator's lid, to the inner side of which a thermometer was attached, I bashed in the other egg from end to end, but, clinging to hope that the chick might survive, I covered the egg with wet paper and began drawing.

My model (Fig. 1) was surprisingly agile. It made no attempt to stand upright, but, shoving vigorously with its feet, it moved in rapid jerks across the table-top, refusing to remain quiet unless I held it in my hand. I could hold it in my left hand and work with my right, but the tips of my fingers continued to annoy or attract it for it jabbed at them repeatedly with its bill. It cheeped frequently but not incessantly; occasionally it gave the long-drawn-out wail described above. It proved, on being prepared as a skin, to be a male. It weighed 89 grams. The testes were very slender, the right being 3 mm long, the left a little less than 1 mm long.

From time to time we examined the bashed-in egg. Sounds from inside the shell assured us that the chick was alive but we did not hear any cheeping until

Fig. 1. *Gavia adamsii*, day-old chick direct from life. Painted 20 July 1962 at Cambridge Bay, Victoria Island, by George Miksch Sutton.

about 7 o'clock on the morning of 21 July. The chick hatched successfully before noon that day and again I made a direct-from-life drawing. This chick was a female (weight 85 grams; ovary 3.5 mm long, 2 mm wide at widest point).

The sibling chicks resembled each other closely. In each of them the bill was pale bluish gray, palest toward the tip but nowhere ivory white except for the egg-tooth. The eyes were dark brown. The legs and feet were gray, paler on the inner side of the tarsus than on the outer, and on the webs than on the toes themselves.

On 4 August, Mr. Hunter reported that he and his party had, during the preceding six weeks or so, caught several Yellow-billed Loons and Red-throated Loons (*Gavia stellata*) in their nets at Ferguson Lake. The nets had been near the surface. Several loons found alive had been set free. René

Jones, of Mr. Hunter's party, informed us that he had on several occasions seen or heard up to ten or twelve adult Yellow-billed Loons at one time. An adult bird found alive in a net on 5 June was photographed by another member of Mr. Hunter's party, John Olson, who was good enough to send me recently an original kodachrome which shows the eye of this bird to have been somewhat more reddish than that of the dead specimen I drew on 17 June. A female bird found in a net on 9 July, and thought by Mr. Hunter's party to be immature, weighed 4,510 grams, had a wingspread of almost 57 inches, and was almost 32 inches long from bill-tip to tail-tip.

Two adult birds brought us by René Jones on 3 September were a male and female in excellent condition. The male, which had been taken from a net on 28 August, weighed 11¾ lb, was 33½ inches long from bill-tip to tail-tip, and had a wingspread of 57⅝ inches. The female, which was obtained on 3 September, weighed 9½ lb and was 30½ inches long from bill-tip to tail-tip (wingspread not recorded). In each specimen the ventriculus was a well-defined, muscular gizzard fairly well filled with gravel and fish remains but containing no feathers. In the male I found the considerably decomposed remains of one testis but no sign of the other. In the female the ovary and oviduct were easily discernible. In both specimens there was evidence of vascularization of the skin in the brood-patch area, but no sign of dropping out or replacement of any of the remiges (see Sutton, G. M., 1943. *Wilson Bull.*, 55:145–150).

The Yellow-billed Loon nested only on the largest lakes in the Cambridge Bay area. On smaller lakes both Red-throated Loons and Arctic Loons (*Gavia arctica*) nested. During a brief stay on Jenny Lind Island, in Queen Maud Gulf, well off the southeastern shore of Victoria Island, we observed many breeding pairs of Red-throated and Arctic Loons but saw the Yellow-billed Loon only once—two adults, 28 June, in the narrow shore-lead (H. A. Stephens).

The Yellow-billed Loon chicks discussed above I have compared directly with a three-day-old chick of the Common Loon courteously lent by Dwain W. Warner of the Minnesota Museum of Natural History. The Common Loon chick is a great deal darker than the Yellow-billed Loon chicks on the upper parts, and the under side of its wing is white, in sharp contrast to the dark gray of all the surrounding plumage, whereas in the Yellow-billed Loon chicks the under side of the wing is of about the same shade of gray as that of the surrounding plumage. The chick of the Common Loon, a male, weighed 52.2 grams at time of preparation. Its exposed culmen measures 12.5 mm, whereas that of the less-than-one-day-old male Yellow-billed Loon measures a trifle over 13 mm. From the evidence before me, I should say that the newly hatched

Yellow-billed Loon is considerably larger than the newly hatched Common Loon.

I wish to thank Dr. Parmalee for inviting me to accompany him to Victoria Island. His expedition was made possible by grants-in-aid from the National Science Foundation and The Arctic Institute of North America.

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF OKLAHOMA, NORMAN, OKLAHOMA, 6 FEBRUARY 1963

NEW LIFE MEMBER

Gordon M. Meade, of Washington, D.C., an active member of the Wilson Ornithological Society since 1938, has become a Life Member. He received his baccalaureate and M.D. degrees from the University of Rochester, and is now Clinical Director of Miners Memorial Hospitals of the United Mine Workers Welfare Fund. Dr. Meade's ornithological interests include banding, bird diseases and pathology, and birds of the Adirondack Mountains; his papers have been published in *The Auk*, *Bulletin of New England Bird Life*, and *The Wilson Bulletin*, and currently he is preparing an extended paper on birds of the central Adirondacks. A member of the AOU, founder and first president of the Federation of New York State Bird Clubs, and Vice President and a past director of the District of Columbia Audubon Society, Dr. Meade's hobby is ornithology, and trying to stimulate and develop interest of teen-age boys and girls in it.

GENERAL NOTES

North American Herring Gulls nesting on a building.—The Herring Gull (*Larus argentatus smithsonianus*) was extirpated as a breeding bird in Massachusetts about 1889, and became re-established in 1912 (Forbush, 1928. "Birds of Massachusetts and other New England States," *1*, p. 74). In the past fifty years it has bred in increasing numbers until now it is probably the most numerous marine bird nesting in the state. The breeding population is estimated to total about 70,000 birds (Wm. Drury, per. comm.).

Starting as a resident of islands and isolated coastal areas it has spread progressively closer to urban centers. Between five and ten years ago the vanguard of a colony became established on a peninsula of filled land jutting into Boston Harbor; by 1961 the colony had grown to approximately 750 pairs.

In June 1961 it was reported by the operators of a large pier, which covers about nine acres in the heart of the Boston waterfront, that Herring Gulls were nesting on the flat, tar-and-gravel roof of the building. The gulls were said to have begun breeding there "a few years" earlier. As the colony has grown it has become an increasingly serious economic problem since nesting material and unedible garbage clog the drains, causing rainwater to flood and damage the roof.

On 6 June 1961 about 150 nests were found. Roughly 100 contained eggs and a few had small chicks. On 28 June 1962 the colony was censused carefully in order to confirm the impression that the population had decreased and that the breeding season was less advanced than it had been in early June of the previous year. This time only 69 nests were found; 46 were empty, 21 had eggs, and two had young chicks. Many broken and punctured eggs were scattered about the roof; I never have seen such extensive cannibalism in a gull colony. The reason for the reduction in the number of breeding birds and the retardation of the season is uncertain, although it is probably partly because the maintenance men had more thoroughly and continually destroyed the nests early in the 1962 season than they had in the previous year.

This seems to be the first recorded instance of Herring Gulls nesting on a building in North America. It may well portend a wider adoption of this habit in the New World, paralleling a similar behavior by *L. a. argentatus*, first noted in Europe about 20 years ago (e.g., Salmon, 1958. *British Birds*, *51*, pp. 399–401; Goethe, 1960. "Proc. XII Inter. Orn. Congress," *1*, pp. 252–258). If this is the first step in the exploitation of a new nesting habitat, we shall probably see a continued increase in the gull population, with colonies springing up on buildings well inland from salt water and a portion of the population feeding extensively in agricultural areas.—Raymond A. Paynter, Jr., *Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, 18 December 1962.*

Notes on behavior of a Cooper's Hawk.—I feed birds regularly in the winter at my home on the banks of the Olentangy River in Columbus, Ohio, so it is not surprising that a Cooper's Hawk (*Accipiter cooperii*) is seen frequently in the vicinity. It is an adult male and appears to be slightly smaller than average. In the vicinity there are shrubs, trees, and lawns.

This bird comes to the yard, perches on a post, sometimes not 10 feet from our picture window, and searches for prey. The feeding birds, however, usually take cover before his arrival. The House Sparrow (*Passer domesticus*) usually enter a martin house or a 6-foot hemlock nearby. When the hawk detects a movement in the hemlock, he darts to it, walks around on the ground and peers up into the branches. If he sees a bird he plunges into the foliage in an attempt to capture it. Usually the small bird flies out the other direction and escapes. On one occasion he attempted for 45 minutes to capture a female House Sparrow and was finally successful. He followed the sparrow from shrub to shrub, each time forcing the bird to flee by plunging into the close-growing branches.

On one other occasion when this hawk bore down on a sparrow in the hemlock the sparrow left the opposite side undetected. After much walking around on the ground and searching the tree, the hawk walked in under it and came out with a dried black walnut in the husk. He perched on one leg on a nearby post for about five minutes before flying to other cover with the nut still held in his claws.

On another occasion, the hawk spied and chased a Belted Kingfisher (*Megaceryle alcyon*) that was flying about 4 feet above the water. Upon seeing the hawk, the kingfisher dropped to a six-inch altitude. Although the hawk was closing the gap in pursuit, it would not fly close enough to the water to capture the prey. The kingfisher escaped when the hawk gave up the chase.

Bent (1937. *U.S. Nat. Mus. Bull.* No. 167:112–125) relates many interesting predator-prey accounts, but my observations were somewhat different, especially that concerning the walnut.—H. Granville Smith, *Soil Conservation Service, 311 Old Federal Building, Columbus 15, Ohio, 28 January 1962.*

Unusual feeding tactic by a migrant Myrtle Warbler.—In the course of seven years of work on Delaware Bay, I have observed many migrant land birds, over the open waters of the bay—nearly all in the autumn, of birds moving into the wind, which usually came from the north or northwest. The majority of these birds maintained a steady flight past our boat, although many landed aboard for variable lengths of time. Many of these birds actively searched for food on deck and rested.

On 17 October 1961, at a location about six miles WSW of Cape May Point, New Jersey, an outbound Navy destroyer passed our northbound boat. The weather was clear and the winds were out of the northwest at about 5 mph, having gradually diminished from velocities of 10–15 mph. As we crossed the destroyer's wake, I saw a small bird flying low with the wake and the wind, and within a few minutes I saw what presumably was the same bird, a Myrtle Warbler (*Dendroica coronata*), following in our wake.

The bird remained within three feet of the water and gradually moved closer to the boat. I suspected that the bird was fatigued and was attempting to come aboard to rest since its flight appeared weak and it would occasionally drop to the surface of the water with legs dangling as though attempting to land on the foam. Eventually I noted that the bird was by no means a weak flyer as it would dart off in any direction in pursuit of insects. After each foray it would return to the wake and flutter along, making occasional hovering pauses, actually picking insects from the surface of the water in our wake. On several occasions the bird caught up to the boat, flew alongside and ahead of the boat without attempting to land, then circled back to again feed in the wake. It was obvious that this bird was keeping well fed on its journey over water. After 20 minutes, or about three miles, of this performance the bird flew westward at an altitude of about 20 feet, still frequently darting after airborne insects. The wind and sea were nearly calm when the bird left.

I had not observed this very active feeding behavior for a warbler on the wing over water before, despite the fact that flies and other insects are often abundant over Delaware Bay at this season, and that Myrtle Warblers frequently rest aboard the boat. On 18 October 1961, under similar conditions (winds light SW) a very weak Myrtle Warbler hit the side of our boat in a landing attempt and drowned in the wash from a passing yacht before we could retrieve it.—Donald E. Kunkle, *Rutgers University, Oyster Research Laboratory, Bivalve, New Jersey, 2 February 1962.*

Diurnal feeding periodicity of juvenile Mallards.—Brood activity of Mallards (*Anas platyrhynchos*) and other species of waterfowl apparently varies with time of day. For example, Diem and Lu (1960. *J. Wildl. Mgmt.*, 24:113–133) counted more broods (and adults) of Mallards, plus other "motile puddlers," in 5:30 AM than 9:30 AM and 1:30 PM censuses. Also, broods of Ring-necked Ducks (*Aythya collaris*) and Canvasbacks (*A. valisineria*) were reported most active in morning and evening by Mendall (1958. *Univ. Maine Bull.* 16, 317 pp.) and Hochbaum (1944. Amer. Wildl. Inst., 201 pp.) respectively.

I observed diurnal peaks in the activity of Mallard broods which appeared to be correlated with feeding activity. The number of food items was greater in the stomach contents of juveniles collected in the evening than in those taken in the afternoon (Chura, 1961. *Trans. N. Amer. Wildl. Conf.*, 26:121–134). Subsequent data on the contents of gullet-gizzard samples from four age classes of juvenile Mallards also indicate greater food consumption in the evening than in the afternoon. Furthermore, birds in two of these age classes also showed the tendency for greater food consumption in the morning as well (Table 1).

TABLE 1

MEAN NUMBER OF FOOD ITEMS OCCURRING IN GULLET-GIZZARD SAMPLES OF MALLARDS ON THE BEAR RIVER MIGRATORY BIRD REFUGE, UTAH, IN 1961

	Morning (7:45–11:30 AM)	Afternoon (2:00–3:30 PM)	Evening (5:05–7:45 PM)
Age class of ducklings:[1]			
Class Ia (1–6 days old)	—	124	184
		(9)[2]	(13)
Class Ib (7–12 days old)	211	76	276
	(6)	(10)	(5)
Class IIa (19–25 days old)	—	28	268
		(3)	(6)
Class IIb (26–35 days old)	306	127	421
	(2)	(4)	(4)

[1]System of aging used by Gollop and Marshall (1954. *Miss. Flyway Council Tech. Sec.*, 14 pp.).
[2]Number of ducklings examined.

The gizzards of all the sampled birds contained food. Freshly ingested food items occurred in most gullets of the birds collected in the afternoon. Young Mallards apparently did not refrain from feeding altogether, but simply fed more sparingly in the afternoon. Thus, an early manifestation of diurnal peaks of feeding exhibited by adults exists in juvenile Mallards. This periodicity in the activity of non-flying young may be likened to the field-feeding flights of adults which appear to be concentrated into morning and late afternoon or evening hours as reported and discussed by Bellrose (1944. *Ill. Nat. Hist. Surv. Bull.* 23:327–372), Hochbaum (1955. Univ. Minn. Press, Minneapolis, 301 pp.), Bossenmaier and Marshall (1958. *Wildl. Monog.* 1, 32 pp.) and Winner (1959. *J. Wildl. Mgmt.*, 23:197–202).—NICHOLAS J. CHURA, *Utah Cooperative Wildlife Research Unit, State University, Logan, Utah, 10 March 1962.*

Diving times of a Common Goldeneye.—The durations of 103 dives of a Common Goldeneye (*Bucephala clangula*) were measured with a stopwatch. Observations were made between 27 and 31 January 1962, on a lone female on two small fresh-water ponds near Allentown, Pennsylvania (Table 1). Air temperatures ranged from 4 C to −6 C and water temperatures from 3 C to 6 C.

TABLE 1

Date	Water depth in feet	Number of diving observations	Diving time in seconds			Mean and standard deviation (for 103 diving times)
			Minimum	Maximum	Mean	
27	4	51	3.2	18.1	14.16	14.15 ± 2.73 sec.
28	4	21	5.6	17.3	13.85	
29	4	27	11.9	17.0	14.15	
31	3	4	8.9	20.5	15.68	

F. S. Hersey (*In* Bent, 1925. *U.S. Natl. Mus. Bull.* 130:9) observed a goldeneye ". . . and found that it dove with great regularity, remaining under for 21 seconds and on the surface for 13 seconds between dives." He does not state the number of dive timings he made.

In contrast, a wide range of diving times was exhibited by the individual which I observed. Two possible factors responsible for this variation could be varying depths of water in which the bird was diving, and varying amounts of vegetation on the floor of the ponds. —DONALD S. HEINTZELMAN, *629 Green Street, Allentown, Pennsylvania, 21 February 1962.*

The first record for Puerto Rico of the nest of the Scarlet-cheeked Weaver Finch.—The Scarlet-cheeked Weaver Finch (*Estrilda melpoda*) was introduced into Puerto Rico from West Africa before 1874. At present it is confined to the southwestern part of the island. What appears to be the first record of the nest of these birds from Puerto Rico was brought to my attention by James B. McCandless, M.D., from Mayagüez. Dr. McCandless reports that a nest was found in the suburbs of Mayagüez (Las Mesas) in a cultivated flower garden 1,000 feet above sea level. The species is common in the area and nearly always is observed in flocks of 10 to 30 individuals. The nest was found in October 1961. It was located 4½ feet from the ground on a "yellow trumpet" or "cup of gold" vine (*Solandra nitida*) growing on a cement block wall. The nest, which was not firmly attached, was a globular structure made of woven grass-like fibers from the same plant. On top of the globular structure was a loosely attached cup of the same material. Adult birds had been seen sitting in this cup but no eggs were observed. At least two adults attended the nest but their sexes were undetermined.

Two days before the nest was collected faint chirping was heard. On examination, feathers and a small piece of tinfoil were found in the cup where an adult was seen sitting earlier. Because no opening was evident the nest was a puzzle until faint squeeks were heard inside the globular structure. A white egg about ½" in diameter fell out and was broken, but it contained no recognizable embryo. Four recently hatched young were inside the narrow passage in the hollow globe. These were removed but only by widening the passageway considerably. They were anaesthetized, preserved, and deposited with the nest in the collections of the Department of Biology of the College of Agriculture and Mechanic Arts of Mayagüez, Puerto Rico.—VIRGILIO BIAGGI, JR., *Biology Department, College of Agriculture and Mechanic Arts, Mayagüez, P. R., 30 March 1962.*

White Pelicans breeding in Colorado.—The first known nesting of White Pelicans (*Pelecanus erythrorhynchos*) in Colorado occurred in 1962, when an estimated 200–250 adults reared about 60 young on an island in Riverside Reservoir, 3 miles north of Masters, Weld County, Colorado. Adult pelicans with small nestlings were first observed by Norman L. Hughes and William H. Rutherford, of the Colorado Game and Fish Department, during a routine aerial count of waterfowl on 29 May 1962. Young were observed from the ground on 23 July by Jack R. Grieb and Howard D. Funk of the same department. On 24 July, Ronald A. Ryder, assisted by Game and Fish Department personnel and students from Colorado State College at Greeley, banded 45 flightless, but nearly full-grown young. Ring-billed Gulls (*Larus delawarensis*) and Double-crested Cormorants (*Phalacrocorax auritus*) were also believed to have nested on islands in Riverside Reservoir, as immatures of these species were seen flying in the area 24 July, but no definite nests or flightless young were found.

Riverside Reservoir is approximately 4 miles long and 2 miles wide, with a surface area of 3,811 acres and a storage capacity of 57,633 acre-feet. The reservoir is relatively isolated and rarely visited except during waterfowl hunting seasons, when portions are leased by private gun clubs. The past two years the reservoir has been filled to near capacity, which has made its islands more isolated than in recent dry years. Personnel of the Colorado Game and Fish Department have banded flightless ducks on the reservoir every summer since 1957.

The AOU Checklist of 1957, Bergtold (1928. *A Guide to the Birds of Colorado*), Sclater (1912. *A History of the Birds of Colorado*) and Cooke (1897. *The Birds of Colorado*) all list the White Pelican as probably nesting in Colorado, but cite no definite dates nor places of nesting. The nearest known nesting colonies are in Great Salt Lake, Utah, Yellowstone Lake, Wyoming, and Bennett County, South Dakota.—Ronald A. Ryder, *Colorado State University*, and Jack R. Grieb, *Colorado Game and Fish Department, Fort Collins, Colorado, 13 August 1962.*

Altitude record for Mallard.—Recently the Operations Division of the Air Transport Association submitted for identification one feather salvaged after an aircraft-bird strike. It was a right primary, in good condition, and was determined by Mrs. Roxie C. Laybourne, of our Bird and Mammal Laboratories, as coming from a Mallard (*Anas platyrhynchos*).

The strike occurred at 4:15 PM on 9 July 1962, between Battle Mountain and Elko, Nevada. The plane, a Western Airlines L–188 Electra, was cruising at an air speed of 345 knots and an altitude of 21,000 feet. The bird was not seen by any of the crew, all of whom were looking outside at the time. The pilot, Captain Markle Sparks of Los Angeles, believed the bird was at a higher altitude than the plane, that it attacked the plane as it approached, and lost control just before impact. He suspected an eagle as the only bird in that area that could climb so high.

The pilot reported that he "felt a light thud and about a minute later the stewardess came forward and said that the passengers in the rear of the airplane felt a small explosion. Upon landing, there was a dent in the leading edge of the right horizontal stabilizer about the size of a football. It hit just at the side of a rib and there was a tear approximately 9 inches long beside the rib. There was down around the tear, and the feather inside. There was no blood nor any other indication that it was a bird that we had struck." The strike did not cause any immediate change in the flight procedure, but did necessitate replacing a 5-foot section of skin on the tail assembly.—Richard H. Manville, *U.S. Fish and Wildlife Service, Washington 25, D.C., 17 October 1962.*

An unusual location for a Clapper Rail.—In August 1962, an injured Clapper Rail (*Rallus longirostris*) was found by my daughter, Daral, on the Margate City, New Jersey beach. The bird had taken refuge in a rock pile that extended into the ocean. The bird had been there no longer than 12 hours since the high water mark would have reached far beyond the bird's point of refuge. We removed the bird and found it to have a right shoulder separation with some fragmentation of the humeral bone. The useless right wing seriously impeded the bird's ability to walk, so Tony Cincotta and I removed it. Blood vessels were tied off and the bird was observed for post-operative bleeding. Later it was transported to the bay region, behind Margate, and released in the tall grass near the bay water. The bird did not hesitate to take cover and was observed to be in complete command of its balance.

This is the first Clapper Rail I have observed on the Margate beach, which is a popular bathing and swimming area. The distance from its natural habitat, the bay, to the ocean beach is about 2 miles.—Bruce Glick, *Box 185, State College, Mississippi, 27 September 1962.*

Population density of Sparrow Hawks in eastern Pennsylvania.—The summer of 1961 produced a record number of Sparrow Hawks (*Falco sparverius*) in an area of one-half square mile on farmland at the foot of Hawk Mountain in the northeast corner of Berks County, Pennsylvania.

In the past eight years one to two pairs of Sparrow Hawks used boxes in this area, despite the fact that six or seven boxes were available. During the 1961 season nine nest boxes were available, of which six were occupied. One pair nested in the eaves of a building. These seven pairs produced a total of 31 young: 15 males and 16 females from 32 eggs—(one infertile egg was found). The nearest distance between two of the nests was 110 feet! The average height of the boxes is 18 feet above the ground.

This high nesting success is interestingly reflected in the record count of 470 Sparrow Hawks observed at Hawk Mountain during the 1961 Fall migration of hawks. This might indicate a highly successful nesting season throughout the east.—Alexander C. Nagy, *Hawk Mountain Sanctuary, Route 2, Gempton, Pennsylvania, 26 April 1962.*

The Lesser Black-backed Gull in Indiana.—On 7 April 1962, Kenn Able, Mr. and Mrs. Ted Chandik, Scott Rea, and Richard Rosche observed a Lesser Black-backed Gull (*Larus fuscus*) at the Willow Slough State Fish and Game Area, near Morocco, Newton County, Indiana. Dozens of observers studied the bird at length the following day, during a field-trip portion of the annual meeting of the Wilson Ornithological Society at Purdue University. Rowe collected this wary bird on 9 April 1962 with a .222 rifle, after we had pursued it for nearly four hours. It rested and flew with Ring-billed Gulls (*Larus delawarensis*). We wish to thank Eugene Eisenmann and Charles Vaurie for verifying its identification as *L. f. graellsii.* The specimen has been deposited in the Purdue University Wildlife Laboratory Collection.

The bird was a moderately fat, adult female weighing 1,093 grams. The wing (arc) measured 409 mm and the largest ovum 4 mm. The feet, tarsi, irides, and gape were yellow; the eye ring and gape border were orange-salmon. A gizzard shad (*Dorosoma cepedianum*) measuring 170 mm in length was in the gullet.

Jehl (1958. *Auk.* 75:349–350) has summarized previous records of this gull for North America. Our specimen is evidently the fourth for the United States and the first for Indiana.—Russell E. Mumford, *Department of Forestry and Conservation, Purdue University, Lafayette, Indiana,* and Warren S. Rowe, *Indiana Department of Conservation, Morrocco, Indiana, 13 July 1962.*

Dual Wood Duck occupancy of a nesting box.—The coincident use of a nesting box by two female Wood Ducks (*Aix sponsa*) was observed at the Dead Creek Waterfowl Area, Addison, Vermont, in the summer of 1961.

An earlier observation by Bellrose (1943. *Auk*, 60:446–447) outlined a similar phenomenon; his discovery originated with the appearance of 15 Wood Duck eggs in a single nesting box during an 8-day period, for a laying rate of nearly two eggs per day.

Simultaneous incubation of a clutch by both females was in progress when the Vermont incident was discovered on 8 June during a routine check of nesting box utilization. The nesting box used was of the cylindrical, galvanized metal type developed in Illinois (Bellrose, 1953. *Ill. Nat. Hist. Surv. Cir.* 45:47 pp.) ; having a 12-inch diameter, the interior was sufficiently commodious to permit the two ducks to hold a side-by-side position on the nest, although one bird obviously covered most of the eggs.

The rate of laying prior to 23 May (when 10 eggs were noted in the nest) could not be established, nor could it be determined from the gross appearance of the eggs whether one or both females had contributed to the final clutch of 13 eggs. However, if only one egg per day was deposited after 23 May, the 13th egg should have been laid on 26 May, incubation should have begun on 27 May (± one day), and hatching should have followed in about 28 days on 24 June. Actual hatching began on 26 June and was complete on 28 June. Therefore, it seems unlikely that more than one egg per day was added after 23 May; accordingly, the clutch of 13 eggs represented the laying of a single duck or, more likely, the dump nesting by a second duck in the established nest of the first.

Both females were banded on 8 June with USF&WS bands (No. 545–10982 and No. 545–10983), at which time No. 982 was observed to be carrying Vermont Tag No. C748 in the web of one foot. The web tag identified this bird as having been hatched at Dead Creek in 1960 in a nesting box ⅓-mile distant from that to which she returned in 1961 as a "novice" (lacking previous nesting experience). The age of No. 983 could not be similarly determined.

Between visits to the box on 9 and 13 June, two eggs disappeared, unaccountably, from the nest. Similar egg losses have been observed at other boxes on the area, and Bellrose (1943. Ibid.) also recorded the disappearance of two eggs from the box in which he observed dual utilization.

On subsequent checks, the clutch was being incubated at one time by bird No. 982, at another time by bird No. 983, and on two additional days by both birds simultaneously. Under the latter circumstance, and the approach of hatching, a differential flushing pattern was exhibited by the two females—one flying quickly away from the box, the other displaying the "broken wing" act typical of advanced incubation and broodiness.

When hatching occurred on 28 June, bird No. 983 was alone on the nest although a second female (possibly bird No. 982) was on the water near the box. Darkness intervened before it could be determined whether one or both females called the brood from the box and attended the ducklings in the marsh.

Normal clutch size for Wood Ducks using Dead Creek boxes has been very similar to that reported by McLaughlin and Grice (1952. *Trans. N. Am. Wildl. Conf.*, 17:242–259) for Massachusetts, 9–12 eggs; however, clutches of 20–40 eggs have been noted each year, and these generally considered to have resulted from dump nesting, particularly by novice females. This report of dual occupancy tends to support such a premise by positive identification of one of the females as such a novice; the information is inconclusive, however, since it fails to establish whether the novice female preempted the nest of another or tolerated the preemption of her own nest by another bird, or that dump nesting actually occurred. Along with the information of Bellrose, it does establish the fact that intraspecific tolerance of incubating Wood Ducks to a common nest site, though rare, does occur. It further increases speculation as to the actual contribution of dump nesting to clutches of a size previously considered normal for one female.—ROBERT W. FULLER and ERIC BOLEN, *Vermont Fish and Game Department, RFD, Vergennes, Vermont, 26 July 1962.*

A partial albino wood pewee.—On 14 September 1961, I collected a partial albino Eastern Wood Pewee (*Contopus virens*) on the University of Wisconsin campus at Madison. The pewee, a male, was observed there for a week before it was mist-netted. The bird was mostly yellow in color; there was a slight grayish tinge on the breast, alula, and primaries. The abdomen was similar in color to that found in normal pewees. Above the bird was pale yellow (closest to Naphthalene Yellow of Ridgway's "Color Standards and Color Nomenclature") rather than the olive-brown of normal birds. The concealed bases of the feathers were pure white. The tail was pale yellow with an indication of gray at the tips of the rectrices. All feather shafts were white rather than the normal blackish-brown. The crown was pale yellow. The nape and sides of the head were bright yellow (closest to Ridgway's Bartya Yellow). The grayish color of the throat of normal pewees was lacking. The maxilla and mandible were pale brown, the tarsus brownish-black, and the iris black in color. It weighed 15.5 grams, had a rectrix that was 64.0 mm long and a wing (worn) 77.0 mm long. Its skull was completely ossified.

The bird was kept successfully in a cage, 3 feet cubed, for six weeks, during which time its song was normal.

Few published records of albinism in Eastern Wood Pewees exist (Berger, 1956. *Auk*, 73:137; and C. C. Ross, in litt.). Previous records are as follows: a "perfect" albino Eastern Wood Pewee, Chicago, Illinois (Deane, 1879. *Bull. Nuttall Ornith. Club*, 4:29); one at Montclair, New Jersey, that was ". . . perfectly white . . . except a soft lemon-yellowish white underneath, and slightest dusky tips to its wing" (Hegeman, 1913. *Bird Lore*, 15:376) and a "complete" albino (Greene Smith Collection, no sex or locality) now housed in the Museum of Comparative Zoology, Harvard University (R. A. Paynter, in litt.). The partial albino Eastern Wood Pewee reported here represents the fourth known record of albinism in pewees.—EMIL K. URBAN, *Department of Zoology, University of Wisconsin, Madison 6, Wisconsin, 10 May 1962.*

Cattle Egrets in north central Pennsylvania.—Davis (1960. *Auk*, 77:421–424) and Sprunt (1955. *Smithsonian Report*, 1954:259–276) reviewed the dispersal of the Cattle Egret (*Bubulcus ibis*) in the continental United States. The observation here reported, of quite possibly an accidental visit (although I can find no real cause—i.e., they did not follow unusual weather), was coincident with observations of unusually large migrant groups of Ring-billed Gulls (*Larus delawarensis*) and Bonaparte's Gulls, (*L. philadelphia*).

A single Cattle Egret was observed on 23 April 1962, and two individuals were observed on 24 April 1962. The birds were feeding in a vernal pond located in the Susquehanna River floodplain area 2½ miles east of Lock Haven, Clinton County, Pennsylvania.

An investigation of several vernal ponds, including this one, revealed an abundance of fairy shrimp (*Eubranchipus vernalis*) as the only sizable prey to be obtained there. It would appear that these temporary populations of *Eubranchipus* were attractive food for the egrets. The pond in question dried up by 15 May 1962 and was much reduced in size on the dates of observation. Two days after the observations no *Eubranchipus* could be found. Thus it appears that the egrets departed shortly after finding a food supply which in this case was only very temporarily available.—G. E. GRUBE, *Lock Haven State College, Lock Haven, Pennsylvania, 11 May 1962.*

Nest buildup by a pheasant hen.—The building up of nests to maintain them above the level of rising water has been reported for several species among both surface-feeding and diving ducks. To my knowledge, the building up of nests by ground-nesting gallinaceous birds has not been reported and probably rarely occurs even though their nests are commonly flooded.

This note reports evidence of a buildup of a nest by a Ring-necked Pheasant (*Phasianus colchicus*) hen during a heavy rain which flooded the nest site. The nest site was located in a low-lying area of an unharvested hayfield, containing tame grasses and legumes, near Sibley, Illinois, on 24 June 1960. About 2 inches of rain had fallen in the period of a few hours on the previous day and had caused a temporary accumulation of between 1 and 2 inches of surface water in the vicinity of the nest site.

There were two nest bowls, spaced only 1 foot apart, at the nest site. One nest bowl was situated typically in a slight depression and contained four dead chicks and the remains of the shells and membranes of six hatched eggs. The chicks had apparently either drowned or died of exposure.

The second nest bowl was atypical in construction, but not in diameter, and consisted of a platform of green and dead vegetation, which was raised 4 inches above ground level. The green vegetation in the nest bowl was still succulent which suggested that the nest had been constructed recently. Two dead chicks were entwined in the vegetation of the nest, indicating that the construction of the built-up nest was probably completed after some of the chicks had died. The dead chicks found in both nests evidently had been hatched shortly prior to or during the rain as they possessed unabsorbed yolk sacs. Three unhatched eggs, which had been subjected to prolonged incubation as evidenced by the decomposition of the egg content, were situated in a slight hollow at the top of the platform nest bowl.

The existing evidence suggests that this pheasant hen originally constructed a typical nest, laid nine eggs, and incubated the clutch. Six of the nine eggs hatched just prior to or during the flooding of the nest. The hen, when confronted with rising water at the nest site, built up a platform nest under the three unhatched eggs that were somehow moved out of the original nest bowl. This type of buildup suggests that the hen elevated the eggs by consistent addition of vegetative materials to the bottom of the platform, which is comparable to the behavior exhibited by duck hens. However, this pheasant hen constructed a separate structure, whereas ducks build up their original nests. The presence of two dead chicks entwined in the vegetation of the platform nest suggests that some of the chicks attempted, but failed, to reach the elevated nest bowl before dying. Although the hen was never observed, she evidently deserted the nest site shortly after the built-up nest had been constructed.—Ronald F. Labisky, *Section of Wildlife Research, Illinois Natural History Survey, Urbana, Illinois, 13 September 1962.*

ORNITHOLOGICAL NEWS

Illustrations of birds first appeared on the front cover of *The Wilson Bulletin* in 1902. Nine species of birds were incorporated into the cover design of the first number of that volume, and they were used on each issue until 1908, when a drawing of Wilson's Warbler replaced them. This new design remained unchanged until 1916, when Wilson's Phalarope replaced the warbler in a newer design. Ten years later a different drawing of Wilson's Warbler appeared on the cover and was used continuously, except on the Fiftieth Anniversary Volume in 1938 when no drawing was used, until the present volume—the Seventy-fifth Anniversary Volume. George Miksch Sutton made the drawing of the Wilson's Warbler that was used from 1926 through 1962, and he made the new one appearing for the first time on this March 1963 number.

We are indeed grateful to Dr. Sutton for our new cover design and for his other kind and generous contributions, including the frontispiece and prefatory remarks pertinent to the first number of our anniversary volume.

The South African Ornithological Society is planning the Second Pan-African Ornithological Congress from 21 to 25 September 1964. The Congress will be held at Pietermaritzburg, Natal, and will be preceded and succeeded by field trips. For further information, address the Society at the Percy FitzPatrick Institute, University of Cape Town, Rondebosch, C.P., South Africa.

The National Science Foundation announces that the next closing date for receipt of proposals for Basic Research in the Life Sciences is 15 May 1963. Inquiries or proposals requesting support should be addressed to the National Science Foundation, Washington 25, D.C.

XIV INTERNATIONAL ORNITHOLOGICAL CONGRESS

The next Congress will be held in Great Britain in 1966, with Dr. David Lack as President. Dr. N. Tinbergen has been elected Secretary-General and, after full consideration of various possibilities, it has been decided to hold the Congress in Oxford. One excursion is planned—a week's cruise of Scottish sea-bird islands in a ship of sufficient size to accommodate most members of the Congress. The provisional dates are: 16–23 July for the cruise, and 24–30 July for the meeting in Oxford.

Mr. John K. Terres is writing an "Encyclopedia of American Birds" and is including biographical sketches of ornithologists of the past who have made significant contributions to American ornithology. If anyone owning separates of biographies that have been published anywhere will send a copy of each to him at P. O. Box 571, Chapel Hill, N.C., he will be very grateful and will make proper acknowledgment for such help in his book.

ORNITHOLOGICAL LITERATURE

Handbook of North American Birds. Volume 1, Loons Through Flamingos. Edited by Ralph S. Palmer. Yale University Press, New Haven, 1962: 7¼ × 10¼ in., x + 567 pp., 6 col. pls., numerous maps and figs. $15.00.

This is the first of a projected series of about ten volumes which will concisely summarize the natural history of the avifauna of North America, exclusive of Mexico. Volume 1 of the Handbook includes much of the data contained in the earliest two volumes of Bent's classic "Life Histories of North American Birds," in addition to a considerable amount of information which has accumulated since that work was begun over forty years ago. The format of the Handbook is markedly different, however. Lacking is the emphasis on subspecies, the lengthy quotations, and the chatty informality that characterize Bent's work and which, while making for entertaining reading, often obscure important material and make quick reference an impossibility. In contrast, the style of the Handbook is stark and crisp, almost telegraphic, with the subject matter rigidly compartmentalized, permitting the prompt location of specific information.

Twenty-five collaborators have contributed to the volume. Their command of the subject matter is varied. Some, such as A. J. Meyerriecks, whose special field is the behavior of herons, have made valuable original contributions. Others have presented pedestrian summaries of published material. In spite of the variability in coverage, R. S. Palmer, the dedicated and conscientious editor, has achieved great uniformity in style and treatment throughout the volume; his elutriating touch is evident down to the smallest detail.

Palmer's concern for consistency and his carefully laid groundwork are apparent in the Introduction, where the scope of the Handbook is precisely delineated and methods, concepts, and terms are defined and standardized. For example, various egg shapes are illustrated and named; there is a brief discussion of avian survival and its specialized terminology; and there are three pages of outline drawings illustrating the topography of birds and how various measurements are made. There is, however, no section on anatomy. While internal morphology is lightly treated in the Handbook, there are paragraphs which will be nearly incomprehensible to readers who are not anatomists. This is demonstrated on the two pages following the Introduction, where ordinal characters for the loons through the ducks are summarized in a table. It is the rare reader who will fully understand what is meant by the diagnosis, for instance, that the Ciconiae have holorhinal or schizorhinal, pervious (in ours) nostrils; a desmognathous palate; thigh muscles with the formulas of AYX±, XY±, or ABYX+; type 1 deep flexor tendons; A–1 (in ours) carotid arteries; and no basipterygoid process. If we may have the formula (p. 14) for a bicone $(L(R_B + R_P)/B^2\text{–}1)$, even though the editor believes (p. 1) that the simple statistical measures of standard deviation and standard error "usually are beyond the scope" of the book, it would not seem inappropriate if we were told a little about A–1 carotid arteries and ABYX+ thigh muscles.

Of serious consequence is the editor's decision to adopt, with minor modifications, Humphrey and Parkes' recently introduced nomenclature for plumages and molts (*Auk*, 76:1–31, 1959). The system attempts to assign uniform names to homologous plumages and molts in all groups of birds, leading to the wholesale replacement of familiar terms, developed and used by several generations of ornithologists. If it were merely a matter of name-changing to achieve ultimate uniformity, a strong case could be made for adopting the Humphrey-Parkes terminology in the Handbook. However, the evolutionary premises on which the system is based have been sharply criticized and may be incorrect. The virtual imposition of this nomenclature on American ornithology seems premature. Its adoption is especially surprising in view of the conservative approach of the editor in other areas, such as his choice of the Wetmore taxonomic sequence, which Palmer explains (p. 1) is being used because "Rather than substituting other uncertainties for a widely used classification, it seems better to begin with the latter and make departures where warranted."

Another notable innovation in the Introduction, and one which is welcome, is a color chart, prepared by J. Villalobos, which will probably become the new standard, replacing Ridgway's classic, and now virtually unobtainable, "Color Standards and Color Nomenclature" (1912).

The emphasis of the Handbook is on the species rather than on higher taxa. However, a brief characterization introduces each order and family. Morphology, especially in the discussion of the orders, is usually the central theme, but behavior, distribution, and the fossil record in North America are touched upon.

Each species account is preceded by a paragraph succinctly describing the bird in non-technical language, giving its measurements in the English system, noting whether it is sexual dimorphic, and similar information. This is followed by longer accounts, in staccato style, falling into the following categories: description; subspecies; field identification; voice; habitat; distribution; migration; banding status; reproduction; survival; habits; and food. Key words (e.g., territory; copulation; clutch) are in boldface type, facilitating quick reference. These accounts vary greatly in length, depending on the complexity of the subject and the information which is available. The section on survival frequently is omitted and the section on banding often is reduced to such biologically useless statements as (p. 200), "Through 1957, total of 386 banded, with 2 recoveries and returns; banded in W. Indies." The distribution map which accompanies each species' account is good; details not readily mapped are noted in the text. The extraterritorial ranges are broadly sketched, both on the map and in the text, and occasionally are slightly inaccurate. Measurements and weights, given under "Description," are sometimes based on the literature but more often were purposely taken from museum specimens for the Handbook. The samples are rather small; only ranges and averages are given, whereas for eggs (under "Reproduction") one specimen from each of twenty clutches has been measured and the mean and standard deviation of the length, breadth, radius of curvature of each end, and elongation are presented, as well as the measures for bicone and asymmetry.

There are six color plates in the book; two by Roger Tory Peterson and four by Robert M. Mengel. Those by Peterson (Northern Fulmars; heads and legs of herons) are precise and almost photographic, while those by Mengel (frigate-birds and pelicans; heads of cormorants; herons; and ibises) are less detailed and almost crude by comparison. The two plates depicting soft parts are useful adjuncts to the text. The other four are embellishments and wasted opportunities to provide illustrations unavailable elsewhere.

Scattered through the book are black and white drawings by Mengel. Some are purely decorative (e.g., a shearwater shown with a lizard; Black-crowned Night Heron on pilings) and informative only in the widest sense, but the majority illustrate physical features (e.g., head of Red-necked Grebe in three plumages) or ethology (e.g., Gannets; Western Grebes) and are useful.

Eleven pages packed with references and an index, mainly to scientific and vernacular names, conclude the volume.

There is not the slightest doubt that the appearance of the first volume of the Handbook marks an important milestone in American ornithology. However, since the Handbook is "sponsored" by the American Ornithologists' Union, there is the strong, unfortunate, possibility that many users will come to look upon this work as the *ultima ratio*. It should be emphasized that while the Handbook is sponsored by the AOU, there is little formal scholarly support from that organization and that the content and organization of the book are the responsibility of the editor. The Handbook does not necessarily represent the consensus of the AOU in the same manner as the Union's "Check-list of North American Birds," which, for better or worse, is the product of a committee's deliberations. In the present volume the editor's prejudices and prerogatives are much in evidence, as they should be when he bears sole responsibility for the book. In a sense, therefore, this is not the AOU's Handbook but rather "Palmer's Handbook."

In the initial stages of any mammoth undertaking there are bound to be errors in judgment and some ineffective groping. It is also certain, no matter what efforts are made, that not everyone will be entirely pleased with the results of any attempt to summarize all the available information on a topic. I have stressed those areas which seem less satisfactory to me, but this should not obscure the fact that the Handbook is a valuable work which, perforce, will be the core of any library on North American birds. In spite of what this reviewer believes are a few errors of decision, which might not have occurred had there been an editorial board, accolades are due Dr. Palmer for a difficult task skillfully done. —Raymond A. Paynter, Jr.

Check-List of Birds of the World. A Continuation of the Work of James L. Peters. Volume 15. Edited by Ernst Mayr and James C. Greenway, Jr. Museum of Comparative Zoölogy, Cambridge, Massachusetts, 1962: $6\frac{1}{2} \times 9\frac{1}{4}$ in., x + 315 pp. $7.50.

As mentioned in my review of Volume 9 of this check-list (1960. *Wilson Bull.* 72: 415–419), a combination of circumstances has made it necessary to publish the volumes out of numerical sequence. Thus, although the present volume is the last numerically, six others remain to be published.

Several statements in my earlier review (*q.v.*), covering such matters as indispensability of the work as a reference, controversial sequence of families, inevitability of taxonomic disagreement in particular cases, attractive format, and general excellence of proofreading (this volume, like Volume 9, was printed in Denmark), apply equally to the present volume and need not be repeated.

Several shortcomings of Volume 9 have been corrected in Volume 15; one notable improvement is the addition of the names of the authors on the title page and table of contents. Authors in this volume and the families for which they were responsible are as follows: E. Mayr (Grallinidae, Artamidae, Ptilonorhynchidae, Paradisaeidae); D. Amadon (Sturnidae, Callaeidae, Cracticidae); C. Vaurie (Dicruridae, Old World Corvidae); J. C. Greenway, Jr. (Oriolidae, Palearctic and Indian Ploceidae); R. E. Moreau (African and Indian Ocean Ploceidae); E. R. Blake (New World Corvidae).

The introduction states that "the authors and editors have attempted to solve the vexing problem of the application of English names by employing those used in the following publications—and in these only: American Ornithologists' Union's Checklist of North American Birds, Fifth edition (1957); Peterson, Mountfort, and Hollum's Field Guide to the Birds of Britain and Europe (1954); Royal Australasian Ornithologists' Union's Official Checklist of the Birds of Australia (1926); The Ornithological Society of New Zealand's Checklist of New Zealand Birds (1953); and Vincent's Check List of the Birds of South Africa (1952)." This solution appears to this reviewer as both arbitrary and unsatisfactory. As mentioned in my review of Volume 9, standard reference books in English are available for virtually all parts of the world's avifauna, and selection of an English name for use in the Peters Check-list would help greatly in stabilizing usage where several alternative English names exist. The arbitrary nature of the present arrangement is nowhere illustrated better than among African birds, for which the political boundary of South Africa determines whether or not a species shall have an English name. And even then the "policy" is not followed consistently. Thus we have 16 species of *Euplectes*, of which only four are allotted English names, although an additional five species occur in South Africa and are given English names by Vincent. Only one of the six species of *Spreo* occurs in South Africa, so *Spreo bicolor* alone rates an English name (although each of the other five species is found in at least one former British colony). The U.S.–Mexico border forms another arbitrary division, so that *Aphelocoma ultramarina*, which occurs in the U.S., may be known as "Mexican Jay," while *A. unicolor*, which does not, gets no English name (although English names for it are available in the literature). I repeat my previous conclusion that English names should be applied to all species or to none in a check-list in the English language.

No new taxa appear to be proposed in this volume; the only new nomenclatorial matter I found was the designation for the first time of a type species for *Ploceolus* Reichenbach, a synonym of *Ploceus* Cuvier. A two-page section of addenda lists two species of Cracticidae inadvertently omitted from the main section, plus seven recently described subspecies, three of which were published after the manuscript completion date of 31 December 1960. I have already indicated (op. cit.: 417) my reasons for believing that a closing date should be faithfully observed once set.

It is interesting to note that the taxonomy of certain families in this volume, especially at the generic and specific level, would probably have been handled quite differently had the manuscript been prepared a decade or two ago. The Sturnidae, for instance, were reviewed twice by Amadon (1943. *Am. Mus. Novit.*, No. 1247:16 pp., 1956. *Am. Mus. Novit.*, No. 1803: 41 pp.). In 1956 he admitted four genera not recognized in his 1943 paper, while synonymizing one previously recognized genus. His treatment of the starlings in the Check-list follows his 1956 paper, except that he has replaced "*Coccycolius*" *iris* in *Lamprotornis*, where he had listed it in 1943, rather than retain a monotypic genus as in the 1956 paper. He has also somewhat rearranged the sequence of the mynah genera *Basilornis*, *Streptocitta*, *Sarcops*, and *Mino*, now placing *Mino* first instead of last in this group.

The same tendency away from "lumping" can be seen in the Corvidae. Blake and Vaurie admit the following genera not considered separable by Amadon in 1944 (*Am. Mus. Novit.*, No. 1251:21 pp.): *Aphelocoma*, *Cissilopha*, *Cyanolyca*, *Urocissa*, *Dendrocitta*, *Temnurus*, and *Pseudopodoces*. On the other hand, when comparing Mayr's present treatment to that in his "List of New Guinea Birds" (1941. *Am. Mus. Nat. Hist.*:260 pp.) we find the same genera of birds of paradise, and one *less* genus of bowerbirds (*Xanthomelus* now included in *Sericulus*). In other cases, recent monographs or reference works are followed closely. Greenway adapted his list of Indian ploceids from an unpublished manuscript by Salim Ali and the Palearctic ploceids from Vaurie's 1959 Palearctic check-list. Vaurie's treatment of the drongos follows his monograph (1949. *Bull. Am. Mus. Nat. Hist.*, 93:199–342) very closely, except for the suppression of three subspecies and the addition of one described in 1952. This reviewer was pleased to see that the editors did not accept the alphabetic "classification" of the African ploceids originally announced for the Peters Check-list by Moreau (1960. *Ibis*, 102:467–468).

It seems to this reviewer that a particularly large number of subspecific names are relegated to synonymy in this volume. Paynter (1962. *Wilson Bull.*, 74:302) commends Ripley for the frequent use in his Indian check-list of footnotes explaining differences of opinion, the reasons for changes, etc., a commendation with which I heartily concur. In the case of the large number of names appearing in synonymy in the Peters list, a significant aid to the taxonomist reader would be the use of symbols as employed by Vaurie in his check-list of Palearctic birds, to indicate which names were synonymized on subjective and which on objective grounds. A consistent symbol, also as used by Vaurie, to indicate weakly marked but separable races would eliminate the occasional text statements (cf. *Petronia petronia exigua*, p. 25—"A poorly marked subspecies") which have been employed most inconsistently.

Detracting scarcely at all from the usefulness of the present volume are several other inconsistencies of usage. Altitudes of type localities are frequently given in modern descriptions of new forms; these are sometimes quoted in the present check-list (*Cyanocorax dickeyi*, 5,200 feet; *Perisoreus canadensis bicolor*, 3,000 feet) and sometimes not (*Cyanocorax violaceus pallidus*, [100 meters]; *Perisoreus canadensis connexus*, [6,800 feet]). An error in spelling of the type locality in the original description of *Cyanocitta cristata cyanotephra* is duly transcribed, adding "(*sic*)," while a similar error in the original description of *Corvus sinaloae* was overlooked. Amadon explains fully in a footnote (p. 75) his reasons for using the spelling *Aplonis* rather than *Aplornis*, whereas Mayr (p. 188), although correctly using Lesson's original spelling *Seleucidis*, does not explain that the literature of the birds of paradise and of New Guinea birds virtually unanimously uses Gray's invalid emendation *Seleucides;* readers without access to Lesson's original (1835) description may wonder at the unaccustomed spelling.

The number of references to important papers covering birds of the families treated has been greatly increased, and the scope of these references usefully expanded to include life histories as well as purely taxonomic and distributional papers. In most cases, general and regional papers are listed at the head of the family, while papers on particular genera and species are listed under the appropriate generic heading. In the case of the Oriolidae, however, all references are listed under the family heading, even though some papers cover only a few species, or even only part of a single species. This arrangement is less useful than the placement of the references near the species concerned.

As mentioned earlier, typographical and other errors seem gratifyingly uncommon. I append a list of a few errors I have found, not in a spirit of criticism, but as a service to those who may wish to make corrections in their copies.

P. 15, line 26—for Ab, el Kuri read Abd el Kuri.

P. 18, line 36—for Transvaall read Transvaal.

Pp. 21–22—overlooked name: *Passer montanus manillensis* Hachisuka (1941. *Tori*, 11:88. Manila, Luzon, Philippines), which should be a synonym of *P. m. saturatus*, the race introduced around Manila (*P. m. malaccensis* is, as correctly stated, the race introduced in Cebu). See Parkes, 1959. *Ibis*, 101:243–244.

P. 74, line 20—for description read designation.

P. 209, line 11—for "near Summerhaven, Santa Catalina Mountains, Carter County" read "Carter Canyon, near Summerhaven, Santa Catalina Mountains."

P. 210, line 11—for 1955 read 1954.

P. 229, line 2—for *lancelatus* read *lanceolatus*.

P. 269, line 21—for *IMPERATUS* read *IMPARATUS*.

P. 276, last line of footnote—for homonyn read homonym.

P. 284—names in the addenda are listed in the index under the page number of the main text where these names would normally appear, rather than under the page number of the addenda. There are footnotes on these text pages referring the reader to the addenda. However, two names (*hercules*, *Cracticus* and *rosa-alba*, *Strepera*) appear only in the addenda, and are not referred to on the pages under which they are indexed.

In my review of Volume 9, as well as in my review of Vaurie's list of Palearctic birds (1959. *Wilson Bull.*, 71:286–288) I gave a summary of differences from AOU treatment for the benefit of interested readers of the *Wilson Bulletin.* In the present volume, other than the two introduced species each of Sturnidae and Ploceidae, the only North American birds are the Corvidae. Blake's treatment differs from that of the AOU as follows:

1. Subfamilies are not recognized within the Corvidae.
2. *Perisoreus* is placed not as the first (presumably most primitive) of the genera of jays, but between the Old World jays (*Garrulus*) and the Blue Magpies (*Urocissa*).
3. *Perisoreus canadensis sanfordi* and *P. c. barbouri* are considered inseparable from *P. c. nigricapillus.*
4. Subgenera are not recognized within the genus *Aphelocoma.*
5. *Aphelocoma coerulescens oocleptica* includes *A. c.* "*superciliosa*" of the AOU Check-list (not of Strickland).
6. *Aphelocoma coerulescens cactophila* is considered inseparable from *A. c. hypoleuca.*
7. *Corvus corax clarionensis* is considered inseparable from *C. c. sinuatus.*
8. *Gymnorhinus* is placed at the head of the New World jays instead of between the nutcrackers and the crows (see Amadon, 1944, *Am. Mus. Novit.*, No. 1251:8).
9. The incorrect spelling *cyanocephala* (in *Gymnorhinus*) is given, following the AOU Check-list, but see Wetmore, 1962. *Auk*, 79:494 for correction.

The authors, editors, and printers of the continuation of the Peters Check-list are to be commended for the general excellence of the latest volume. It is hoped that they will take into consideration the constructively meant criticism and suggestions by this and other reviewers as each of the remaining volumes approaches publication.—Kenneth C. Parkes.

The Mallee-fowl: The Bird That Builds an Incubator. By H. J. Frith. Angus & Robertson Ltd., Sydney, 1962: 5¾ × 8¾ in., xii + 136 pp., 34 photos., 4 figs. 35s (about $4.20).

This well-written popular account of the remarkable Australian Mallee-fowl (*Leipoa ocellata*) summarizes nearly a decade of ecological analysis by Frith and reviews pertinent information for other species of megapodes. Topics include incubation of the eggs in mounds, behavior of adults in regulating mound temperatures, social relations, territories, breeding seasons, eggs, chicks, predation, evolution of the reproductive habits, and conservation. A wide variety of techniques was employed, ranging from soil analyses to spotting mounds from aircraft. The accuracy with which the Mallee-fowl and its habitat are portrayed is impressive to this reviewer who spent about eight weeks in the mallee region in 1960. My only disappointment was the poor reproduction, at least in the review copy, of a few photographs. The book is the first ever devoted exclusively to megapodes and is an excellent contribution to the literature of natural history.—George A. Clark, Jr.

Functional Anatomy of the Feeding Apparatus in Waterfowl. (Aves: Anatidae). By Donald C. Goodman and Harvey I. Fisher. Southern Illinois University Press, Carbondale, 1962: 6 × 9 in., xi + 193 pp., 11 figs., 40 tables. $6.50.

Professors Goodman and Fisher have made another fine contribution to the literature of avian anatomy in their latest joint work. Their book presents a thorough analysis of the feeding apparatus and the feeding habits of 17 species in 14 genera of anatids (*Cygnus, Branta, Dendrocygna, Anas, Spatula, Aythya, Bucephala, Clangula, Melanitta, Oxyura, Lophodytes, Mergus, Cairina, Chloëphaga*).

The anatomical features discussed in detail include: epidermal structures of the bill, osteology of the skull, muscles of the jaws and anterior third of the neck, extrinsic tongue muscles, pertinent ligaments of the skull, and the kinetics of the upper jaw. The 40 tables in the text present a wealth of data both on measurements of the basic anatomical features and on ratios among them. The most significant aspect of this book is the emphasis throughout on functional anatomy and the adaptive significance of differences found among the various species. Of special interest are the tables that present indices of the total effective forces of the individual jaw muscles.

Goodman and Fisher's book contains so much detailed information that summarization in a short review is impossible. A few of their conclusions, however, will be of general interest to ornithologists:

"There appears to be a direct correlation between the total effective force of the functional muscle groups and the differences in feeding behavior in the family Anatidae. The grazers (*B. canadensis*, *B. nigricans*, and *C. hybrida*) all have a relatively large total effective force of adduction and of retraction. A forceful closure of the bill is necessary to hold grass firmly in the bill so that when the head and neck are drawn down and backward, the grass will snap off rather than pull out of the bill" (p. 169). "The canvasback has the greatest potential ability to close its jaws of any of the known strainers. . . . The shoveler has the least potential ability to adduct and to retract its jaws. However, its extreme specialization for straining food from the water, as demonstrated by the large amount of plankton in its diet, does not require strength for the closing of the jaws" (p. 170).

"Those anatids that are highly specialized for straining, as the shoveler, green-winged teal, and ruddy duck, are small in size. This type of food habit probably will not support a large body size. (The whales are a notable exception.) The canvasback, mallard, and surf scoter are larger in size and therefore have a stronger functional potential in their jaws. They can eat more difficult-to-obtain foods than the other ducks in the straining group" (p. 172).

In general, the grazers have the smallest amount of kinetic action (the movement of the upper jaw around the frontonasal hinge); "the fish-eaters have the largest potential movement of the upper jaw, and the straining anatids are intermediate between these two feeding groups in degree of kinetics. . . . In general, the trend appears to be an inverse relationship between relative bill height and degrees of movement of the upper jaw" (p. 176).

"The manner of feeding of the anatids can be divided into two major functional types. The grazers (Canada goose, black brant, kelp goose, and mute swan), the sea-diving ducks (surf scoter, goldeneye, and oldsquaw), and the fish-eaters (the mergansers) use a powerful adduction of the jaws, the *grasping-action*, to secure the major portion of their food. The dabbling-strainers (mallard, green-winged teal, and shoveler) and the diving-strainers (lesser scaup, canvasback, and ruddy duck) use a less powerful, but rapid opening and closing of the jaws, the *straining-action*, to obtain most of their food. The Muscovy duck and the black-bellied tree duck seem to be functional intermediates between the grazers and strainers" (pp. 177–178).

"The pattern of the jaw muscles in the members of the family Anatidae is quite homogeneous. Only in *M. merganser* and *L. cucullatus* are there major anatomical variations that alter the muscle pattern" (p. 181). The mergansers share certain osteological and myological characters "in common and distinct from the other anatids."—Andrew J. Berger.

A Field Guide to Western Bird Songs: Western North America and the Hawaiian Islands. Arranged to Accompany, Page by Page, Roger Tory Peterson's A Field Guide to Western Birds, 2nd Edition. By William W. H. Gunn and Peter Paul Kellogg. Houghton Mifflin Company, Boston, 1962: album, 12½ × 12½ in., with table of contents; 3 12-inch vinylite records, 33⅓ r.p.m. $12.95.

Superlative statements are risky, but surely "A Field Guide to Western Bird Songs" contains the largest collection of bird sounds ever gathered into one phonograph record album. Vocalizations of 512 species are announced. A few more birds heard only in the background add to this impressive total. The region covered is also large: all of North America north of Mexico and west of the 100th meridian. The marginal areas of the Lower Rio Grande Delta of Texas and the Hawaiian Islands are included as a bonus.

Dr. Arthur A. Allen clearly announces a vernacular name for each continental species and refers the listener to the approximate page number in Roger Tory Peterson's 2nd edition of "A Field Guide to Western Birds" where the species is discussed. Peterson makes similar announcements and referrals for the Hawaiian birds.

Since over 500 birds are introduced and presented on only three discs (six sides), each species is allowed only a short time in which to recite its repertoire. The editors have attempted to place the most "typical" song of each bird on the discs, but some call notes are lacking or poorly represented. This lack occasionally renders the records less useful for instruction in bird finding. For example, when I want to locate Verdins in central or southern Texas, I go to a patch of brush and listen for a rapid chipping note. Adult and immature Verdins of both sexes give their characteristic chipping throughout the year. Vocalizations similar to those on the record usually are voiced too seldom to be of much use in a Verdin census. The chipping, though frequent through the day, is difficult for the sound recorder to capture because of its irregular starting and stopping times.

Representation of White-winged Dove calls in "A Field Guide to Western Bird Songs" is unbalanced. The *ooo-uh-cuck'-oo* is repeated several times, but the one *who cooks for you*, which in nature is about as frequent, is almost blotted out by loud wing-beats.

Beginners in field identification by ear could become confused when counterpart notes of closely related forms are missing. For the Yellow-shafted Flicker the sound track gives one type of call and bill drumming; three types of calls represent the Red-shafted Flicker. Both flickers winter together on the Southern Great Plains. Both make winter woods echo with call type Number 2 as presented under Red-shafted Flicker; yet a literal interpretation of the record would indicate that this sound is absent from the Yellow-shafted's vocabulary.

Data printed beside species names on the record jackets often indicate activity of the birds when they were recorded (call in flight, pair display, feeding calls, song, etc.). Locality and time of year are also given for most species. Months and states (or provinces) are the smallest time and geographic units recognized.

It is unfortunate that lack of space prevented more precise statements of localities. To say that the Golden-cheeked Warbler was recorded in "Tex." is of little help to the bird finder who is trying to locate the species. Even though Texas has been demoted to only the second largest of the United States, it still contains 263,513 square land miles, most of which have not furnished a perch for a Golden-cheeked Warbler within historic time. Admittedly "the song of this male bird was recorded along Wildcat Hollow in juniper-oak clad hills in the western outskirts of Austin, Travis County, central Texas" would have been overlong, but "c. Tex." or even "cent. Texas" could have been printed on the jacket with room to spare.

In some instances the geographic designation is even larger than state size. The Bristle-thighed Curlew call came from the "South Pacific." The South Pacific Ocean, with its more than 35,000,000 square miles, is a rather large place in which to look for a curlew that nests in a very small part of Alaska and winters to a considerable extent on the leeward Hawaiian Islands in the North Pacific Ocean!

Captives are usually labeled as such, but there are slip-ups. The Black Brant and Emperor Goose were each recorded in "England." These two species are of course unknown as wild birds in the British Isles.

The present album, unlike its eastern counterpart, "A Field Guide to Bird Songs," omits scientific names. This omission is likely to reduce its value for foreigners. Even some Americans may find "Elepaio," "Apapane," "Iiwi," and "Palila" a bit strange. "Rice-bird" without a technical name could mean any one of a number of species. Clearly, a purchaser of the record album should also buy the 2nd edition of "A Field Guide to Western Birds" to insure correct identification of sound track species.

The inclusion of Hawaiian birds in a North American book and album is a bold, unprecedented stroke. Those who object to this association of the Islands with the mainland might do well to consider the following: (1) All the common regular migrants—Pintail, Shoveler, American Golden Plover, Ruddy Turnstone, Bristle-thighed Curlew, Wandering Tattler, Sanderling, Pomarine Jaeger—to and from Hawaii are North American; (2) 57 of the 62 species listed as rare migrants, casuals, and accidentals are in the AOU Check-list; (3) not counting the single doubtful element (the genus *Pennula*), 11 of the 13 natural colonizations of Hawaii by fresh water and land birds probably came from North America (see Ernst Mayr, 1943. The Zoogeographic Position of the Hawaiian Islands, *Condor*, 45: 45–48). It is true that among the pelagics and the introduced birds North American species do not show majorities, but zoogeographers customarily do not include these categories when they are determining the faunal affinities of land masses.

The sound track of "A Field Guide to Western Bird Songs" is notably free from background noise. The Wandering Tattler and the Dipper are exceptions. Here the noisy background is an asset. Separation of the Tattler from its roaring surf or of the Dipper from its rushing trout stream would have constituted a most unnatural amputation.

"A Field Guide to Western Bird Songs" is a magnificent introduction to many of the bird sounds of the great West. Now that high spots in this huge area have been hit, future albums can concentrate on a more complete repertoire and fuller data for each species. —Edgar Kincaid, Jr.

Silent Spring. By Rachel Carson. Houghton Mifflin Company, Boston, 1962: 6¼ × 8¾ in., xvi + 368 pp., illus. $5.00.

Neither Rachel Carson, nor her latest book, "Silent Spring," needs any introduction to the readers of *The Wilson Bulletin.* Portions of this exciting new work first appeared in *The New Yorker* in June 1962. The immediate response was a ferment of controversy which boiled even more briskly when the book itself appeared on the market in late September. A wide array of reviews has appeared in leading newspapers and magazines. Responses ranged from highly favorable in *The New York Times* and *Saturday Review* to airy dismissal by *Time.*

Those who have read "The Sea Around Us" or "The Edge of The Sea" will note that Miss Carson again displays the same amazing talent for weaving massive amounts of factual material into a highly literate work. The reader will, however, be startled to note that the author has brusquely dropped her former stance of nicely balanced detachment. Miss Carson is indignant with man's arrogant abuse of nature. She has assumed the role of prosecutor and the pesticide industry stands accused.

The book begins with a vivid description of spring in a town in middle America which becomes blighted with mysterious maladies and complaints. The birds of field, marsh, and woodland fall silent; streams are lifeless; there are no bees among the apple blossoms. The scene is reminiscent of Nevil Shute's "On The Beach." "Silent Spring" moves on to a statement of charges; i.e., that we are in danger of fatally polluting our environment with an accumulation of lethal materials.

Successive chapters contain discussions of the chemical composition of pesticides ("Elixirs of Death") and their effect on living systems. Case histories of the contamination of surface and ground water by pesticides are next presented. The incredible history of control operations on Clear Lake, California, is included among these examples. In this case the pest species is an abundant but harmless gnat which annoys resorters and fishermen. The results of this control program create an ecological disaster in which DDD residues are concentrated as they pass along the aquatic food chain from plankton to fish to grebe. At the end of nearly ten years of intermittent treatment, a local population of over 1,000 pairs of Western Grebes had been reduced to a remnant of unsuccessful breeders. It is significant that the sportsman of Clear Lake is no longer willing to accept hardship or even slight annoyance as a Spartan value of the outdoor experience. His counterpart in the east complains of midge swarms overhead as he cranks up his outboard to cross a quiet pond.

Succeeding chapters take up herbicides and their overuse on roadsides and right-of-ways, as well as material on pesticide abuses in suburb, countryside, and forest. Miss Carson also presents examples of biological control measures which suggest alternatives to rigorous chemical treatment.

Some of the most interesting material in this book is contained in the later chapters which deal with energy transformations and metabolic cycles in the cell. Miss Carson relates pesticide function to cellular physiology and builds a fascinating hypothetical relationship between cancer and pesticides. Some of these chapters are among the best science writings that this reviewer has been pleased to read. Sandwiched in between this background material are carefully assembled arrays of fact which build a devastating argument against our continued emphasis on chemical rather than biological control of insect and plant pests.

While the reader of "Silent Spring" would be likely to overestimate the extent of pesticide spraying, Miss Carson's critics have been quick to point out that 95 per cent of the land and water surface in the United States does not receive pesticides under current annual spraying programs. Those of us concerned with wildlife values are nevertheless alarmed by the trend toward massive use of toxic chemicals. The wholesale value of pesticidal chemicals has increased from $40 million in 1940 to $245 million in 1953 to approximately $301 million in 1961. The rosy predictions of the agricultural chemical industry indicate that this trend can be expected to continue.

It would be regrettable if alarmist reaction to "Silent Spring" would result in pesticide and herbicide regulations which were unfair to the responsible farmer, forester, or orchardist. We should hope, however, that the controversy will encourage a careful review of research needs with greater emphasis upon biological control studies as well as increased support for studies on the ecological effects of chemical control methods. A review of regulatory procedure is also in order. Indeed the agricultural chemical producers are already ruefully admitting to themselves that they should have taken vigorous action long ago to encourage a uniform code of certification for professional pesticide applicators.

In closing, I do not wish to suggest that Miss Carson could have achieved her aims with anything less than the dramatic presentation which she has constructed. "Silent Spring" makes fascinating reading and provides an excellent background to a problem which should concern every thoughtful citizen.

Those of us who are committed to the cause of wildlife conservation should be deeply grateful for the services of so eloquent an advocate as Rachel Carson.—Daniel Q. Thompson.

Men, Birds, and Adventure: The Thrilling Story of the Discovery of American Birds. By Virginia S. Eifert. Dodd, Mead & Company, New York [1962]: 6 × 9½ in., xiv + 273 pp., illus. $4.50.

"Americans are mad about history," an English woman told me recently. Although I resented her slightly derogatory tone, her statement was probably true. We Americans do enjoy history, especially history presented in the style of Virginia Eifert. This book, as the title indicates, is concerned with the adventures of the men who discovered and described the birds of North America. Each of the twenty chapters, written in a clear, narrative style, stands alone as a tale of romance and adventure, yet each is bound to the other by a central theme—birds—against an unfolding background of historical events.

The first chapter deals with the excavation of a burial mound in southern Illinois where, in 1954, archaeologists found two stone pipes, one accurately carved to depict a raven, the other a falcon. These pipes, estimated to be about 2,500 years old, may be examples of the earliest known American bird art. The last chapter is contemporary (possibly dangerous in a basically historical book), describing the discovery of Sutton's Warbler (still in question as a species), the rediscovery of the Ivory-billed Woodpecker, and the detection of two invasion species, the Cattle Egret and the Spotted-breasted Oriole.

Columbus recorded birds on his first expedition and sent specimens back to Europe. Other explorers and early settlers did the same and a few left brief notes on the wildlife encountered. In a short time, wherever a path opened into the great wilderness of North America, there was a botanist or zoologist or naturalist ready to follow it and to collect, preserve, name, and label every new living form that came within view.

Some of these men had sufficient energy, courage, and funds to travel alone for the study of natural history, but the majority were attached to expeditions bent on acquiring territories, surveying boundaries, or constructing railways. Many times these naturalists had other duties so that the collecting and preserving of specimens was secondary, done in off hours under conditions that were unbelievably primitive. Even when a man's position was officially that of botanist or zoologist with an expedition, he was often barely tolerated by an unsympathetic leader who considered the collections a burden and refused to linger in the best places for birds. But whether natural history was their chief aim or not, everywhere the naturalists pressed on—collecting, possibly painting, and describing birds. Their names live on in Steller's Jay, Franklin's Grouse, Wilson's Warbler, Clark's Nutcracker, Lewis' Woodpecker, and Baird's Sparrow, just to mention a few.

This is not a comfortable book. One suffers frustration with Georg Wilhelm Steller who, after only a few hours on an island offshore, stood on the deck of the Russian ship, *St. Peter*, and watched "Alayshka" vanish in the mist. Alaska, the land he had labored so hard to reach! One is tired and hungry and cold while crossing the mountains with Meriwether Lewis and William Clark, and terrified by the alligators that surrounded William Bartram in a Florida swamp; one grieves over the collections and paintings of Prince Maximilian of Wied that were lost when the Mississippi River steamer ran aground and burned. Yet despite all the tribulations and setbacks, one feels the forging ahead and the gradual triumphs—in the paintings of Catesby, Wilson, and Audubon; in the collections of Say, Baird, and Cassin; in the gradually developing appreciation of the wilderness in the writings of Thoreau, Muir, and Burroughs; and in the appearance of "tools" for bird study—binoculars, cameras, and bird guides, the first of which was a modest volume by Chester A. Reed.

Mrs. Eifert is a competent historian as well as a trained naturalist. Her material, based on sound fact, is written with such a verve and touch of the dramatic that the reader may stay up too late just to "finish the chapter." The photographs are excellent. A good map, as is always the case, would have been an asset.—ELEANOR RICE PETTINGILL.

SUBANTARCTIC CAMPBELL ISLAND. By Alfred M. Bailey and J. H. Sorensen. Proceedings No. 10 of the Denver Museum of Natural History, 1962: 7¼ × 10½ in., vi + 305 pp., 232 photos., 2 maps. $7.00 (soft covers, $5.50).

Campbell Island, lying south of New Zealand in the low fifities, has all the usual characteristics of a windblown, subantarctic outpost—bold, rocky coastline and mountainous terrain, treeless landscape with dense scrub on sheltered slopes and tussock grassland. Though unsuited to a permanent human population despite an above-tide area of some forty square miles, Campbell Island has been visited for varying periods by parties of sealers and of numerous expeditions since its discovery in 1810. On the Island during the war years, 1941–45, the New Zealand Government based coastal watchers, among whom was a talented New Zealand naturalist, Mr. J. H. Sorensen. Later the Government established a permanent meteorological station with several men on duty continuously. Beginning 7 January 1958 a seven-man expedition under the auspices of the Denver Museum of Natural History spent six weeks on Campbell Island. Members of the party included Dr. Alfred M. Bailey, its leader, and two New Zealand naturalists, Dr. Kaj Westerskov and Mr. Robert Street.

The text of this book deals in turn with the geology, vegetation, mammals, and birds of Campbell Island. Much of the information about the birds, to which well over half the text is devoted, comes from the junior author's experiences and studies during his four years on the Island, but it also includes many observations by the senior author and other naturlist-explorers and draws upon, or makes reference to, the already considerable literature on subantarctic ornithology.

Each bird species is treated separately and, in the case of the commoner breeding sea-birds, at great length. The presentation under each species I find poorly organized and the information generally uncoordinated. This is due to the method of the authors in quoting field notes, their own and those of others, verbatim and often in full, paragraph after paragraph, sometimes without regard to the relevancy of certain subject matter. Little attempt is made at synthesizing data. The total result is a collection of observations and facts loosely strung together. My criticism of the method of presentation, however, must not be taken as belittling the value of the work. The authors have given us a wealth of information which cannot be ignored by anyone doing research on subantarctic ornithology. Perhaps their method, which I have taken to task, was to give the researcher the observations and facts as they are and let him do what he wants with them. On that score there is virtue in their method.

Three species of penguins, three gulls, eight passerines, one shag, one duck, and the Skua breed on Campbell Island, but the distinguishing ornithological feature is the procellariiform representation—no less than five nesting albatrosses together with four procellariids. Quite appropriately, many pages are devoted to the albatrosses, particularly the Wandering and Royal (*Diomedea exulans* and *epomophora*), with respect to behavior, nesting activities, duration of the young's dependency, age when young birds first return to breed, and so on, but all the breeding species come in for a reasonable share of attention.

I doubt that there is any natural-history treatise on a subantarctic island that was ever more extensively and handsomely illustrated than this one. It has altogether 232 photographs, many full page, and not an inferior one in the lot! One hundred of the photographs have to do with albatrosses—always rewarding subjects for the camera.—Olin Sewall Pettingill, Jr.

The Complete Book of Nature Photography. By Russ Kinne. A. S. Barnes and Company, New York [1962]: 7¾ × 10¼ in., 191 pp., many photos. by the author. $7.50.

Any book which professes by title or otherwise to be complete is opening itself to immediate challenge, but this book seems to be reasonably secure it its claim. Cameras, lenses, and accessories; the care and transportation of photographic equipment; the techniques for photographing plants and flowers, birds and other wild, land vertebrates, insects, animals in zoos and aquaria, under-water life, even rocks and minerals—there is pertinent information and advice here on all these topics, presented in non-technical language for the beginner or advanced amateur. The author, himself a free-lance photographer, is an "old hand" at camera work in many parts of this country, in the arctic and tropics, above water and below. In giving suggestions and admonitions he is able to speak from personal experience and is not averse to the light touch when expressing himself. Thus his book is almost as entertaining as it is instructive.

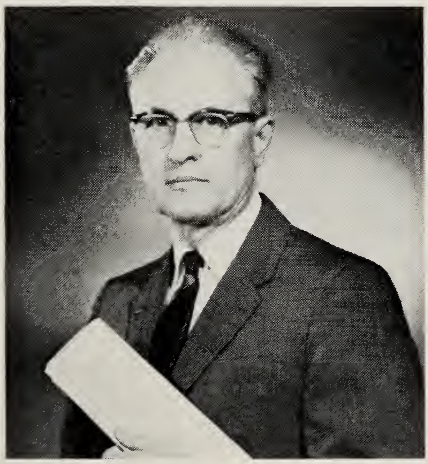
It should be pointed out that this is a complete book of *still* photography, the problems of motion-picture photography not being considered. While reasonably complete now, it may not be so next year or the year after at the rate new refinements in equipment and film are appearing. Nevertheless the basic materials and methods in nature photography will not change hurriedly. From my viewpoint the day is indeed far away when, for pictures of birds, the reflex camera, the blind, the long-focus lens, and the strobe light will be obsolete and the key to successful pictures will not be unlimited time, an immunity to frustration, and that much-too-rare attribute—patience!—Olin Sewall Pettingill, Jr.

The Natural History of the Lewis and Clark Expedition. Edited, with an introduction by Raymond Darwin Burroughs. Michigan State University Press, East Lansing [1961]: 5¾ × 9½ in., xii + 340 pp. $7.50.

This is essentially a compilation of all the notes on the mammals, birds, reptiles, amphibians, and fishes from the journals of Meriwether Lewis and William Clark on the famed 1804–06 journey to the Pacific. Heretofore, the complete notes, verbatim and unedited, were available only in R. G. Thwaites' "The Original Journals of the Lewis and Clark Expedition," altogether eight volumes published in 1904 and long since out of print. The notes were scattered through the entire work, appearing in the chronological order in which they were written. In Mr. Burroughs' work the arrangement is by species and thus we have under each species, again verbatim and unedited, exactly what the two explorers wrote about it. This makes most interesting reading. The ornithologist with an historical bent will right away turn to the collection of passages under such species as the Western Grebe, Sage Grouse, Lewis' Woodpecker (named for Meriwether), American Magpie, Steller's Jay, and Western Tanager, because here are the first written descriptions of these species and the basis on which Lewis and Clark were credited with their discovery. Mr. Burroughs has been very careful to let Lewis and Clark speak precisely in their own words but at the same time he has, in a very scholarly way, welded the notes into a satisfactory whole through his introductory (and occasionally concluding) remarks and through his interpretations and evaluations.

The introduction to the book is Mr. Burroughs' narrative of the Expedition, how it came about, the journey itself, and what it accomplished. To anyone wanting a brief story of this remarkable feat, for an evening or two of reading, I heartily commend it. The writing is excellent, the pace is brisk, and the narrative, while giving the highlights and pointing up many of the hardships and disappointments, is not overly dramatized. My only criticism is the lack of any sort of map. Since many of the place names mentioned are not shown on modern maps, one has difficulty following the route and determining exact locations of stops and other events along the way.—Olin Sewall Pettingill, Jr.

NEW LIFE MEMBER



Paul Eugene Belcher, of Akron, Ohio, an active member of the Wilson Ornithological Society since 1938, is now a Life Member. He received his A.B. from Ohio University, his LL.B. from American Extension University, and his J.S.D. from Lake Erie School of Law. As Senior Vice President and General Counsel of the First National Bank of Akron, Dr. Belcher has lectured and written a newspaper column on economic and business subjects, has authored a bank economic publication for 10 years, and has published on avian subjects; and he usually gives 20–30 talks/year on some phase of bird life. He is a member of the American, Ohio, and Summit County Bar Associations, American Marketing Association, and many bankers' associations; he is a life member of the American Ornithologists' Union and a member of the Cooper Ornithological Society. His principal interests in ornithology include scientific aspects of worldwide ornithology, field work and photography, and his extensive ornithological library.

PUBLICATION NOTES AND NOTICES

Aves in *The Zoological Record* (Vol. 98, Sect. 18, 1961) is the most recent number of this invaluable, world-wide bibliography of current publications (books, papers in journals, etc.) in ornithology. Edited by W.P.C. Tenison, it appears annually 12 to 18 months after the year closes. The present number, published late in 1962, covers publications in 1961 and those in the preceding years that did not reach the editor in time for inclusion in Volume 97. Each *Aves* section consists of four parts: (1) Titles of publications listed alphabetically by authors. (2) An index to subjects of listed publications. (3) An index to listed publications dealing with bird distribution. (4) An index to bird species featured in the listed publications. The present *Aves* section is priced at 13 shillings ($1.82) and should be ordered from the Scientific Director, The Zoological Society of London, Regent's Park, London, N.W. 1. Payment, which should accompany the order, can be by personal check made out to the Zoological Society of London. You may place a standing order for future sections. They will be mailed you on publication and you will be billed either at the time of publication or at a later date.

VIII Bulletin of the International Council for Bird Preservation. Published by the International Council for Bird Preservation, 1962: 124 pp., 13 pls. (1 col.). $2.25. (For copies, direct inquiries to Dr. S. Dillon Ripley, Peabody Museum of Natural History, Yale University, New Haven, Connecticut.)

Contains reports on bird-conservation problems in many countries, delivered at the Twelfth World Meeting in Tokyo, Japan, during May, 1960.

The Birds of Guilford, Connecticut: An Annotated List. By Locke MacKenzie. Peabody Museum of Natural History, Yale University, New Haven, 1961: 110 pp., map (in pocket, inside back cover). $1.50.

A record of 266 species that "may well become a model for other local publications," according to Roger Tory Peterson in his foreword. The annotations under each species represent careful summaries of distributional information gathered by many people over a long period of years. The area covered is typical of the coastal region of southern Connecticut, a fact that should give this work a wide use.

How to Know the Birds: An Introduction to Bird Recognition. By Roger Tory Peterson. Second edition. Houghton Mifflin Company, Boston, 1962: 4⅝ × 7½ in., 168 pp., 72 col. illus., 400 line drawings. $3.50.

Identical to the first edition (1949), except for the addition of 24 pages of full-color illustrations from the National Wildlife Federation's Conservation Stamp Series. Four of the old color plates are retained, with the Bobolink and Red-winged Blackbird now figured twice in color, in the old plates and in the new.

Desert Wildlife. By Edmund C. Jaeger. Stanford University Press. Stanford, California, 1961: 5¾ × 8¾ in., xii + 303 pp., drawings by Merle Gish, many photos. $5.95.

A revision of the author's "Our Desert Neighbors" (Stanford University Press, 1950), with additional chapters, drawings, and photographs. The chapters are mostly sketches of mammals, birds, and a few other animals. Certain chapters feature the Prairie Falcon, Roadrunner, Poor-will, Common Raven, Piñon Jay, Cactus Wren, Rock Wren, Le Conte's Thrasher, Loggerhead Shrike, and Scott's Oriole.

This issue of *The Wilson Bulletin* was published on 2 April 1963.

SUGGESTIONS TO AUTHORS

Manuscripts intended for publication in *The Wilson Bulletin* should be neatly typewritten, double-spaced, and on one side only of good quality white paper. Tables should be typed on separate sheets. Before preparing these, carefully consider whether the material is best presented in tabular form. Where the value of quantitative data can be enhanced by use of appropriate statistical methods, these should be used. Follow the AOU Check-list (Fifth Edition, 1957) insofar as scientific names of United States and Canadian birds are concerned unless a satisfactory explanation is offered for doing otherwise. Use species names (binomials) unless specimens have actually been handled and subspecifically identified. Summaries of major papers should be brief but quotable. Where fewer than five papers are cited, the citations may be included in the text. All citations in "General Notes" should be included in the text. Follow carefully the style used in this issue in listing the literature cited; otherwise, follow the "Style Manual for Biological Journals" (1960. AIBS). Photographs for illustrations should be sharp, have good contrast, and be on gloss paper. Submit prints unmounted and attach to each a brief but adequate legend. Do not write heavily on the backs of photographs. Diagrams and line drawings should be in black ink and their lettering large enough to permit reduction. Authors are requested to return proof promptly. Extensive alterations in copy after the type has been set must be charged to the author.

A WORD TO MEMBERS

The Wilson Bulletin is not as large as we want it to be. It will become larger as funds for publication increase. The Society loses money, and the size of the *Bulletin* is cut down accordingly, each time a member fails to pay dues and is put on the "suspended list." Postage is used in notifying the printer of this suspension. More postage is used in notifying the member and urging him to pay his dues. When he does finally pay he must be reinstated in the mailing list and there is a printer's charge for this service. The *Bulletin* will become larger if members will make a point of paying their dues promptly.

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If your address changes, notify the Society immediately. Send your complete new address to the Treasurer, Merrill Wood, Dept. of Zoology and Entomology, Frear Laboratory, Pennsylvania State University, University Park, Pennsylvania. He will notify the printer.

PLAN TO ATTEND THE 1963 ANNUAL MEETING

Charleston, South Carolina, 2–5 May 1963

Charleston is famed for its historic houses, its gardens and its hospitality, and our anniversary meeting promises to be a memorable one. Hosts are the Charleston Museum, the Charleston Natural History Society, and the Carolina Bird Club. E. Milby Burton, Director of the Charleston Museum, heads the Local Committee on Arrangements. Headquarters will be at the Fort Sumter Hotel, overlooking The Battery.

Alexander Sprunt, Jr., will open the meeting with a showing of his film, "Coastal Carolina," on Thursday evening, followed by a reception at the Charleston Museum. The papers sessions on Friday and Saturday will include a blackbird symposium headed by Dr. Oliver H. Hewitt. A barbecue supper is planned for Friday on Sullivan's Island, a barrier beach, and the Annual Dinner will be held at the Fort Sumter on Saturday. There will be afternoon tours of old Charleston houses and gardens and ample opportunity to visit famous Magnolia and Middleton Gardens.

Early morning field trips will be directed to possible Bachman's Warbler locations, and the Sunday excursion will include a boat trip on the Ashley and Cooper Rivers to observe herons and other water birds and a visit for luncheon, as guests of John Henry Dick, to Dixie Plantation.

The Wilson Bulletin

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CONTENTS

BREEDING SUCCESS OF THE COWBIRD

Howard Young

The Brown-headed Cowbird (*Molothrus ater*) has always been of special interest as our only obligate nest parasite. Since Friedmann's (1929) monograph, there have been many published notes on new species victimized, and papers on the breeding activities of other species frequently comment on the effect of cowbird parasitism. However, the success of the parasite itself has usually received only incidental attention in these reports.

Studying the reproductive activity of such a species, which builds no nest, obviously presents special problems. Under unusual circumstances it may be possible to trace the activities of an individual female, if the egg markings are distinctive, as was done by Walkinshaw (1949). But ordinarily this cannot be done with any degree of accuracy.

To investigate breeding success in the cowbird, the only feasible approach is to record all eggs laid, then carefully keep track of them, and note the number of eggs which produce fledglings.

Considerable data of this sort are imbedded in various papers, so that an attempt to estimate the cowbird breeding success seems reasonable at this time. The material that follows contains data gleaned from these different papers, plus information I gathered during field studies in Wisconsin. The field studies during 1959 and 1960 were supported by NSF Grant G–7446.

It is evident that the cowbird breeding success varies widely with the species parasitized. The Robin, for example, almost never accepts the cowbird egg, and the same applies to the Catbird. In these cases the striking contrast of the mottled cowbird eggs against the blue of the hosts' eggs is probably the cause of the rejection. The Cedar Waxwing also appears to be unsatisfactory as a foster parent. I have found single nestling cowbirds in three different waxwing nests. In each case the parasite died in the nest, while the waxwing young fledged. The color of the mouth of the young waxwing is distinctive, and it may be that the gaping of the young cowbirds was not a proper stimulus, so that they were not adequately fed. I find no records of cowbirds fledging successfully from waxwing nests.

Because none of these three species is parasitized to any significant extent, this low success has no great effect on cowbird breeding. This suggests the possibility that the cowbird is adapted to parasitize most frequently those birds which are most likely to rear cowbird young successfully—a point which will be considered in more detail later.

In general, however, the breeding efficiency of the cowbird appears to be quite low. Norris (1947) presented information on 74 parasitized nests of

15 different species. One hundred and eight cowbird eggs laid in these nests resulted in only 29 cowbird fledglings. In other words the breeding success was 27 per cent.

Berger (1951) reported on 112 parasitized nests of 20 different species. In these cases, 204 cowbird eggs produced 43 fledglings, a breeding success of only 22 per cent.

When data are gathered for a number of different specific hosts (Table 1), a range of success in cowbird breeding is found. For most of these hosts the data are inadequate, but for three different hosts there are data on 75 or more cowbird eggs. Of these, the Red-eyed Vireo (23 per cent of 121 cowbird eggs produced fledglings) and the Song Sparrow (30 per cent of 223 cowbird eggs produced fledglings) show results comparable to those cited immediately above. The Yellow Warbler (only 8 per cent of 75 cowbird eggs produced fledglings) seems not to be a particularly desirable host, even though it is frequently parasitized (40 per cent of 126 nests).

For certain of the other species, some information can be gained by grouping data. Among the warblers, 23 per cent of 251 cowbird eggs, and among the fringillids, 27 per cent of 361 cowbird eggs produced fledglings.

It will be noted that fledging success is considerably in excess of hatching success, and this pattern is repeated in the majority of the host species. The reason is apparent; there are certain hazards faced by both eggs and nestlings: predation, weather, death of the female, etc. But in addition there are dangers particularly faced by the cowbird egg, but not by the young. Many birds will desert when a strange egg appears, some will remove it, some will bury it. In addition, a significant number of cowbird eggs are laid in nonactive nests, where desertion has occurred, or even in nests where the young have already fledged.

Considering the 36 host species listed in Table 1, the over-all success of the cowbird was 25 per cent (218 fledglings from 879 eggs). However, to get a precise figure, one would have to know what proportion of cowbird eggs are laid in the nests of each parasitized species, which have varying suitability as hosts.

Such exact figures are unavailable. However, the success of cowbird breeding efforts will be determined mainly by those eggs laid in the nests of abundant species which are commonly parasitized. These will constitute the bulk of its reproductive attempts.

Table 1 shows five common species with at least 40 per cent parasitism, for which information is available on at least 50 cowbird eggs. These are: Red-eyed Vireo, Ovenbird, Yellow Warbler, Yellowthroat, and Song Sparrow. Totalled, the data on these species again give a cowbird success of 25 per cent (134 young fledged from 543 eggs).

TABLE 1

COWBIRD BREEDING SUCCESS

Host species	Total nests	Parasitized		Total cowbird eggs	Avg. per parasitized nest	Eggs hatched		Young fledged		% eggs producing fledglings	References
		No.	%			No.	%	No.	%		
Eastern Phoebe (*Sayornis phoebe*)	15	5	33	8	1.6	5	63	5	100	63	Berger (1951)
Acadian Flycatcher (*Empidonax virescens*)	68	17	25	19	1.1	7	37	7	100	37	Brandt (1947); Walkinshaw (1961)
Traill's Flycatcher (*E. traillii*)	115	12	10	16	1.3	8	50	5	63	31	Batts (1958); Berger (1951); Walkinshaw (1961); Young
Least Flycatcher (*E. minimus*)	37	3	8	3	1.0	2	67	2	100	67	Terrill (1961); Walkinshaw (1961)
Catbird (*Dumetella carolinensis*)	3,349	11	0.3	13	1.2	1	8	1	100	8	Berger (1951); Nickell (1958); Norris (1947); Terrill (1961); Young
Brown Thrasher (*Toxostoma rufum*)	19	1	5	2	2.0	0	0	0	0	0	Norris (1947); Young
Robin (*Turdus migratorius*)	200	2	1	2	1.0	0	0	0	0	0	Batts (1958); Young
Wood Thrush (*Hylocichla mustelina*)	18	3	17	4	1.3	1	25	1	100	25	Berger (1951); Norris (1947)
Veery (*Hylocichla fuscescens*)	11	7	64	8	1.1	8	100	4	50	50	Norris (1947)
Cedar Waxwing (*Bombycilla cedrorum*)	93	7	8	7	1.0	3	43	0	0	0	Lea (1942); Putnam (1949); Young
Bell's Vireo (*Vireo bellii*)	6	5	83	9	1.8	0	0	0	0	0	Mumford (1952)
Red-eyed Vireo (*Vireo olivaceus*)	131	67	51	121	1.8	43	36	28	65	23	Batts (1958); Lawrence (1953); Norris (1947); Southern (1958)
Yellow Warbler (*Dendroica petechia*)	126	51	40	75	1.5	8	11	6	75	8	Batts (1958); Berger (1951); Schrantz (1943); Young

TABLE 1. CONTINUED

Host species	Total nests	Parasitized No.	Parasitized %	Total cowbird eggs	Avg. per parasitized nest	Eggs hatched No.	Eggs hatched %	Young fledged No.	Young fledged %	% eggs producing fledglings	References
Black-throated Blue Warbler (*D. caerulescens*)	7	3	43	3	1.5*	1	33	0	0	0	Terrill (1961)
Black-throated Green Warbler (*D. virens*)	1	1	100	1	1.0	0	0	0	0	0	Pitelka (1940)
Chestnut-sided Warbler (*D. pensylvanica*)	2	1	50	3	3.0	0	0	0	0	0	Norris (1947)
Prairie Warbler (*D. discolor*)	17	4	24	4	1.0	1	25	1	100	25	Walkinshaw (1959)
Ovenbird (*Seiurus aurocapillus*)	51	30	59	57	1.9	29	51	13	45	23	Berger (1951); Hann (1937); Norris (1947)
Louisiana Water-thrush (*S. motacilla*)	15	8	53	17	2.1*	?	?	12	?	71	Eaton (1958)
Yellowthroat (*Geothlypis trichas*)	88	37	43	67	1.8	?	?	19	?	28	Batts (1958); Berger (1951); Hofslund (1957); Norris (1947); Stewart (1953); Young
Yellow-breasted Chat (*Icteria virens*)	14	11	79	22	2.0	7	32	6	86	27	Berger (1951); Nickell (1955)
American Redstart (*Setophaga ruticilla*)	18	1	6	2	2.0	0	0	0	0	0	Sturm (1945)
Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*	120	1	0.8	1	1.0	1	100	1	100	100	Young
Red-winged Blackbird (*Agelaius phoeniceus*)	2,021	45	2	48	1.1	12	25	5	42	10	Batts (1958); Berger (1951); Nickell (1955); Wood (1938); Young
Common Grackle (*Quiscalus quiscula versicolor*)	82	1	1	1	1.0	0	0	0	0	0	Petersen and Young (1950); Young
Scarlet Tanager (*Piranga olivacea*)	4	4	100	5	1.3	2	40	2	100	40	Norris (1947)
Cardinal (*Richmondena cardinalis*)	38	15	39	25	1.7	6	24	6	100	24	Berger (1951); Laskey (1950); Norris (1947); Young

TABLE 1. CONTINUED

Host species	Total nests	Para-sitized		Total cow-bird eggs	Avg. per para-sitized nest	Eggs hatched		Young fledged		% eggs produc-ing fledg-lings	References
		No.	%			No.	%	No.	%		
Rose-breasted Grosbeak (*Pheucticus ludovicianus*)	3	2	60	2	1.0	0	0	0	0	0	Berger (1951); Young
Indigo Bunting (*Passerina cyanea*)	26	12	46	17	1.4	6	35	6	100	24	Berger (1951); Phillips (1951); Norris (1947); Young
American Goldfinch (*Spinus tristis*)	326	3	0.9	4	2.0*	0	0	0	0	0	Berger (1951); Stokes (1950); Young
Rufous-sided Towhee (*Pipilo erythrophthalmus*)	42	21	50	36	1.7	16	48	12	75	36	Batts (1958); Berger (1951); Nice (1937); Norris (1947); Walkinshaw (1938)
Vesper Sparrow (*Pooecetes gramineus*)	13	3	23	3	1.0	3	100	1	33	33	Batts (1958); Berger (1951)
Chipping Sparrow (*Spizella passerina*)	91	10	11	12	1.2	2	17	2	100	17	Batts (1958); Berger (1951); Norris (1947); Walkinshaw (1944)
Clay-colored Sparrow (*S. pallida*)	19	8	42	14	1.8	0	0	0	0	0	Fox (1961); Walkinshaw (1939)
Field Sparrow (*S. pusilla*)	126	19	15	25	1.3	7	28	5	71	25	Batts (1958); Berger (1951); Norris (1947)
Song Sparrow (*Melospiza melodia*)	329	149	45	223	1.5	124	56	68	55	30	Batts (1958); Berger (1951); Nice (1937); Norris (1947); Young

* Information not available on all nests.

It was suggested earlier that the cowbird seldom parasitized those species which were not good hosts. This idea also can be examined by using data from Table 1. Here we find five species, Traill's Flycatcher, Catbird, Red-winged Blackbird, Field Sparrow, and Chipping Sparrow, where the incidence of parasitism does not exceed 15 per cent, and where at least 10 cowbird eggs are recorded. The number of eggs in this sample is small, but it is clear that data on cowbird eggs from lightly parasitized nests will accumulate very slowly, so it is appropriate to use the information at hand. In this group we find a cowbird success of 16 per cent (18 fledglings from 114 eggs). This shows a significant difference from the heavily parasitized hosts ($\chi^2 = 4.185$, $P < 0.05$), but more information would be desirable. As previously noted, the Yellow Warbler also appears to be a poor host, but is heavily parasitized.

The poorer success of the cowbird with the lightly parasitized group seems to be due almost entirely to differences in egg acceptance. Forty-three per cent (204/476) of the cowbird eggs hatched in the nests of heavily parasitized species, while only 26 per cent (30/114) hatched in the nests of the lightly parasitized hosts. The difference is highly significant ($\chi^2 = 10.516$, $P < 0.01$). The fledging success was similar in each group: 56 per cent (115 fledglings from 204 nestlings) in the nests of heavily parasitized species, and 60 per cent (18 fledglings from 30 nestlings) in the nests of those lightly parasitized. The difference here is of no statistical significance ($\chi^2 = 0.015$, $P > 0.90$).

While no general rule for cowbird reproductive success is advanced here, the information indicates that figures in the range of 20 to 30 per cent will often approach the over-all actual success. As with other species, of course, this will vary with the season, locality, and other factors.

Studies of other passerine species usually indicate a considerably better fledgling/egg ratio. For example, a sample of 548 Robin eggs (Young, 1955) showed 45 per cent of them producing fledglings. Nice (1937) found 36 per cent of Song Sparrow eggs producing fledglings, and a study of six species (Young, 1949) showed an over-all average of 40 per cent.

The unimpressive breeding efficiency of the cowbird is perhaps compensated for by increased egg production. This is typical of parasitic forms—witness the myriads of eggs produced by helminth endoparasites, scarcely any of which result in a new adult. Conceivably the cowbird is adapted in a similar fashion, but of course on a much milder scale.

Information on this point is scanty, but such as there is does not invalidate the idea. According to Friedmann (op. cit.), a caged cowbird laid 13 eggs in 14 days. And Walkinshaw (1949) estimated 25 eggs produced during one season by a single female. If this latter case is at all typical, and if 25 per cent approaches the actual fledging rate, we would have an average of about six young produced per adult female per season. Data on the Robin (Young, 1955) indicate that the average female produces about 11.5 eggs per season, which result in about 5.6 fledglings. The figures on cowbird production, of course, are purely hypothetical, and show that much still needs to be learned about the life history of this species.

Although there is ample evidence to show that cowbird parasitism reduces the success of the host species (Nice, op. cit.; Norris, op. cit.; Hann, 1937; etc.), it must be remembered that these species have evolved with the problem, and over centuries they have demonstrated their ability to survive with the cowbird. While it is not a popular species, the cowbird is a natural part of our American avifauna, with a reproductive pattern distinctive among native species. Fewer cowbird eggs should be removed by well-meaning people, and more information should be gathered on their fate, so that eventually we may get a more detailed and accurate picture of its breeding biology.

SUMMARY

Data were gathered on the hatching and fledging success of 879 cowbird eggs from 580 nests of 36 host species. Fledging success was distinctly better than hatching success, reflecting the special perils faced by the cowbird eggs, and over-all reproductive success was 25 per cent (218 fledglings from 879 eggs). The fledging rate for eggs laid in the nests of heavily parasitized species was 25 per cent; for those laid in the nests of lightly parasitized nests it was 16 per cent. The difference appears to be due to varying degrees of egg acceptance. It is hypothesized that there are approximately six young produced per adult female cowbird per season.

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CHANGES IN THE REPRODUCTIVE ACTIVITY OF THE BROWN-HEADED COWBIRD WITHIN THE BREEDING SEASON

D. M. Scott

The Brown-headed Cowbird (*Molothrus ater*) commonly parasitizes the nests of the Cardinal (*Richmondena cardinalis*) at London, Ontario, Canada. This behavior results locally in a reduction of 15–20 per cent in the annual production of the Cardinal (Scott and Lemon, unpublished data). To understand more fully the relationship between parasite and host, I began a study of the reproductive cycle of the cowbird.

Seasonal variation in the incidence of parasitism is immediately obvious in Table 1. This should depend upon changes in the reproductive activity of the cowbird and in the relative availability of nests of different hosts. Lacking detailed knowledge of the latter, I will deal mainly in this paper with the former. Evidence will be adduced from three sources: 1) data on parasitism on the Cardinal, 2) examination of reproductive organs of adult cowbirds, and 3) observations on post-nuptial flocks of adult cowbirds.

Financial assistance from the National Research Council of Canada and the Ontario Research Foundation is acknowledged. I am grateful to Mr. Dougald Murray, R.R. 1, Melbourne, Ont., for permission to collect cowbirds on his farm. Messrs. P. Bowen and A. Middleton greatly assisted in the collection of material.

PARASITISM ON THE CARDINAL

Table 1 shows that by the end of April, about two weeks after the first Cardinal clutch, the incidence of parasitized nests had reached 100 per cent. Afterwards, the incidence remained high until 2 July, fluctuating between 71 per cent and 100 per cent. It then declined rapidly, reaching zero before August. Changes in the intensity of parasitism (number of cowbird eggs per

TABLE 1

PARASITISM BY THE BROWN-HEADED COWBIRD ON 187 CARDINAL NESTS AT LONDON, ONTARIO, 1955 TO 1961*

Week ending	April			May				June				July					August			
	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
No. of nests	1	8	8	11	9	18	17	18	15	7	10	2	15	13	8	5	10	6	4	2
Per cent parasitized	0	50	100	82	78	78	71	83	87	100	80	100	53	15	25	20	0	0	0	0
Mean no. of cowbird eggs per parasitized nest	–	1.3	3.3	3.0	2.4	1.5	2.1	2.1	1.8	1.7	1.9	1.0	1.5	1.0	1.0	1.0	–	–	–	–

* Data are based entirely on nests in which Cardinal laying had been completed. Nests containing young are excluded.

parasitized nest) did not always parallel changes in incidence. Intensity of parasitism rose rapidly to a maximum of 3.3 eggs by 30 April, then declined, more rapidly in May than in June, to the absolute minimum of one egg by 16 July.

Some of the observed variation in the incidence and intensity of parasitism seems definitely attributable to seasonal changes in the reproductive activity of the cowbird. Since the Cardinal is the first of the common local hosts to begin breeding, the observed rise in late April in incidence and intensity must result from increasing numbers of cowbirds laying at that time. The decreased parasitism on the Cardinal in July can be ascribed to waning reproductive activity of the cowbird. All hosts have begun nesting by early June, and a marked increase in July in the availability or use of their nests seems unlikely. But the causes of the decline in intensity in May and June, while the incidence remained high, are less obvious. I was unable, from the data in Table 1, to distinguish the effect of changes in the availability of nests of all hosts from that of reduced reproductive activity of the cowbird. To elucidate the relative importance of these factors, I examined the reproductive organs of adult cowbirds collected in 1959 and 1962.

REPRODUCTIVE ORGANS

To avoid disturbing the local cowbirds at the height of the breeding season, specimens were usually collected outside the study area but within a 25-mile radius of London. Late in June and after (see beyond), I was forced to collect wherever cowbirds could be found. Changes in the sampling areas possibly introduced some bias, since late samples may have contained a disproportionately large number of birds which had finished breeding.

The extent of cranial ossification was examined in all specimens, and only those in which it appeared complete are subsequently considered. This precaution was probably unnecessary since it is unlikely that any juvenile could have completed its post-juvenal molt (normally completed in August and September) in time to be confused with an adult in the late samples.

Gonads and oviducts were removed within 10 minutes of death, and fixed in Bouin's solution. Following paraffin-embedding, each right testis was sectioned at 7 μ and stained with Ehrlich's hematoxylin and eosin. The left testes were weighed on a Becker "Chainomatic" balance. I unfortunately neglected to weigh the right testes. As the disparity in size between the left and right testes was not extreme, however, the histology of the right testis was assumed to be reasonably similar to its left counterpart. Hence, it was not thought necessary to prepare sections of the left testes.

Testes.—Each right testis was assigned to one of two groups. Testes showing tubules with regularly aligned bundles of sperm and no degenerative

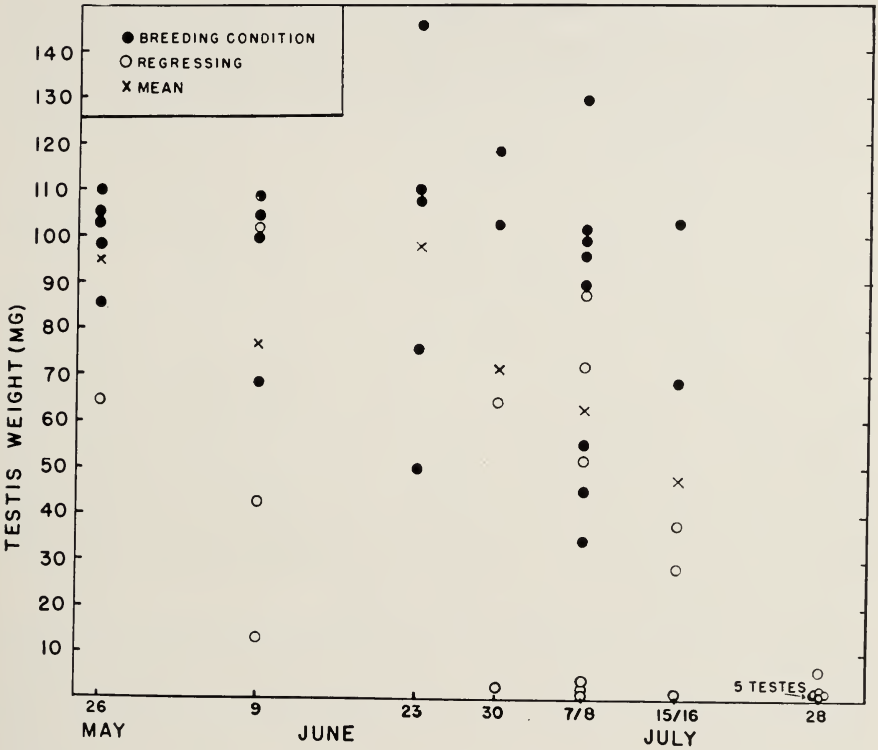

FIG. 1. Changes in the weight of the left testis of 47 Brown-headed Cowbirds collected in 1959 near London, Ontario. The histological condition of the right counterpart of each left testis is shown.

changes were considered to be in breeding condition. The remainder were classified as regressing.

Figure 1 shows the changes in weight and internal condition of 47 testes collected from 26 May to 28 July 1959. The average weight changed little until late June. Noteworthy, however, were pronounced degenerative changes in one testis on 26 May, and in three on 9 June. Later, mean weights dropped from 97.6 mg on 23 June to 2.3 mg on 28 July. Concurrently, spermatogenesis had clearly ceased in an increasing proportion of testes, until by 28 July a sample contained no testis in a breeding condition.

The significance of the low weights of a testis (50.0 mg) on 23 June and of three testes (34.2, 45.0, and 55.0 mg) on 7–8 July is not clear. These testes, despite their small size, were apparently still in breeding condition. Possibly, some testes decrease in size before post-nuptial regressive changes become obvious. Alternatively, these testes may have been taken from one-year-old birds. In some icterids, year-old males have smaller testes than older males in a comparable reproductive phase (Wright and Wright, 1944; Selander and Nicholson, 1962). Cowbirds may exhibit the same characteristic. Unfortunately I was unaware in 1959 of the technique for distinguishing year-old male cowbirds from older individuals (Baird, 1958) and therefore did not determine the ages of my specimens.

A seasonal trend seems clear: some males were no longer reproductively active in early June; many were still in breeding condition in mid-July, but all in a small sample had finished breeding by the end of July.

Ovaries and oviducts.—All females were collected after 7:00 AM EST. By this hour, ovulation would probably have occurred in any bird ready to ovulate on that day. In interpreting the data, I took as evidence of breeding the presence of an egg in the oviduct or, lacking that, the presence in the ovary of at least one oocyte exceeding 5 mm in diameter. The latter criterion was based on the observation that, in females with an egg in the oviduct, the largest oocyte in the ovary was invariably wider than 5 mm. This suggests, then, that birds with oocytes of this size but lacking an egg in the oviduct had either just completed laying a clutch (assuming that cowbirds lay clutches) or were within the day or so preceding ovulation.

Marked changes in the proportion of females in breeding condition occurred within the period spanned by the data (Table 2). None of 13 specimens taken through 24 April was breeding. The first birds found with an egg in the oviduct or with large oocytes were killed on 27 April. In the week ending 1 May, eight of 16 birds had not attained breeding condition. But, in the following week, all five females were breeding. Afterwards, in the seven-week period ending 26 June, 23 (65.7%) of 35 birds had an egg in the oviduct. All but three of the remainder had enlarged oocytes. Two exceptions (15 and 24 May) had enlarged oviducts but small oocytes; their breeding status was uncertain. The third (23 June) had certainly finished breeding: its oviduct was shrunken and its oocytes were minute. Appreciable numbers of birds, lacking either an egg in the oviduct or enlarged oocytes first appeared in the samples for the week ending 3 July. The proportion of such females increased successively in each of the two subsequent weeks. Of 12 birds collected in the week ending 17 July, only one, with an egg in the oviduct on 16 July, was still breeding. Two individuals taken later in July were not breeding.

POST-NUPTIAL FLOCKS

A noticeable change in the behavior of adult cowbirds occurred about the third week of June. At this time cowbirds became difficult to find in their customary haunts and, simultaneously, flocks composed preponderantly of adult males appeared in grain fields, in pastures with cattle, and on lawns of

TABLE 2

FREQUENCY OF EGGS IN OVIDUCTS AND OF LARGE OOCYTES IN 104 BROWN-HEADED COWBIRDS COLLECTED NEAR LONDON, ONTARIO, IN 1959 AND 1962*

Week ending		N	With egg in oviduct	Without egg in oviduct Diameter of largest oocyte	
				> 5 mm	< 5 mm
April	17	3	0	0	3
	24	10	0	0	10
May	1	16	4	4	8
	8	5	4	1	0
	15	4	2	1	1
	22	0	–	–	–
	29	12	7	4	1
June	5	0	–	–	–
	12	11	7	4	0
	19	3	1	2	0
	26	5	4	0	1
July	3	7	4	0	3
	10	14	5	2	7
	17	12	1	0	11
	24	1	0	0	1
	31	1	0	0	1

* All 1959 specimens (15) were collected from 26 May onwards.

the university. A few detailed observations will illustrate this point. On 26 June 1959, at 7:30 PM EST, a flock of about 40 adult male cowbirds settled momentarily in a large maple tree outside my home in the city. By 29 June 1961, flocks containing more than 100 birds, predominantly adult males, were present on the campus. On 25 June 1962, I counted about 100 adult males and one adult female feeding together on university grounds. Larger numbers appeared in the following three weeks in 1962, and there was an increase in the proportion of adult females. The numbers of adult males and females trapped at this time were: 27–30 June, 29 males and 7 females; 4–6 July, 19 males and 9 females; and on 12, 14, 20, 21 July, a total of 21 males and 8 females. At no time did the numbers of adult females exceed or even closely approach those of adult males. The flocks of adult cowbirds disappeared from the campus after the third week in July.

Overt sexual behavior was rarely observed in July. Small groups of two or three males courting a female were seen sporadically, but courtship behavior was no longer the common sight so characteristic of May and June. The latest date on which I saw such behavior in four years of observations was 24 July 1962. Hence, the general absence of sexual activity in the large mixed flocks indicates that most of these birds were indeed in a post-nuptial condition.

DISCUSSION

The information on nest parasitism agrees closely with that on the female reproductive organs in showing, first, that few females begin laying before the final week in April and, secondly, that the onset of breeding is sudden.

The condition of the ovaries and oviducts in May and June indicates that maximum reproductive activity is maintained from the first week of May to the penultimate week of June, a period of about eight weeks. This conclusion differs from that of Norris (1947) who stated that near Butler, Pa., "the crest of the laying season comes late in May." His Fig. 2 shows a gradual increase in the number of cowbird eggs, found in 1944 and 1945, from 15 April to a maximum on about 30 May preceding a gradual decline terminating on 12 July. I think his conclusion is questionable because it is apparently based on the erroneous assumption that the number of cowbird eggs found is necessarily an index to the laying activity of the species. This will be true only when all, or at least a constant proportion, of the nests of each species of host are found throughout the entire breeding season of the cowbird. Norris' data indicate that this requirement was not met, his activities being evidently restricted largely to May in 1944, but expanded in 1945 to include the period from April to July. Since no allowance seems to have been made for this bias in sampling, it is not surprising that his data showed a laying peak in May. In contrast, Mayfield's data (1960:151) on cowbird parasitism on the Kirtland's Warbler support the idea that cowbird laying is maintained at a high level over several weeks and that there is not a clearly defined peak of laying activity.

Breeding wanes towards the end of June; all my observations agree on this point. Cessation of breeding appears earlier in males, perhaps by as much as a week. The significance of this difference is not clear. If, as Friedmann (1929) stated, males outnumber females, the first post-nuptial flocks may be formed by the surplus males. This suggestion is, however, unimportant in the present context. The critical point is that most females are still breeding by the end of June. The observed decrease, at this time, in the proportion of females still laying is apparently real, not merely a vagary of sampling, since it coincides with an abrupt decline in the intensity of parasitism on the Cardinal.

Several conclusions relating the reproductive cycle of the cowbird to parasitism on the Cardinal seem warranted. First, the rapid increase in the incidence and intensity of parasitism in late April is caused by the sudden onset of laying by the cowbird. Secondly, the intensity of parasitism declines rapidly in early May and then slowly until the end of June, in the absence of a corresponding decline in laying activity. The decline in parasitism during this period must therefore depend on increased use of other hosts by the cowbird. Finally, the decrease in the incidence and the intensity of parasitism beginning in early July results from a contemporaneous and continuing reduction in the reproductive activity of the cowbird.

SUMMARY

The breeding season of the cowbird extends from late April to late July. Within this period maximum reproductive activity of female cowbirds is maintained over approximately an eight-week period in May and June. Parasitism on the Cardinal is discussed relative to changes in the laying activity of the cowbird.

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ASPECTS OF COWBIRD PARASITISM IN SOUTHERN OKLAHOMA

John A. Wiens

Aspects of the parasitic breeding habits of the Brown-headed Cowbird (*Molothrus ater*) have been documented extensively by Friedmann (1929), Laskey (1950), Berger (1951), Norris (1947), and others. It was the purpose of this study to investigate some of the major aspects of such parasitism in the breeding avifauna of southern Oklahoma. Particular emphasis was placed on observation of the incidence of nest parasitism by the cowbird on host species in this population, the nesting success of the cowbird in relation to its hosts, and the nature of the laying period of the cowbird.

SURVEY AREA

The study was conducted between 15 June and 6 August 1960, and 8 June and 4 August 1961, at the University of Oklahoma Biological Station, Marshall County, Oklahoma. The biological station is located along the north shore of Lake Texoma, a large impoundment of the Red and Washita Rivers, 18 miles south of Madill, Oklahoma. The area is characterized by tall grass prairies and blackjack-post oak forests, but the major portion of the study was carried out in the bottomland-floodplain area bordering the lake. This habitat was rather open, clumps and thickets of black willow (*Salix nigra*), persimmon (*Diospyros virginiana*), American elm (*Ulmus americana*), cottonwood (*Populus deltoides*), buttonbush (*Cephalanthus occidentalis*), and other shrubs being scattered through open mixed grasslands which were sporadically grazed.

Nests in this area were tagged and observed three or four times per week until young fledged or the nest was deserted or destroyed.

INCIDENCE OF PARASITISM

Cowbird parasitism was noted at 31 nests of eight species during the study. Table 1 indicates the degree of parasitism for each species observed. Similar data from the study of Ely (1957), conducted in the same area in 1956, are included in the table for comparison. Parasitism of each species is discussed in more detail below. Nests of species which were not parasitized were not considered in this study. Nest heights are from ground level to the nest rim.

Vireo bellii.—The Bell's Vireo was one of the commonest breeding species in the study area, and one of the most heavily parasitized. Of 31 active nests found during 1956, 1960, and 1961, 22 (71.0%) were parasitized. Overmire (1962*a*) found 61 nests in northern Oklahoma, 18 (30%) of them parasitized. Three of five nests (60%) observed in Illinois by Pitelka and Koestner (1942) were parasitized, while Mumford (1952) noted parasitism

TABLE 1
INCIDENCE OF COWBIRD PARASITISM, 1956,[1] 1960, 1961

Species	Total nests	Parasitized nests
Bell's Vireo	17	12 (70.6%)
	14	10 (71.4%)
Dickcissel	15	5 (33.3%)
	14	1 (8.5%)
Cardinal	4	4 (100%)
	12	1 (9.1%)
Lark Sparrow	4	3 (75.0%)
	17	1 (5.9%)
Orchard Oriole	3	3 (100%)
	13	6 (46.2%)
Blue Grosbeak	5	2 (40.0%)
	8	6 (75.0%)
Painted Bunting	2	1 (50.0%)
	5	4 (80.0%)
Field Sparrow	1	1 (100%)
	4	3 (75.0%)
Red-winged Blackbird	33	0 ——
	73	2 (3.0%)
TOTAL	84	31 (36.9%)
	160	34 (21.2%)
TOTAL (excluding Red-winged Blackbird)	51	31 (60.8%)
	87	32 (36.8%)

[1] Second line of data is from Ely's 1956 study.

at seven of 13 nests (53.8%) in Indiana. Barlow (1962) observed 35 nests in Kansas, 24 (68.6%) of them parasitized. Of the 17 nests found during the present study, eight were in persimmon, six in willow, and three in buttonbush; all were on the edges of low clumps of these plants. These nests were from 2.2 to 4.2 feet (average, 2.9 feet) from the ground. Ely (1957) found 13 nests in persimmon, one in osage orange (*Maclura pomifera*), and none in willow or buttonbush; these nests were from 1 to 8 feet (average, 6 feet) above the ground. Barlow (1962) recorded an average nest height of 2.25 feet for 36 nests found in Kansas.

Spiza americana.—Twenty-nine Dickcissel nests were found during 1956, 1960, and 1961. Table 1 shows that a difference exists in the incidence of parasitism found in 1956 by Ely (8.5%) and in 1960–61 by me (33.3%). Nineteen of 61 nests (31%) found by Overmire (1962*b*) in northern Oklahoma were parasitized, while Hergenrader (1962) reported an incidence of 52.9 per cent in 17 nests found in Nebraska. During 1960–61, 11 nests were found in willow saplings, three in greenbriar (*Smilax* sp.) clumps, and one in bunch grass (*Andropogon* sp.). These nests were usually near the center of the sapling or clump, but were exposed and well lighted. The nests were from 1 to 6 (average, 3.3) feet from the ground.

Richmondena cardinalis.—Sixteen Cardinal nests were found during my survey and that of Ely. Only one of the 12 nests found by Ely (9.1%) was parasitized, while all four of the nests I found held cowbird eggs. Berger (1951) found 10 of 22 nests (45.4%)

parasitized in Michigan. Three of eight nests (37.5%) observed by Norris (1947) in Pennsylvania were parasitized. The four nests found during the present study were in juniper (*Juniperus virginiana*), persimmon, winged elm (*Ulmus alata*), and a greenbriar tangle about a sapling willow. They were from 3.5 to 4 feet (average, 3.7 feet) above the ground.

Chondestes grammacus.—During 1956, 1960, and 1961, 21 Lark Sparrow nests were found, four (19.0%) of them parasitized. Table 1 indicates the difference in incidence which existed between Ely's study and my own. During the present study nests were found in persimmon, post oak (*Quercus stellata*), juniper, and winged elm, from 4 to 10 feet (average, 5.5 feet) above the ground.

Icterus spurius.—Of the 16 Orchard Oriole nests found during 1956, 1960, and 1961, nine (56.3%) were parasitized. As before, Table 1 indicates that a difference existed in incidence of parasitism between Ely's study and my own. The population of orioles was apparently larger in 1956 than in 1960 and 1961, this factor perhaps influencing parasitism incidence. Two of the nests found during my study were in willow saplings, one in a cottonwood tree; all were in exposed situations. These nests were from 8 to 11 (average, 9.0) feet up.

Guiraca caerulea.—During Ely's study and in 1960 and 1961, 13 Blue Grosbeak nests were found in the area, eight (61.5%) of them parasitized. In the present study four nests were found in willow saplings, one in a persimmon. They were from 6 to 10 feet (average, 7.6 feet) from the ground.

Passerina ciris.—Five of seven Painted Bunting nests (71.4%) found during 1956, 1960, and 1961 were parasitized. Parmelee (1959) found 13 of 45 nests (28.9%) parasitized in the same area during the summer of 1957, despite the fact that he attempted to remove cowbirds from the area by collecting. Both of the nests found during the present study were in winged elm saplings, 4 and 5.5 feet (average, 4.7 feet) from the ground.

Spizella pusilla.—Four of five Field Sparrow nests (80.0%) found during Ely's survey and my own were parasitized. Berger (1951) reported six of 33 nests found (18.1%) to be parasitized in Michigan, while Norris (1947) noted parasitism at nine of 57 nests (15.8%) in Pennsylvania. The one nest found during the present study was 4 feet up in a winged elm sapling in a clearing in a post oak woods a short distance from the main study area.

Agelaius phoeniceus.—Friedmann (1929) regards the Red-winged Blackbird as "a fairly common but rather local victim" of the cowbird. The species appears to be only rarely parasitized in southern Oklahoma. Two of 106 nests found during the present survey and that of Ely contained cowbird eggs. Berger (1951) examined 99 nests in Michigan, five of which (5.0%) were parasitized, and Terrill (1961) found only two of "many hundreds" of nests examined in southern Quebec to hold cowbird eggs. Hergenrader (1962), on the other hand, noted a high incidence of parasitism (54.2%) among 59 nests found in Nebraska. Nests found during the present study were invariably in willow saplings over water.

Sayornis phoebe.—No Eastern Phoebe nests were found during the present study, but Ely found one of two nests (50%) parasitized in 1956. Friedmann (1929) lists the phoebe as one of the "very commonest" victims of the cowbird.

The data in Table 1 show that the degree of parasitism for several host species found by Ely in 1956 is different from that of the present study. These differences may be due to changes in population size of cowbirds and host species between 1956 and 1960–61. These changes in turn apparently are due to a shift in the comparative abundance of habitat types during this period. For some years prior to 1956 the entire area was dry, with tall persimmons or willows widely scattered through the grasslands bordering the lake, and little low brushy edge growth. In 1957, the drought was broken by heavy rains. The increase in moisture during the following summers initiated the growth of a number of sapling willows and persimmons, and, in some areas, clumps of buttonbush, thus increasing considerably the amount of low exposed brushy vegetation.

It is interesting to note that for a particular host species there appear to exist regional differences in the incidence of cowbird parasitism, or in the importance of that species as a host. This is especially apparent in the Red-winged Blackbird and Dickcissel. The cowbird's range includes a number of avian communities, each with a particular species composition. It would seem that such regional differences in incidence of parasitism of a species might to some extent depend upon the position of the species in a particular regional community with respect to the abundance of other possible host species in the community.

Another factor possibly correlated with the incidence of parasitism is the breeding ecology of the cowbird. The cowbird appears to have originally been a bird of open short-grass plains (as indicated by its present centers of abundance), and Friedmann (1929) attributes its spread during the past century to deforestation and colonization of areas which before were virgin forests. Berger (1951) has noted that parasitized nests of field-nesting species in Michigan were in open areas bordered by a woodlot or thicket, while nonparasitized nests were not near such vegetation. Parasitized nests found during the present study were usually on the edges of low brushy thickets bordered by fairly open expanses of mixed grasslands, while nests found in such open grasslands were, as a rule, not parasitized.

Parasitized nests did not differ appreciably from nonparasitized nests with respect to substrate or nest height. Parasitized nests were found in willow saplings (12), persimmons (6), greenbriar clumps (3), winged elm saplings (3), buttonbush clumps (3), junipers (2), cottonwood saplings (1), and post oak (1). Nonparasitized nests were found in willow saplings (11), persimmons (5), tangles of pepper-vine (*Ampelopsis arborea*) (2), greenbriar clumps (1), and winged elm saplings (1). Parasitized nests were from 2 to 11 feet (average, 4.4 feet) above the ground; nonparasitized nests were found from 1 to 10 feet (average, 4.0 feet) up.

Friedmann (1929) has concluded that it is characteristic for a cowbird to lay one egg in a nest, and Mayfield (1960) has suggested that after the first cowbird egg is deposited in a nest the distribution of additional eggs in these nests is completely random. In six of the 31 parasitized nests found during

TABLE 2

SUCCESS OF PARASITIZED AND NONPARASITIZED NESTS, 1956,[1] 1960, 1961

Species	Parasitized nests				Nonparasitized nests	
	Cowbird eggs	Cowbirds fledged	Host eggs	Host fledged	Host eggs	Host fledged
Bell's Vireo	15	3 (20.0%)	28	2 (7.1%)	18	4 (22.2%)
	15	1 (6.7%)	25	3 (12.0%)	8	0 ——
Dickcissel	5	0 ——	10	0 ——	34	17 (50.0%)
	1	0 ——	3	0 ——	43	24 (55.8%)
Cardinal	4	1 (25.0%)	14	4 (28.6%)	—	— ——
	2	0 ——	2	1 (50.0%)	23	12 (52.2%)
Lark Sparrow	4	0 ——	4	0 ——	3	2 (66.6%)
	1	1 (100%)	2	0 ——	60	19 (31.7%)
Orchard Oriole	4	4 (100%)	11	7 (63.6%)	—	— ——
	9	4 (44.4%)	20	11 (55.0%)	13	9 (69.2%)
Blue Grosbeak	2	0 ——	2	0 ——	11	0 ——
	13	4 (30.8%)	13	4 (30.8%)	4	4 (100%)
Painted Bunting	1	1 (100%)	2	1 (50.0%)	3	2 (66.6%)
	5	0 ——	3	1 (33.3%)	4	0 ——
Field Sparrow	2	0 ——	2	0 ——	—	— ——
	4	1 (25.0%)	3	0 ——	3	1 (33.3%)
TOTAL	37	9 (24.3%)	73	14 (19.2%)	69	25 (36.2%)
	50	11 (22.0%)	71	20 (28.3%)	158	69 (43.6%)

[1] Second line of data is from Ely (1957).

the study, two cowbird eggs were laid; the other 25 nests held one cowbird egg each. Four of these six nests were deserted during incubation. Norris (1947) noted that nests in which more than one cowbird egg were laid were usually deserted, but Berger (1951) listed several nests which contained as many as four cowbird eggs and were not deserted.

NESTING SUCCESS

Another important aspect of cowbird parasitism is its effects upon the reproductive success of the host species. While parasitism may reduce the success of a host species in an area, the nesting success of the cowbird itself may be wholly dependent upon that of the host. Barlow (1962) attributed the failure of 12 of 35 Bell's Vireo nests he found to cowbird parasitism, and further noted that the percentage of cowbird eggs hatched in relation to the number laid in these nests was relatively low. Table 2 analyzes the success of parasitized and nonparasitized nests of eight host species. Again the data of Ely (1957) are included.

Parasitized nests were equally successful in fledging cowbird and host young (24.3% and 19.2%, respectively, in the present study), while fledging success was notably higher (36.2%) in nonparasitized nests of the same species. Berger (1951) listed a fledging success of 21.9 per cent for 204 cowbird eggs laid in nests of 19 species in Michigan. In Pennsylvania, Norris (1947) found a fledging success of 26.8 per cent for 108 cowbird eggs laid in nests of 14 species.

Sample sizes are generally too small to make statements concerning specific host efficiency, but it can be noted that the Bell's Vireo, one of the major hosts in the study area, was not a particularly efficient or successful host, and that Dickcissels were totally unsuccessful in fledging either their own or cowbird young from parasitized nests. Overmire (1962*b*) noted that none of the cowbird eggs laid in 19 Dickcissel nests he found in northern Oklahoma hatched.

Thirty-one parasitized nests were observed during the study. Of these, seven were successful in fledging young, nine were deserted during incubation, nine were destroyed by predators, two were failures due to poor nest construction, and three were unsuccessful for unknown causes. Of the 20 nonparasitized nests observed, six were successful, four were deserted, seven were destroyed by predators. one was a failure due to poor construction, and two were unsuccessful for unknown causes.

LAYING PERIOD

The reproductive success of a host species is to a considerable extent dependent upon the laying period of the cowbird. Obviously, a species which begins nesting only after cowbird egg-laying has ceased will be relatively free of parasitism. Such is the case of the American Goldfinch (*Spinus tristis*) in Michigan, which normally begins nesting in mid-July, after the majority of cowbird activity has ceased (Sutton, 1959). Only when the cowbird lays late or the goldfinch nests early is the species victimized.

The laying period of the cowbird usually extends from about mid-April to early or mid-July. Norris (1947) gave 12 July as the latest egg-laying date over a two-year period in Pennsylvania, while Berger (1951) listed 26 July as the latest date of egg-laying over a four-year period in southern Michigan. Hann (1937) gave 6 July as the latest date for egg-laying in nests of the Ovenbird (*Seiurus aurocapillus*) during a three-year period in Michigan, and Sutton (1959) listed 21 July as the latest date for egg-laying in goldfinch nests in Michigan. The latest date for egg-laying I recorded was 29 or 30 July, in a Bell's Vireo nest.

I knew to the exact one- or two-day period the laying dates of 13 cowbird eggs, and, using the incubation period of 11.6 days obtained by Norris (1947) for the cowbird in Pennsylvania, I was able to estimate the date of laying of 15 additional eggs. Data for these 28 eggs are presented in Fig. 1.

The distribution of these egg-laying dates indicates that two peaks in egg production existed during June and July. Between these peaks there appeared

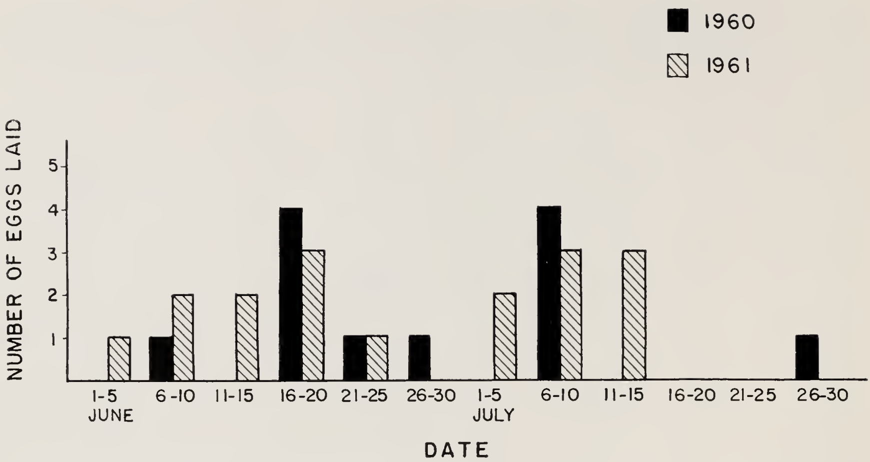

FIG. 1. Chronology of cowbird egg-laying, 1960, 1961.

to be a marked slump in egg production. The data show a similar distribution for 1960 and for 1961.

The laying dates for 97 eggs of the eight host species listed in Table 2 were determined, and are shown with the laying dates for the 28 cowbird eggs in Fig. 2. Observations for 1960 and 1961 are totaled.

Apparently, host egg production gradually decreased at an even rate from early June on, showing no peaks or marked slumps. Thus the pattern in cow-

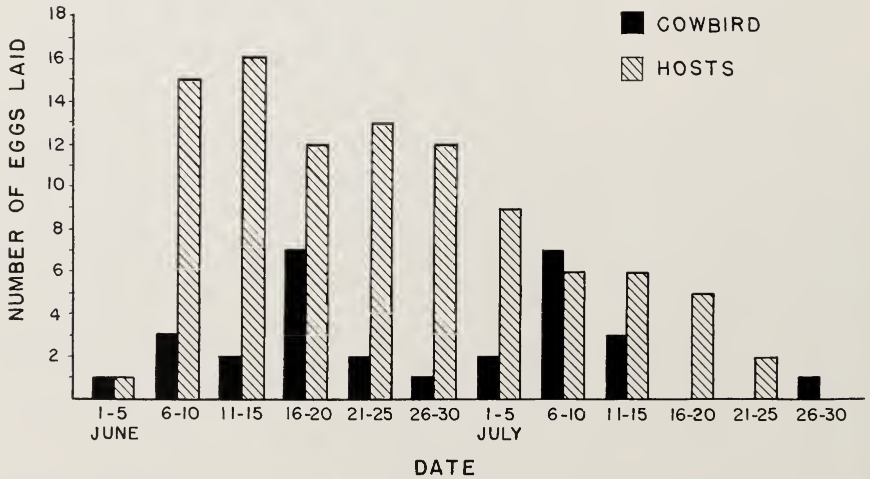

FIG. 2. Cowbird egg-laying in relation to egg-laying of eight host species, 1960–61.

bird egg-laying does not appear to be dependent upon host availability, and shows no correlation with host activity. Sample sizes are too small to permit speculation regarding the causes of such peaks in cowbird egg-laying, but apparently they are not due to random fluctuations in the data.

Cowbird eggs are usually laid during the laying period of the host. Hann (1937), in studying the relationship between the cowbird and Ovenbird, noted that "extreme cases of laying . . . were three days before the first Oven-bird's egg was laid, and three days after incubation began." Berger (1951), Norris (1947), and Mayfield (1960) have observed instances of cowbird activity well after host incubation had begun. I found cowbird-host laying periods to be coincident in most cases, but in one instance a cowbird egg was apparently laid in a Bell's Vireo nest which had been partially destroyed by a predator, and in another an egg was deposited (on 29–30 July) in a Bell's Vireo nest containing a well-developed cowbird chick. Mayfield (1960) has noted that it is "a rare event" for a cowbird egg to be deposited in a nest containing young. Such instances have been recorded in nests of the Red-eyed Vireo (*Vireo olivaceus*) (Mumford, 1959), the Kirtland's Warbler (*Dendroica kirtlandii*) (Leopold, 1924), Indigo Bunting (*Passerina cyanea*) (Friedmann, 1929), Chipping Sparrow (*Spizella passerina*), and Field Sparrow (Berger, 1951).

SUMMARY

From 15 June to 6 August 1960, and from 8 June to 4 August 1961, Brown-headed Cowbird parasitism in the breeding bird population about the University of Oklahoma Biological Station, Marshall County, Oklahoma, was studied with respect to incidence, success of cowbirds and hosts, and the laying period of the cowbird.

Parasitism was noted at 31 of 84 nests (including 33 Red-winged Blackbird nests which were not parasitized). Six of these 31 nests contained two cowbird eggs; in each of the remaining 25 a single cowbird egg was laid. Nests of the Bell's Vireo, Dickcissel, Cardinal, Lark Sparrow, Orchard Oriole, Blue Grosbeak, Painted Bunting, and Field Sparrow were parasitized. Parasitized nests of these species were usually in somewhat exposed situations on the edges of bottomland thickets, bordering open mixed grasslands. Nests found in more open areas without edge growth were generally not parasitized. Parasitized nests did not differ appreciably from nonparasitized nests with respect to height from ground or substrate.

Seven of the 31 parasitized nests (22.6%) and six of the 20 nonparasitized nests of the same species (30.0%) were successful. Thirty-seven cowbird eggs and 73 host eggs laid in parasitized nests produced nine (24.3%) and 14 (19.2%) young, respectively. Twenty-five young (36.2%) fledged from 69 eggs laid in nonparasitized nests of the same species.

The laying dates of 28 cowbird eggs and 97 host eggs were determined. The distribution of these dates indicates that two peaks existed in egg production in the cowbird, one in mid-June, the other in early July, while host egg production gradually decreased from early June on. The pattern of cowbird egg production was thus independent of host availability. Cowbird egg-laying declined after mid-July, the last egg being laid on 29 or 30 July. Cowbird-host laying periods were generally coincident, but one cowbird egg was

apparently laid in a partially destroyed nest, and another was laid in a nest containing a well-developed cowbird chick.

ACKNOWLEDGMENTS

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DEPARTMENT OF ZOOLOGY, UNIVERSITY OF WISCONSIN, MADISON 6, WISCONSIN, 4 JUNE 1962

NEW LIFE MEMBER

Stephen W. Eaton, of Allegany, New York, is Professor of Biology at St. Bonaventure University and is a new Life Member of the Wilson Ornithological Society. Dr. Eaton, an active member of the Wilson Ornithological Society since 1942, received his A.B. degree at Hobart College and his M.S. and Ph.D. degrees at Cornell University. His ornithological interests include anatomy and behavior of parulid warblers, ecology of the high plateaus of New York and Pennsylvania, and biology of the wild Turkey.

Dr. Eaton has published life history studies of the two waterthrushes; results of faunal studies in Canada, Mexico, Cuba, and New York; on fish distribution in the Allegheny River; and on plant distribution of high plateaus of New York. In addition, he has edited *Kingbird* (published by the Federation of New York State Bird Clubs), is a member of the AOU, AAAS, Cooper Ornithological Society, and Ecological Society of America, and is presenty Chairman of the WOS Endowment Committee.

RANGE EXPANSION OF THE CARDINAL AND OTHER BIRDS IN THE NORTHEASTERN STATES

Barbara G. Beddall

The populations of the Cardinal (*Richmondena cardinalis*) and the Tufted Titmouse (*Parus bicolor*) have recently "exploded" in southern New England and the adjacent Hudson River Valley. The Carolina Wren (*Thryothorus ludovicianus*) and the Mockingbird (*Mimus polyglottos*) are also undergoing a range expansion in the same area, although to a much slighter degree. Both the Cardinal and the Tufted Titmouse are newcomers as breeding birds in the region east of the Hudson River and north of Long Island Sound. The Mockingbird, on the other hand, seems to be reinvading a territory it occupied several hundred years ago (Merriam, 1877). The Carolina Wren became established as a breeding bird in Stamford, Conn. about 1895 (Sage, 1913).

It is the purpose of this paper to investigate the characteristics of these range and population changes and to examine possible reasons for them.

SOURCES OF DATA AND METHODS OF STUDY

Audubon Christmas Counts have been used as a basis for determining population and range changes. Stewart (1954) has considered carefully many valid objections to these figures. He concludes that their "application . . . should be restricted to the indication of trends in population. . . ." With this restriction in mind, one notes that the figures do present a plausible and consistent picture, one not analyzable by refined mathematical techniques, but one which is nevertheless useful as a point of departure. Moreover, the general population trends so shown are substantiated by independent observations noted in *Audubon Field Notes, Records of New England Birds,* and other local ornithological publications.

Local or regional Christmas Count figures have been converted to numbers of birds seen per 100 party hours. (Stewart would prefer a conversion based on mileage rather than time, unfortunately an impossibility under present reporting methods.) No other adjustments have been attempted because of the difficulties in applying them equably.

Table 1 shows numbers of birds seen per 100 party hours for the four species for several contrasting regions. "Southern New England" includes the states of Connecticut, Massachusetts, and Rhode Island, and Long Island and the Hudson River Valley in New York State as well.

Figure 1 illustrates the changes in distribution and abundance of the four species from 1945 to 1960 in the area defined as "Southern New England." Figures 2 and 3 show details of individual counts for the Cardinal and the

TABLE 1

NUMBER OF BIRDS PER 100 PARTY HOURS ON AUDUBON CHRISTMAS COUNTS

Species and place	Number of birds by year																						
	1938	'39	'40	'41	'42	'43	'44	'45	'46	'47	'48	'49	'50	'51	'52	'53	'54	'55	'56	'57	'58	'59	'60
Tufted Titmouse																							
Southern New England							0	0.5	0	2	11	7	9	8	12	13	11	11	17	18	21	29	52
New Jersey		72	65	70	145	120	168	94	88	99	90	102	115	84	80	106	96	85	105	130	119	142	185
Pennsylvania		120	159	116	149	124	149	100	110	129	134	166	113	96	87	132	120	128	108	174	111	139	158
Michigan	72	65	38	92	101	28	97	96	84	46	52	48	78	57	45	49	57	49	40	57	112	70	73
Carolina Wren																							
Southern New England							0.2	0.2	0.2	0.2	0	0.4	0.8	0.9	2	2	3	2	6	9	4	7	11
New Jersey		5	1	2	3	5	8	2	13	10	5	5	15	17	13	10	14	13	17	19	16	22	10
Pennsylvania		6	4	6	7	5	13	3	7	8	7	12	9	11	9	15	20	15	15	34	15	23	15
Mockingbird																							
Southern New England							0	0.5	0	0	0.1	0.5	0.2	0.3	0.9	0.6	0.2	0.4	1	0.8	0.7	1	1
New Jersey		1	0.5	0	3	2	0.7	2	1	0.8	0.9	1	0.8	2	3	6	9	12	8	31	20	38	45
Pennsylvania		0.3	0.5	0.5	0.5	0	0.3	0.5	0.6	0.5	0.5	1	2	1	2	5	6	12	6	26	23	37	41
Cardinal																							
Southern New England							7	3	5	6	7	6	9	11	7	14	14	21	26	31	31	51	90
New Jersey		47	34	48	55	67	80	66	56	70	78	63	90	87	89	127	108	142	136	154	144	174	221
Pennsylvania		173	149	148	179	158	149	103	150	124	164	163	161	156	131	160	163	179	153	260	170	186	231
Michigan	122	155	109	114	257	120	266	114	156	152	108	151	154	170	171	137	108	148	144	181	206	156	210
Ontario	3	13	39	49	27	54	62	69	68	82	127	104	78	86	110	59	85	110	94	82	127	155	108
Eastern South Dakota											37	96	40	56	39	45	54	42	6	21	28	23	23
Pasadena, California									43	17	19	30	19	26	32	85	19	32	15	6	8	3	2

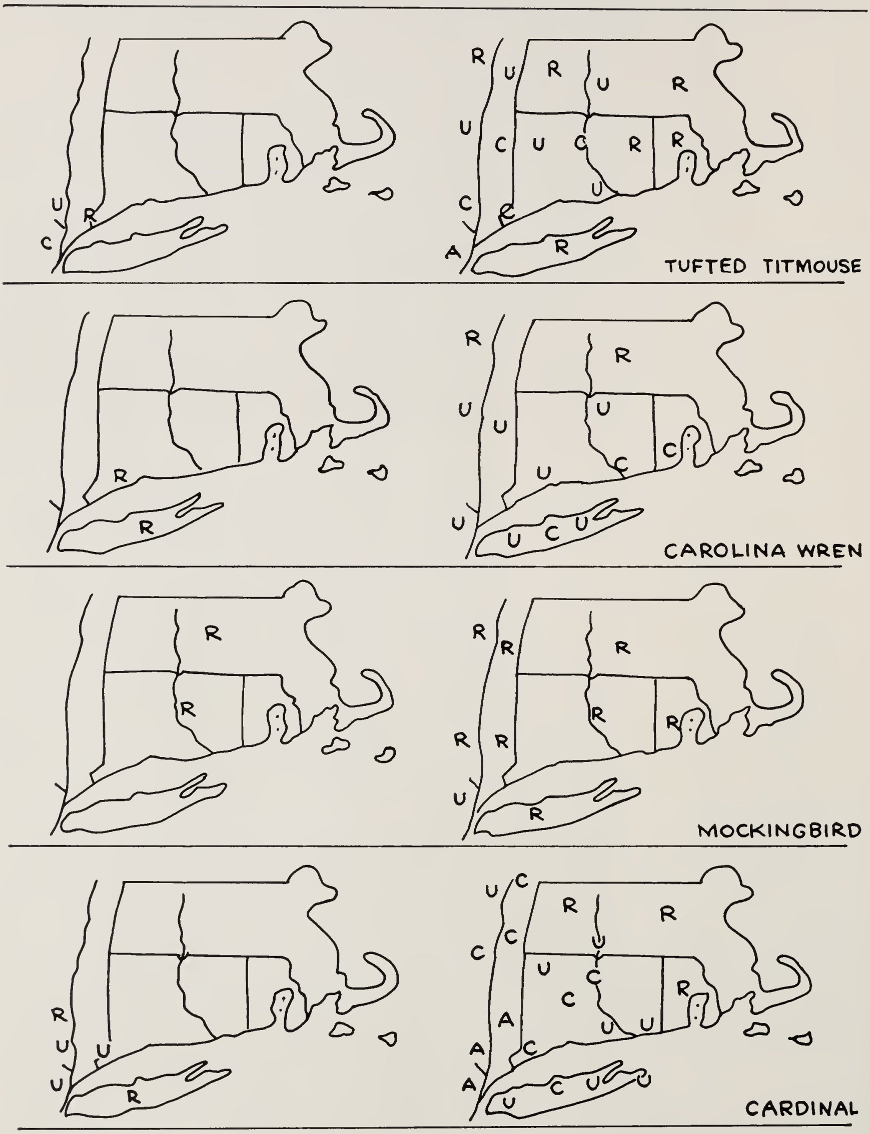

Fig. 1. Changes in distribution and abundance of four species of birds, 1945–1960, in Connecticut, Massachusetts, Rhode Island, and in Long Island and the Hudson River Valley, New York, based on Audubon Christmas Counts. Rare: 1–10 birds per 100 PH (party hours); Uncommon: 10–50/100 PH; Common: 50–250/100 PH; Abundant: over 250/100 PH.

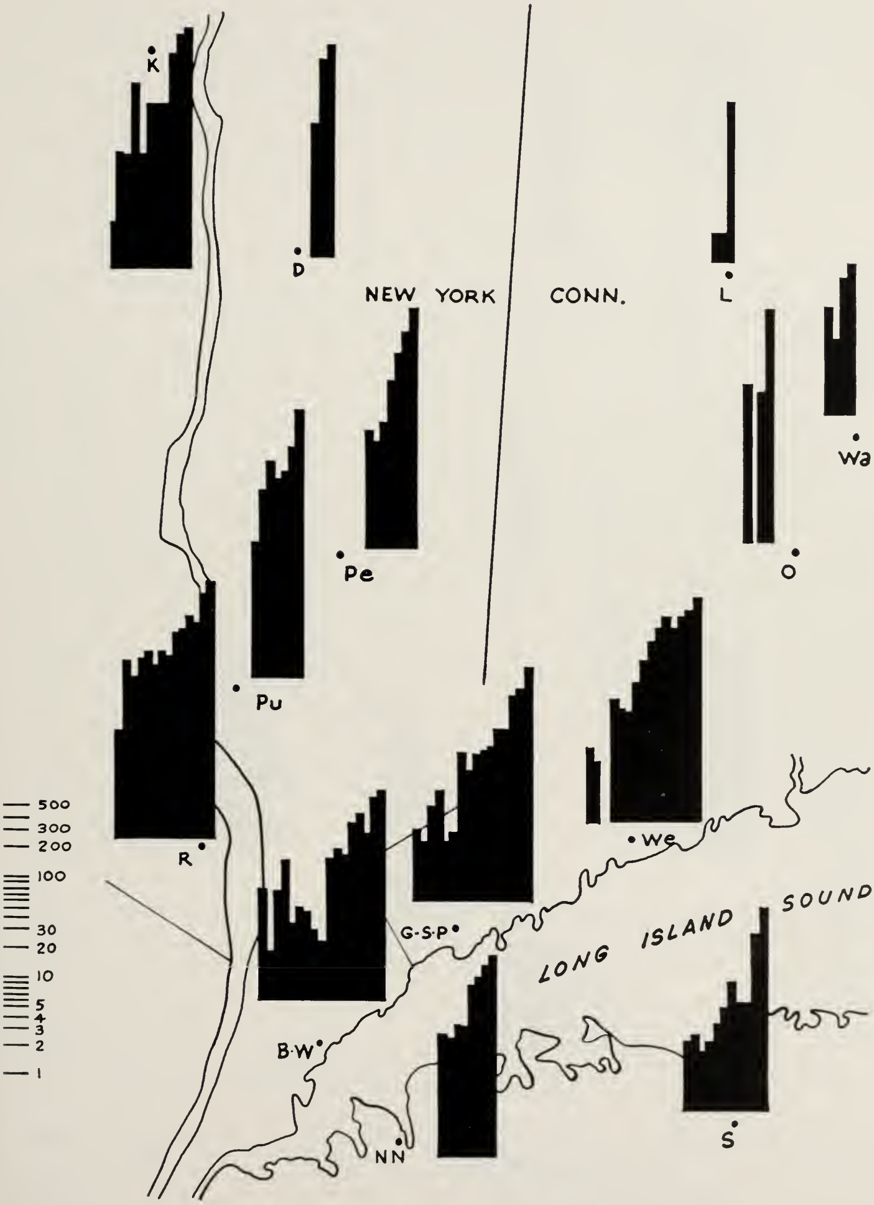

FIG. 2. Rate of population growth of the Cardinal, 1945–1960, in southeastern New York and southwestern Connecticut, based on Audubon Christmas Counts (see text). Last bars on right refer to 1960.

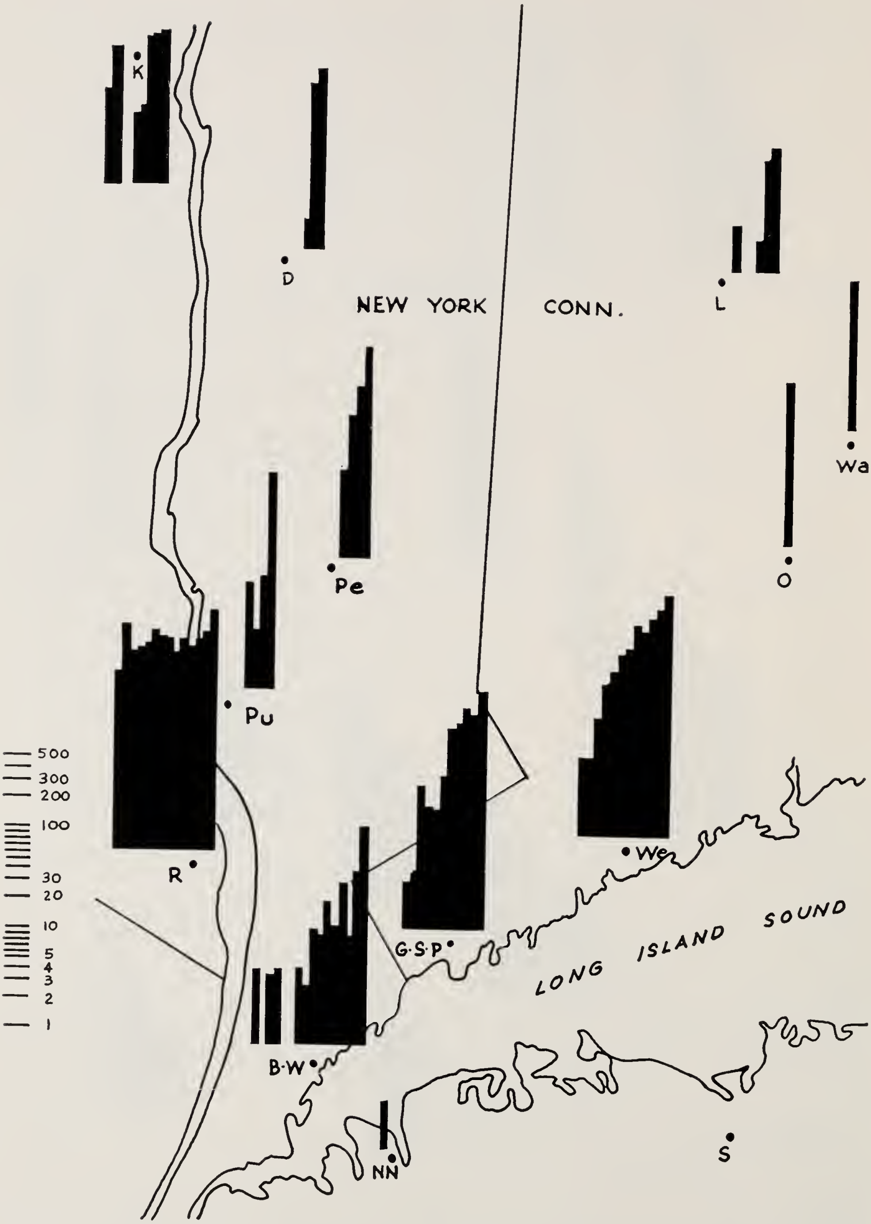

Fig. 3. Rate of population growth of the Tufted Titmouse, 1945–1960, in southeastern New York and southwestern Connecticut, based on Audubon Christmas Counts (see text). Last bars on right, or single bars, refer to 1960.

Tufted Titmouse in the area that includes the lower Hudson River Valley (Bronx-Westchester Region, Dutchess Co., Kingston—Lake Mohonk, Peekskill, Putnam Co., Rockland Co.), northern Long Island (Northern Nassau Co., Smithtown), and southwestern Connecticut (Greenwich—Stamford—Portchester, Litchfield Hills, Oxford, Waterbury, Westport). A logarithmic scale has been used to indicate rate of growth.

RANGE AND POPULATION CHANGES

The Cardinal population in Southern New England has increased spectacularly in the past 15 years. This species first nested in Connecticut around 1943, and in eastern Massachusetts in 1958 (*Audubon Field Notes*). Westward across the Hudson River it is now a common year-round resident in Rockland Co., N.Y., although 30 years ago it was confined to the southeastern corner of this county (Rockland Audubon Society, 1959). The New Jersey population has been increasing steadily for the past 20 years. In Pennsylvania there has been an increase in the northeastern part of the state, although in general the population has been relatively stable for the past 20 years (based on state and local Christmas Counts). An earlier increase in this state is noted by Sutton (1928). Relative stability has also been reached in Michigan, following an increase that began about 1900 (Burns, 1958). The apparently related increase in Ontario, dating from about 1938 (Snyder, 1951), is now slowing down. The population in South Dakota, on the other hand, shows a marked decline in the last decade. The Cardinal population is also decreasing in Pasadena, California, where the species was successfully introduced in 1923 (Grinnell and Miller, 1944). At its present rate of decline it appears headed for extinction there.

The Tufted Titmouse is much less widely distributed in Southern New England than the Cardinal, but the pattern of its population growth is similar. This species first nested in Connecticut in 1946 and in eastern Massachusetts in 1958 (*Audubon Field Notes*). It has become established in Rockland Co., N.Y., within the past 30 years (Rockland Audubon Society, 1959). The recent increases in New Jersey are actually confined to a few places in the northern part of the state, while there has been little recent change in Pennsylvania.

The Carolina Wren population has also increased in Southern New England. It is quite limited in both distribution and numbers, however, being largely confined to areas along Long Island Sound. Earlier upward trends in New Jersey and Pennsylvania have leveled off.

The Mockingbird population has increased slightly in Southern New England but, at the rate of one bird seen per 100 party hours, it is certainly far from common. On the other hand, the New Jersey and Pennsylvania populations have increased as sharply as have those of the Cardinal and Tufted Titmouse in New England, although the numbers are smaller. An earlier increase in Maryland dates from about 1900 (Stewart and Robbins, 1958).

A population buildup within the original range preceding an extension of the range was suggested by Odum and Johnston (1951) as a factor in the southward movement of the House Wren. Population pressure does appear to play a part in the northward movement of the four species considered here (see Table 1; Figs. 1 and 2). Such a buildup and the resulting population pressure may also lead to the successful crossing of geographical barriers and the invasion of previously isolated territory (see below). The conditions encountered in such new and isolated territory must be unusually favorable to permit more than temporary occupation of it. This seems to have been true for the Cardinal and the Tufted Titmouse in Southern New England. The rapid increase in their numbers is still continuing, resulting in fairly large, native populations which are no longer dependent on irregular immigration.

Furthermore, such a rapid increase implies a high survival rate, greater success in rearing young, an increase in clutch size or number of broods, or some combination of these factors. It is possible that the Cardinal may be more successful in rearing a large brood in this area where the population density is still comparatively low and intraspecific competition presumably less intense. Four live young have been reported several times in New England (*Audubon Field Notes*). At a similar latitude in southeastern Michigan where the Cardinal is common, Sutton (1959) found that only three eggs hatched in the two nests where four were laid. Three successful broods have been reported for a pair of Cardinals and two for a pair of titmice in Massachusetts (*Audubon Field Notes*), both high for the species involved.

Another point is the rapidity of the response to changing environmental conditions. Since time would be required for the population buildup, Odum and Johnston (1951) concluded that a time lag would exist between changing biotic conditions and range extension. This lag may also exist in connection with climatic changes (see below).

FACTORS INFLUENCING RANGE AND POPULATION CHANGES

Relevant characteristics of the birds are their general adaptation and adaptability and their general mobility; significant environmental factors are climate and weather, available habitat, geographical barriers, and man. There is constant interaction among all these factors whose relative importance also varies according to species, location, etc.

Adaptation and adaptability.—Here is meant the general type of habitat for which the species is adapted and its ability to make use of changed conditions. The Cardinal, Carolina Wren, and Mockingbird show a preference for thickets, tangles, underbrush, and shrubbery (Bent, 1948; Burleigh, 1958; Hundley, 1953; Laskey, 1944; Pough, 1946). Thus, activities of man which increase this sort of habitat should be beneficial to these species. This seems to be true for the Cardinal and Mockingbird, which also show great adaptability to the presence of man himself. Wilson (1831) noted that all except the Carolina Wren were common around farm houses, particularly in winter. The behavior of the Carolina Wren, the least common of the four species, shows considerable ambivalence (Bent, 1948; Pough, 1946). Some individuals are willing to accommodate themselves to man as a close neighbor and others are not. Certainly this species' chances of long-term survival would be improved if its acceptance of man were increasing.

The Tufted Titmouse is largely a forest bird (Pitelka, 1941), although it may wander in more open areas outside the nesting season. It shows great adaptability to man himself, being a frequent visitor at feeding stations. But its general adaptation to a forest habitat means that its success is limited by the availability of this habitat.

Mobility.—Powers of dispersal are naturally important in a discussion of range extension. All four species are considered to be nonmigratory, but a certain amount of movement does exist and can be demonstrated in various ways. Banding records for individual birds indicate a minimum amount of movement for the Cardinal (Geis, pers. com.; Hundley, 1953; Laskey, 1944; Lincoln, 1939; Stewart and Robbins, 1958). In general, those recovered have been found within a distance of five miles of the banding station, although long distance records do exist. The Titmouse is found within an even smaller area (Van Tyne, 1948). The Mockingbird has been recovered at greater distances (Lincoln, 1939). This indeed seems a necessary corollary to the small, widely scattered population in New England.

Of equal interest are the birds which are never seen again, generally a rather high percentage of those banded. Either they have died, become trap-shy, or moved on. That there must be a good deal of movement, particularly during the winter, is shown by the marked seasonality of the appearance and disappearance of Cardinals where banding has taken place at one location over a period of time (Geis, pers. com.; Hundley, 1953; Laskey, 1944). The largest numbers of new birds are banded in the months from November to February. This point is also corroborated by *Records of New England Birds*, which reports twice as many Cardinals seen in these same months as in the remainder of the year.

Another method of demonstrating movement is to compare occurrence and population density in the winter-bird and breeding-bird censuses published in *Audubon Field Notes* (see Table 2). No attempt has been made to compare habitats because of the many difficulties involved in classifying them. How-

TABLE 2

COMPARISON OF WINTER-BIRD AND BREEDING-BIRD CENSUSES, 1956–1960*

Species	Winter-bird censuses				Breeding-bird censuses**			
	Present on		Over 13/100 acres		Present on		Over 13/100 acres	
	No.	%†	No.	%‡	No.	%†	No.	%‡
Tufted Titmouse	75	51.3	20	26.7	75	40.0	38	52.0
Carolina Wren	51	35.0	5	9.8	60	32.8	17	28.4
Mockingbird	25	17.3	2	8.0	16	8.75	3	18.8
Cardinal	98	67.0	11	11.2	88	47.0	51	59.2

* From *Audubon Field Notes.*
** Pairs converted to individuals, young not included.
† Per cent of total censuses.
‡ Per cent of censuses where present.

ever, it is clear that for each species the winter populations are both more widely dispersed (with the possible exception of the Carolina Wren) and less dense than the summer populations. The change in density is plainly shown by the winter and summer censuses taken at two locations in El Dorado, Arkansas (see Table 3). The winter decrease in density must be attributed more to dispersal than to mortality since the species are then found at more places, and the succeeding increase in breeding-bird density does not include young of the

TABLE 3

COMPARISON OF WINTER-BIRD AND BREEDING-BIRD POPULATIONS, EL DORADO, ARKANSAS*

	Number/100 acres					
	Tufted Titmouse		Carolina Wren		Cardinal	
	Winter	Breeding**	Winter	Breeding**	Winter	Breeding**
Year	Upland pine and pine–oak woodland					
1953	9	26	9	38	+	34
1954	9	30	9	30	+	34
1955	9	44	4	30	4	30
1956	13	48	13	26	4	60
1957	13	52	13	60	9	74
	Mature oak–pine stream bottomland					
1951		40		18		54
1952	9	54	9	40	4	50
1953	25	36	10	50	5	50
1954	15	112	20	50	15	70
1955	25	90	10	56	15	60
1956	25	60	25	122	10	56
1957	30	80	20	150	40	70

* From *Audubon Field Notes.*
** Pairs converted to individuals, young not included.

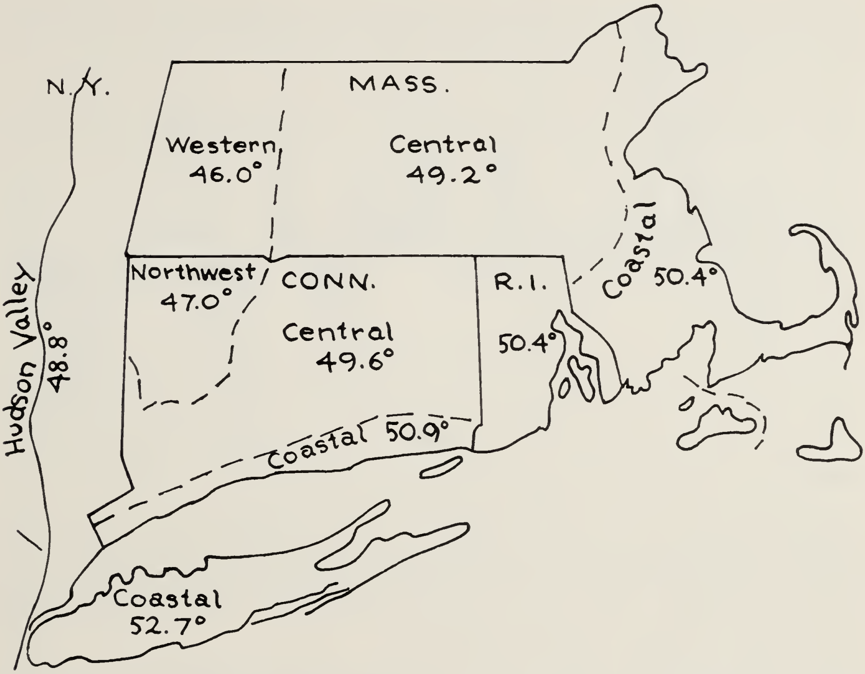

FIG. 4. Climatic divisions, with mean annual temperatures, 1931–1955. From U.S. Weather Bureau data.

year. This implies a winter dispersal followed by a withdrawal (to more favorable breeding areas?) before the breeding season begins.

Thus, a certain amount of exploratory activity occurs in all four species, making range extension possible under advantageous conditions.

Climate and weather.—Little is known about the temperature tolerances of birds. Nevertheless, it seems possible to draw certain general conclusions from present distribution and abundance (based on local Christmas Counts). These have been compared with the mean annual temperature of the climatic divisions of the states as drawn by the U.S. Weather Bureau (1959, 1960). Figure 4 summarizes this information for Southern New England.

The Cardinal is the most temperature tolerant of the four species. It is common in all the climatic divisions of Pennsylvania with a mean annual temperature above 48 F, although it is also present in the two colder divisions, the Pocono Mountains and the Upper Susquehanna. In Southern New England, only northwest Connecticut (47 F) and western Massachusetts (46 F) fall below 48 F, an indication that climatic conditions in most of this area are generally suitable for the Cardinal. Here one might note that northwest

Connecticut appears to be a barrier and that the Cardinal seems to be spreading up the Hudson River Valley and the Connecticut River Valley more or less independently (see Figs. 1 and 2).

The Tufted Titmouse is fairly numerous in all the climatic divisions of Pennsylvania with a mean annual temperature of 50 F and above. On this basis, one would expect the main population growth of the titmouse in New England to be confined to coastal areas and the lower Hudson River Valley. Northward movements into New Hampshire and even Maine were noted in the fall of 1961 (*Audubon Field Notes*); it will be interesting to see if breeding records follow.

The Carolina Wren is found in Pennsylvania and New Jersey where mean annual temperatures range from 50 to 53 F, although it is more numerous in the warmer sections. Again, one would expect the principal development in New England to be in the coastal areas. It is commonly noted in the literature, however, that this species is subject to winter kill. Its numbers are very erratic within a wide span along its northern boundary.

The Mockingbird is relatively common in those climatic divisions of Pennsylvania and New Jersey having mean annual temperatures of 53 F and above. It seems unlikely, on this basis, that the Mockingbird will become common in New England under present conditions.

All of these species appear to have definite climatic limitations. From this it may be deduced that climatic warming would favor northward expansion and, conversely, that climatic cooling would lead to a contraction of range at the northern edge. Figure 5 shows the mean annual temperature above and below the long-term average for the states of Connecticut, Massachusetts, and Rhode Island combined, since 1900. The long-term trend has been upward, although the most recent years suggest a reversal of this trend. The trend for New Jersey follows a similar pattern. In Pennsylvania, however, the peak was reached in 1931 and the trend has been downward ever since.

Drury (1957, 1958) notes the vegetational changes in old-field successions in southern New England as a result of climatic warming. There has been a northward expansion of red cedar (*Juniperus virginiana*) and gray birch (*Betula populifolia*), and an accompanying northward retreat of new white pine (*Pinus Strobus*).

In looking for relationships in the trends, one finds that the Cardinal became established in Southern New England in the late 1940's and the early 1950's, during the long period of above average temperatures which began in 1931. The previous increases in New Jersey and Pennsylvania may well have been sparked by the rising temperature trends there. It is noteworthy, however, that the Cardinal has continued to increase in New England while weather conditions in recent years have become much more severe. From

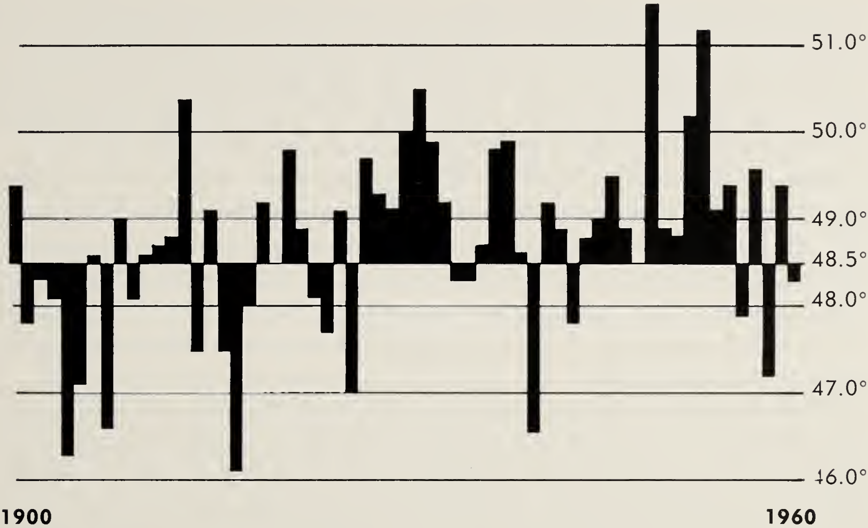

Fig. 5. Mean annual temperatures, 1900–1960, for Connecticut, Massachusetts, and Rhode Island, with deviations from long-term average (1888–1960). Based on U.S. Weather Bureau data.

this one may conclude that the mild period permitted the population to build up to a size sufficient to withstand the recent harsher period. The less hardy birds might not now survive, but this would not cause the destruction of a sufficiently large and generally hardy population. The same reasoning may be applied to the Tufted Titmouse and perhaps also to the Carolina Wren in New England (though see above), and to the Mockingbird in New Jersey and Pennsylvania.

In Michigan the temperature trend has been relatively steady for the past 30 years, following an earlier increase. The relative stability of the Cardinal and Tufted Titmouse populations in this state may be a reflection of this condition.

A long-continued temperature decrease might, however, cause a reversal of these population trends. In South Dakota there was a strong upward temperature trend, culminating in the year 1931, followed by a sharp decrease. Mean annual temperatures averaged by decades show an increase from 44.6 F for 1911–1920 to 47.1 F for 1931–1940, and a subsequent decrease to 45.6 F for 1951–1960. In spite of this, both the breeding and wintering ranges of the Cardinal continued to extend northward there into the early 1950's (Krause and Froiland, 1954). The population, however, has now begun to decrease (see Table 1), possibly as a delayed reaction to decreasing temperatures.

The decreasing temperature trend in Pennsylvania apparently has not reached a point where it is causing any decrease in the well-established Cardinal and Tufted Titmouse populations, although it may be affecting the much more sparse population of the Carolina Wren and slowing down the increase in the Mockingbird population.

If the Mockingbird really was an early inhabitant of New England, perhaps one of the reasons for its extirpation was the long cold period extending from 1811 to 1904. This was interrupted by only three very short warmer periods (based on the record at New Haven, Connecticut; Kirk, 1939). Connecticut Mockingbird records going back to the 1860's (Sage, 1913) fall generally in the warmer periods. This long cold period may have affected the other species adversely as well.

Habitat.—Habitat changes have been extensive in the area under consideration. Deforestation became important after 1800 as agriculture made increasing demands on the land. This trend was reversed with the opening of the West. The resulting farm abandonment has continued in New England to the present day. One hundred years ago only 27 per cent of Connecticut land was in forest. At the present time, 63 per cent of this land is covered by forest, though much of it is young and scrubby. At the same time, there has been a large increase in human population. This has caused other changes in land use, ranging from rural to suburban to completely urban conditions. With the exception of parks, the latter obviously are unsuitable for the four species of birds, and in fact may act as a barrier to quite sedentary birds. Where human population is less dense, the four species of birds have reacted in different ways.

The Cardinal first became established in southwestern Connecticut in the 1940's. Per cent of land used for agriculture in Fairfield County, Connecticut, declined from 53 per cent in 1935 to about 8 per cent in 1959. The abandoned farm land resulted in an increase in brush and young forest, i.e., habitat suitable for the Cardinal. At the same time, residential land use increased rapidly, also providing habitat suitable for this species. Perhaps the "tip point" has been reached here, however, for the most spectacular growth of Cardinal populations has taken place not in Fairfield County, Connecticut (human population density 1,033/sq. mi.), but in Putnam County, New York (135/sq. mi.) and northwestern Westchester County, New York. At the same time, it has been noted that range expansion of the Cardinal has occurred in settled rather than in unsettled areas in northern New Jersey (Fables, 1955) and in Michigan (Burns, 1958). In other words, some human settlement is a favorable factor, but a point may be reached where human density is too great.

The Carolina Wren and the Mockingbird are more limited climatically, but there are further differences. The Carolina Wren has done comparatively well in the less heavily settled areas on Long Island Sound, confirming previous remarks on its rather poor adaptability to the presence of man. The scarcity of the Mockingbird must be due more to climate, since it is the most "domesticated" of the four.

The Tufted Titmouse is quite limited by its habitat requirements. Although much of the forest in the oak-hickory region of Southern New England is young (Thomson, 1958), enough older forest apparently exists to allow the titmouse a foothold. The increase in the Tufted Titmouse population in New Jersey is largely confined to areas of less dense human population in the northern part of the state. Increasing warmth has not led to an increase in titmice where the habitat is not suitable.

Food supply does not appear to be an important limiting factor at present for any of the species, with the probable exception of the Carolina Wren. This species is almost completely insectivorous throughout the year. The Cardinal, Tufted Titmouse, and Mockingbird are typical of the songbirds wintering in New England in eating a large proportion of seeds, nuts, and fruits at this time of year (Martin, Zim, and Nelson, 1951). However, the reportedly poor acorn crop in 1961 may have been a factor in the northward expansion of the Tufted Titmouse in the fall of that year. At times of short supply, the prevalence of feeding stations may be valuable to the Cardinal and Tufted Titmouse, both of which are constant winter visitors.

Geographical barriers.—Geographical features such as mountains, rivers or other bodies of water, and metropolitan areas (man-made, but a fact of geography all the same) may have opposite effects on range extension, depending particularly on population pressure.

The importance of these features as barriers can be deduced from various sources. None of these species is common in the high northwestern section of New Jersey (local Christmas Counts; Fables, 1955). In addition, many Christmas Counts have been made at various altitudes in the Appalachian Mountains. Arranged according to decreasing importance of altitude as a barrier, the four species may be listed as follows: Mockingbird, Carolina Wren, Cardinal, Tufted Titmouse. None of them reaches the highest points.

The importance of water as a barrier can also be deduced from the Christmas Counts (see Figs. 1–3). Again arranged according to decreasing importance of the barrier, the species may be listed as follows: Tufted Titmouse, Cardinal, Carolina Wren, and Mockingbird. As recently as 1942, Cruickshank considered the Tufted Titmouse to be only a rare possibility east of the Hudson River or on Long Island. The population buildup in Rockland County, New York began about this time and led to the successful crossing of the Hudson River. The subsequent increase in southeastern New York and southwestern Connecticut has apparently resulted in its re-invasion of Long Island, where it is once again listed as a breeding bird (Buckley, 1961). It seems probable that the Cardinal followed the same route, although it is impossible to prove this without banding data. Rivers may be barriers, while their valleys may be pathways for expansion. The climate of the Hudson River Valley is milder than that of the higher lands on either side and thus could be expected to be more suitable for climatically limited species.

The land passageway north from New Jersey is further narrowed for the Cardinal and the Tufted Titmouse by the New York metropolitan region.

A small population in New Jersey that has limited access to new territory may find northward expansion impossible. But population pressure may turn these barriers into a funnel leading to the successful invasion of new territory. This seems to apply to the Cardinal and the Tufted Titmouse, for both of which New England was a relatively isolated area. On the other hand, New England has long been within the reach of both the Carolina Wren and the Mockingbird. Their more modest success seems related rather to less suitable climatic and/or habitat conditions.

Man.—All four species were present on Long Island 100 years ago (Giraud, 1844). By about 1900, the Cardinal had become uncommon around New York City, the Mockingbird was rare, and the Tufted Titmouse only accidental on Long Island (Chapman, 1906; Cruickshank, 1942; Eaton, 1910; Griscom, 1923). The Mockingbird had disappeared from the Philadelphia area as early as 1830 (Wilson, 1831), and near the turn of the century was listed as very rare in eastern Pennsylvania and New Jersey (Stone, 1894). Both the Cardinal and the Mockingbird were called shy and difficult to approach by Gentry (1876).

Much of this reduction in numbers seems due to direct intervention by man. Both the Cardinal and the Mockingbird were popular as cage birds, at prices ranging from ten dollars and up per bird. Songbirds were used as food and for decorative purposes. Hunting and trapping would thus have been important in limiting numbers, especially at the edges of ranges. Early deforestation posed an equally serious threat to the Tufted Titmouse. These much-reduced populations would have made settlement of new areas unlikely, even if they were suitable. The relaxation of hunting pressure has undoubtedly contributed to the present increase in Cardinal and Mockingbird populations, while the renewed growth of the forest has aided the Tufted Titmouse.

SUMMARY AND CONCLUSION

Granting the imperfections in the data, as previously noted, it still seems possible to venture some conclusions.

The Cardinal has become a common-to-abundant resident in southern New England and the lower Hudson River Valley within the past 15 years. Although resident in the area around New York City 100 years ago, it had become very rare there by 1900, probably as a result of hunting pressure and of the long cold period in the 1800's. Increasing temperatures and a relaxation of hunting pressure, plus sufficient suitable habitat, led to a population increase in New Jersey. The resulting population pressure brought about the successful crossing of the Hudson River. The firm establishment of the population in southern New England occurred during a period of maximum warmth. With suitable habitat available, it seems that the Cardinal will continue to prosper in southern New England and the lower Hudson River Valley, threatened only by a long-continued temperature decrease or a drastic change in habitat.

The Tufted Titmouse has followed a similar pattern, although it is more limited by climatic and habitat requirements than is the Cardinal and is, therefore, not likely to achieve as great a success in southern New England. Change in amount of suitable habitat (deforestation and reforestation) was a more important influence than hunting pressure. The titmouse seems firmly established in southern New England and, with the increasing age of forests, may even have added habitat available. Its future here seems fairly secure, barring the leveling of the forests or a long-continued temperature decrease.

The Carolina Wren is apparently responding to changes in temperature and is succeeding moderately well along Long Island Sound. At the same time, it seems to be the most sensitive of the four species to the presence of man. Its stricter temperature and habitat requirements do not pressage a bright future for it in New England. Furthermore, increasing human population density, which seems a fairly certain prospect, would militate against it; decreasing temperatures would have an additional depressing effect.

The Mockingbird's record is similar to the Cardinal's, although on a more elongated scale geographically. Its northeastern population was reduced both by hunting and by decreasing temperatures, and the reversal of these conditions has led to an increase in numbers. It is the most limited climatically of the four species but, at the some time, apparently the most wide-ranging. Therefore, a small, though not necessarily self-sustaining, population in New England is a likelihood, while any great increase is an improbability. A long-continued temperature decrease would be detrimental.

Range extension of these sedentary species seems to be preceded by a population increase within the original range. This increase may be stimulated by climatic warming (all four species), habitat changes (favorable for all but the Carolina Wren), or relaxation of hunting pressure (Mockingbird, Cardinal). A time lag in responding to these changes, particularly the climatic changes, is evident. Possibilities for range expansion, given proper conditions, are always present in the winter exploratory activity exhibited by all four species.

The pressure resulting from these population increases may lead to gradual range extension where geographical barriers are unimportant and the new area is more or less suitable (Carolina Wren, Mockingbird). The results may be more dramatic, however, when this pressure leads to the invasion of a suitable area from which the species had been excluded by geographical barriers (Tufted Titmouse, Cardinal).

It does not seem necessary to postulate evolutionary changes in these species of birds to account for the range and population changes discussed above. The species are occupying areas in southern New England and the Hudson River Valley that might be expected on the basis of their distribution elsewhere and that seem in accord with biotic and climatic changes. However, the new, rapidly expanding and relatively isolated populations of both the Cardinal and the Tufted Titmouse might well result in evolutionary changes. This possibility requires further study.

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SOME ECOLOGICAL NOTES ON THE GRASSHOPPER SPARROW

Robert Leo Smith

From 1944 through 1947, and to a limited extent in 1948, I had the opportunity to study both the songs and ecology of the Grasshopper Sparrow (*Ammodramus savannarum*) in some detail. In an earlier paper (Smith, 1959) I described the songs and their functions, and in this paper will describe some observations on the ecology of the species.

The study area consisted of 30 acres on and about the family farm three miles west of Reynoldsville, Jefferson County, Pennsylvania. Elevation ranged from 1,700 to 1,948 feet and the land sloped to the west and northwest. Soil fertility was low and the sod thin when the farm was acquired in 1942. Subsequent applications of manure and fertilizer increased the fertility and produced a much heavier sod. At first the layout of the fields followed the practices of the past, but in 1946 the farm was put in contour strips. Rotations consisted of corn, oats or wheat and hay, a mixture of red clover (*Trifolium pratense*), alfalfa (*Medicago sativa*), and common timothy (*Phleum pratense*). Later timothy was replaced with awnless brome-grass (*Bromus inermis*). Pastures were seeded to a mixture of orchard-grass (*Dactylis glomerata*) and ladino white clover (*Trifolium repens*). Yearly crop rotations are shown in the territorial maps (Fig. 1).

Observations began with the arrival of the first birds and continued through the season. I attempted to band all birds for positive identification. Since the Grasshopper Sparrow is very difficult to trap, the effort was only partially successful. Three banded males, however, returned in successive seasons, 3 M and 10 M for two years and 5 M for three years.

Habitat and population.—The Grasshopper Sparrow is a grassland bird and it appears to be most abundant on cultivated grasslands, particularly those containing orchard-grass, alfalfa, red clover, bush-clover (*Lespedeza* spp.), all of which form bunches, seemingly required by this species. Old fields of poverty-grass (*Danthonia spicata*), bramble (*Rubus* spp.), and beardgrass (*Andropogon* spp.) also are inhabited by Grasshopper Sparrows, but the birds leave as the fields fill with shrubs. Johnston and Odum (1956) observed that in Georgia these birds were absent in fields having 35 per cent of the area in shrubs, and were most abundant in managed grasslands. Grasshopper Sparrows to a limited extent inhabit small grain fields, but their densities in such areas are a fraction of those found in grassland, even in the western race, *A. s. perpallidus* (Johnston and Odum, 1956; Dambach and Good, 1940; Good and Dambach, 1943; Johnston, 1949).

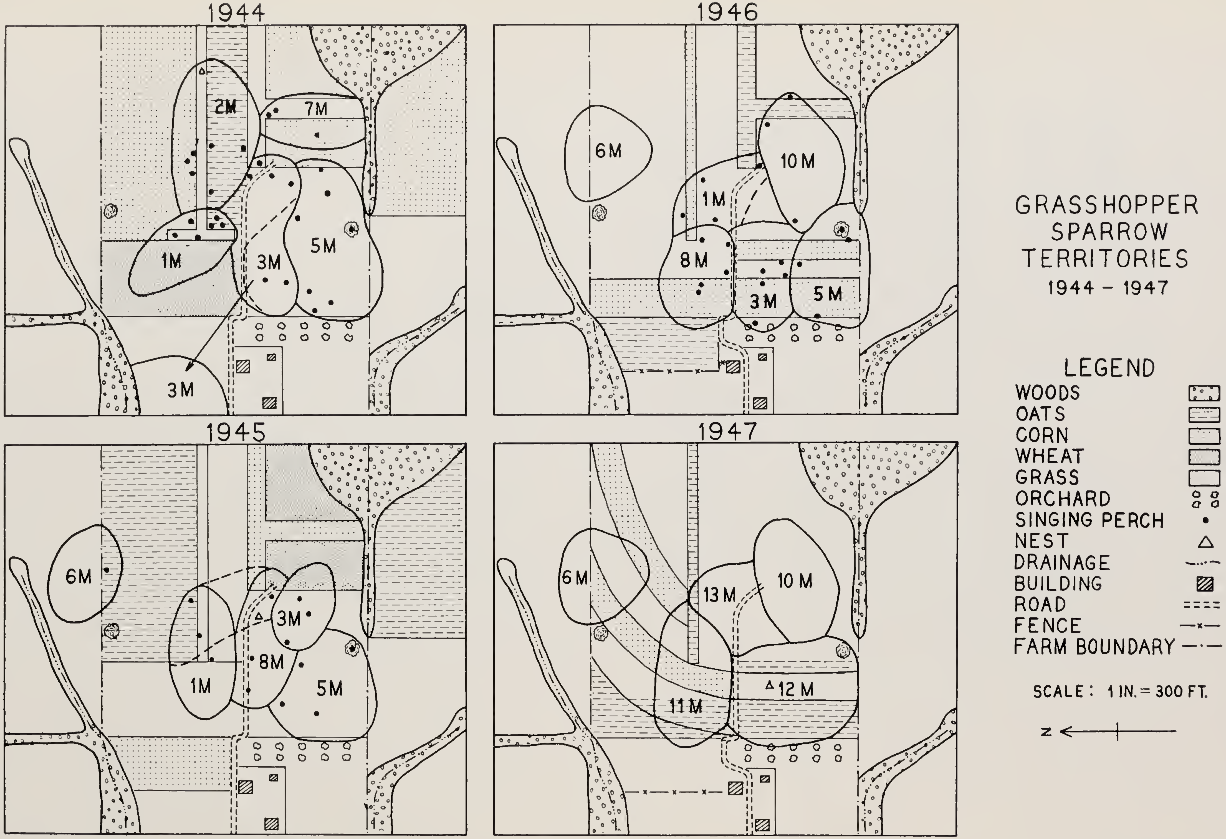

FIG. 1. Grasshopper Sparrow territories. Location of singing perches was mapped for 1944–1946 only. The dash lines inside territories for 1944–1946 indicate territorial adjustments prior to second nesting. During 1944, 3 M established a new territory, part of which is shown, and 5 M expanded his to include the area inside the dashes. In 1945, 1 M and 8 M adjusted their territories apparently due to haying; 8 M occupied the lower territory, 1 M the upper. 3 M in 1946 enlarged his territory to include area inside the dashed lines.

Grasshopper Sparrows inhabiting forested regions of the East originally were restricted to extensive natural clearings and sparsely wooded areas. They are found in such situations today in Minnesota (Roberts, 1936) and Michigan (Walkinshaw, 1940). Clearing of the land for agriculture permitted the species to spread into territory far beyond its original altitudinal and ecological limits (Todd, 1940). Forbush (1929), for example, noted that the species was rarely found in New England much above 1,000 feet, but today in Pennsylvania and West Virginia the Grasshopper Sparrow is found at elevations well over 2,000 feet. In fact, the species occurs on the Allegheny Backbone in Pocahontas County, West Virginia, at an elevation of 4,300 feet (Brooks, 1944). Changing agricultural patterns with emphasis on grassland farming appears to be favoring an increase of Grasshopper Sparrows in Georgia (Burleigh, 1958).

This sparrow depends upon man for maintenance of its habitat through grassland management, but haying usually begins in mid-June, the height of this bird's nesting season. Nests usually escape destruction from mower blades but some are crushed by implement wheels. If the nest escapes destruction by haying operations, it is exposed to weather and predators. Grass used for silage is cut early, around the first of June. This is the height of nest building by the Grasshopper Sparrow. I have found that in fields regularly cut for grass silage, resulting in early loss of cover, the population of Grasshopper Sparrows is very low. The loss of cover during the nesting season does not result in abandonment of the field or the nest, if the nest has not been destroyed. I have never noted any Grasshopper Sparrow leaving the field after haying, despite the loss of cover. This is in sharp contrast to the Henslow's Sparrow (*Passerherbulus henslowii*), which abandons a field after the grass is cut.

Somewhat colonial during the breeding season, Grasshopper Sparrows do not occupy all apparently suitable habitats, and the species fluctuates considerably in abundance from year to year.

The population on the study area varied from five pairs (20 per 100 acres) in 1944 and 1945, six pairs (30 per 100 acres) in 1946, five pairs in 1947. and one pair (5 per 100 acres) in 1948. This drop in the Grasshopper Sparrow population also was noticeable in the surrounding countryside. Fields which once supported the birds either were abandoned by Grasshopper Sparrows or held only a fraction of the original population. Since 1953. their populations began to increase in surrounding areas, but failed to do so on the old study area. From 1957 to 1962, only two breeding pairs were on the area, although the entire tract was in grass.

One cause of the population change on the study area might be attributed to grassland management. During the early part of the study the fields supported a thin stand of timothy, alfalfa, and red clover, in contrast to the dense heavy growth of alfalfa and brome grass four years later. From 1955 to 1958, the bulk of the Grasshopper Sparrow populations was located in hay and abandoned fields that supported less vigorous growth while hayfields of heavy grass, including the study area, were occupied by Henslow's Sparrows.

Oscar Root (1957, 1958, and letter) reports that at North Andover, Massachusetts, the Grasshopper Sparrow population built up to highs followed by a severe reduction the following year, and that certain areas always productive in the past were in prime shape and undisturbed yet without Grasshopper Sparrows. Similar fluctuations have been reported for the Concord region (Griscom, 1949), for Nantucket Island (Griscom and Folger, 1948), and Martha's Vineyard and Essex County, Massachusetts (Griscom and Snyder, 1953), where the species has been replaced by the Savannah Sparrow (*Passerculus sandwichensis*).

Thus it appears that populations of Grasshopper Sparrows fluctuate sharply at times in spite of available and suitable habitat. No reason can be given, but in some instances it appears that this species after extending its range into forested regions cleared for agriculture is giving ground to the Savannah Sparrow, a bird which not only occupies the same fields, but also is able to maintain its numbers when shrubs invade the area.

Territory.—The Grasshopper Sparrow returns to its nesting grounds usually from mid-April to early May. My earliest arrival date for north-central Pennsylvania, however, is 31 March 1945. The first arrivals are males who immediately establish territories, which they proclaim by singing the "grasshopper" or territorial song, alternated with wing flicking, all described in detail in a previous paper (Smith, 1959).

Territorial clashes, usually resulting from aerial trespassing, consist chiefly of pursuit in which the bird chases the intruder, retires to his singing perch, flicks his wings, and sings the "grasshopper" song.

"Grasshopper" or territorial songs usually are delivered from the highest perches in the territory. These may include a clump of grass, an alfalfa stalk, a tall weed, a small bush, fence post, utility wire, or tree. The birds are restricted to low perches only when high ones are unavailable. This was demonstrated experimentally by placing a wooden stake tall enough to stand two feet above the grasstops in the bird's territory. The bird would claim the high perch within minutes. The next day a still higher perch was introduced. The birds abandoned the first for the new, higher perch. Farm equipment left in the field, hay cocks, or grain shocks, all are used by the birds when they are available in their territories.

Song perches are clustered about certain singing areas, usually located near the periphery of the territory (Fig. 1). Location of singing perches may be influenced by row crops in the territory, since Grasshopper Sparrows confine their singing perches to the vicinity of grass plots. This was particularly true of 1 M and 2 M in 1944, and 3 M and 5 M in 1946. The birds appeared to have their singing areas separate from the nesting areas. Among the birds I have studied, singing perches were from 165 to 412 feet from the nest.

The size of 22 territories plotted on the study area ranged from 1.2 to 3.3 acres (Fig. 1). The average size was 2.03 acres. Of these, 11 were between one and two acres; nine between two and three acres; and two over three acres. Kendeigh (1941) reported that the average size of six territories was 3.4 acres.

Territorial boundaries are rigidly maintained during the periods of territorial establishment, nest building, and incubation. After the young have hatched, territorial defense declines and considerable movement of birds into the territory of others takes place. The movement frequently appears to be initiated by young birds just able to fly. They may flutter into adjoining territories and the parent birds follow in answer to the feeding call.

Prior to second nesting in late June and early July territorial defense increases sharply for two to three days. The males sing the "grasshopper" song and flutter their wings. Territorial boundaries may be shifted—a response to changes or disturbances within the territories due to harvesting of hay and small grains. In one instance, 1 M shifted his territory for the second nesting in 1945 to include the eastern half of the territory of his neighbor, 8 M. The hay on this portion had been mowed early and new growth provided cover, lacking in the original territory. 8 M in turn took over the western half of 1 M's old territory. In the end, both birds had new growth and newly mowed hayfields in their respective territories. Interestingly, these two birds occupied approximately the same territories the following year. In 1946, 3 M, whose territory was bisected by a strip of field corn, took over a corner of 1 M's territory when the increasing height of the corn effectively walled off and made useless the lower half of his territory.

During the incubation period the male spends his time singing both the territorial and sustained (see Smith, 1959) songs and defending the territory, but shows little concern over human intruders. When a person appears, the bird simply ceases his singing and hides in the grass.

The female alone incubates the eggs and broods the young. (Based on data from the literature and from my own observations, the clutch size in 42 nests ranges from two to six. Of these, one clutch contained two eggs, two had three eggs, 21 contained four eggs, 17 contained five eggs, and one had six eggs.) The female sits closely on the nest. When leaving undisturbed she slips off, runs a distance through the grass, and then flies up. Upon her return she seldom approaches the nest directly, but drops down into the grass and goes to the nest on foot, arriving by one of several well-worn paths. If flushed from the nest the female may dart off, run a short distance, arise in a short fluttering flight, and then drop to the ground again where she spreads her tail and trails her wings as if injured. At other times the female may flutter directly off the nest as if crippled or may fly from the nest to a point 25 or 30 feet away, and hide in the grass and scold.

After the young hatch, both male and female share nest duties and show greatly increased concern over human and other intrusion into their territory. (The incubation period still is unknown due largely to the difficulty of locating nests before any eggs are laid, although incomplete observations indicate that it may be 12 or 13 days.) The birds may fly in wide circles about the trespasser. They raise their crest feathers, flick their wings and tail, and when on the ground, bob up and down on their legs and utter a sharp *chi-ip* or *til-lic.* At high-intensity alarm the birds give this double note so rapidly that it almost runs into a trill. Often the male will interrupt his chipping to break into a "grasshopper" song. Less frequently, especially under situations of low-intensity alarm, the call note is a monosyllable, a sharp *tik.* If the birds are carrying food to the young at the time, they invariably eat the insect and continue their alarm. When a dog enters their territory, however, the birds drop into the grass, crouch low, and remain silent until the animal passes.

Young birds remain in the nest nine days. Michigan birds observed by Walkinshaw (1940) remained in the nest the same length of time. When out of the nest the young run mouselike through the grass and rarely appear above the grasstops.

While feeding, the Grasshopper Sparrow utters a single note, *tik* or *chip,* similar to the alarm note, but higher pitched and less sharp and vigorous. The food call of the young is a double note, *chi-ip,* similar to that of the adult but possessing a more liquid quality.

Grasshopper Sparrows no longer defend territorial boundaries after second broods leave the nest, although adults and young remain in the general vicinity until they disappear in the fall.

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COPULATION IN THE PIED-BILLED GREBE

Nancy M. McAllister and Robert W. Storer

The only published descriptions of "copulation" in the Pied-billed Grebe (*Podilymbus podiceps*) are those of Glover (1953) and Kilham (1954). Both authors describe a "forced copulation" on open water with both birds flapping their wings and the "female" sometimes diving away. This is entirely different from published accounts of copulation in other grebes (e.g., Simmons, 1955, for the Great Crested Grebe, *Podiceps cristatus*; Wobus, 1960, for the Red-necked Grebe, *P. grisegena*; Hosking, 1939, for the Horned Grebe, *P. auritus*; McAllister, 1958, for the Eared Grebe, *P. nigricollis*; Buddle, 1939, for the New Zealand Dabchick, *P. rufopectus*; and Hartley, 1937, for the Little Grebe, *P. ruficollis*). Our field data on the Red-necked Grebe and Storer's on the Horned and Eared Grebes are in agreement with the published accounts. Observations on the Western Grebe (*Aechmophorus occidentalis*) by Robert W. Nero and Fred Lahrman and by Storer, and on three South American species (*Podiceps occipitalis*, *P. chilensis*, and *P. major*) by Frank B. Gill and Storer indicate that the copulatory behavior of these four species follows the same general pattern as that in the six other species.

In the ten species, copulation takes place on a platform built by the birds, often the one used as a nest. Two soliciting postures: rearing (illustrated by Hosking and Newberry, 1946, Pl. 78; Buddle, 1939, Pl. 11, upper right-hand figure; Wobus, 1960, Fig. 2) and inviting (figured by these and several other authors) are employed by the "passive" bird prior to mounting by the "active" bird. The latter dismounts over the head of the "passive" bird and, in the case of most species, treads water in a "false bathing" posture (Simmons, 1955; and others). Observations on the Horned, Eared, Red-necked, and Western Grebes by Storer and on the Red-necked Grebe by McAllister indicate that the "active" and "passive" roles may be taken by birds of either sex (as reported for the Great Crested Grebe by Simmons, 1955). Reverse mounting appears to be more frequent in the early part of the breeding cycle than after the deposition of the first egg.

In view of the differences in the published descriptions of copulatory behavior between the Pied-billed Grebe and other species, it is of considerable interest to report in detail our independent observations on the platform behavior of the Pied-billed Grebe, which show that in most details it is similar to that of other grebes.

In May 1958, McAllister observed a nest of this species in Livingston County, Michigan. There was only one pair on the pond and therefore no territorial defense. The birds were observed for four hours each day, 21, 23, 25, and 29 April, during which no copulation calls were heard and no "forced copulation" was attempted in open water. On 1 May the nest containing two fresh eggs was found. From 1 through 6 May, when the clutch was complete, daily observations were made from a blind 25 feet from the nest. On 4 May the nest was checked; on the other days, six to eight hours were spent in observation. A table of observations follows:

2 May	9:00	observer arrived
	9:30	female solicited
	9:40	copulation
	10:10	third egg laid
	12:10–1:20	observer out of blind but within hearing distance. No copulation call heard.
	2:30	copulation
	3:53	observer left
3 May	9:30	observer entered blind
	11:10	copulation
	11:40–1:45	observer out of blind but within hearing distance. No copulation call heard.
	2:20	fourth egg laid
	3:08	copulation
	3:50	observer left blind
4 May	2:30	four eggs present
5 May	9:30	five eggs present
	3:00	female solicited
	3:30	observer left blind
6 May	10:15	six eggs present
	3:05	observer left blind

Motion pictures were made of three of the four observed copulations at this nest. From these, Fig. 1 was traced. The only soliciting posture observed was inviting, simply the use of the passive copulatory posture on the nest. The second soliciting posture, rearing, was not observed at this nest. Only the female was seen in the inviting posture, and only infrequently. She adopted this posture immediately before copulation each time and only twice briefly otherwise. Neither inviting nor copulation was observed after the clutch was complete, although intensive observation was continued.

Once the female rose on the nest and covered the eggs, then with the brood patch closed flopped down on them and invited. The other three times she invited without first standing. Inviting was similar to that in *Podiceps* spp. with the neck outstretched on a level with the belly and the bill pointed forward, making a straight line with the belly and neck. This position was held while the male swam around the nest and finally mounted. Then with the bill still pointing forward, she slowly retracted her neck, doubling it back over her shoulders until after a little more than a second the back of her head touched the male's breast. After approximately two seconds, during which she turned her head four or five times slowly from side to side and rubbed her crown

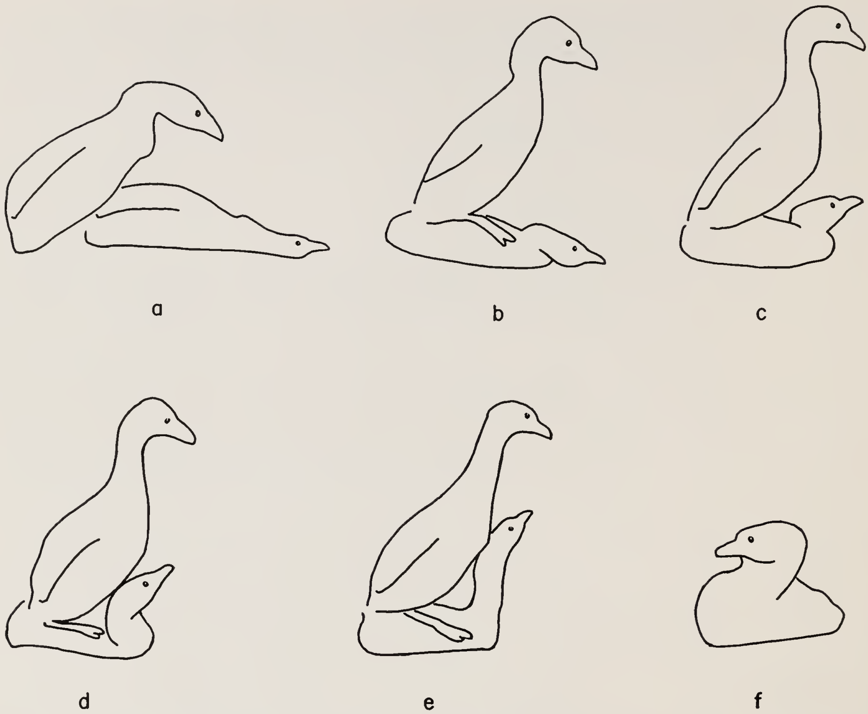

Fig. 1. Successive stages in copulation of Pied-billed Grebes (a. to e.). Postcopulatory posture of male on the water (f.). Traced from motion pictures by N. M. McAllister.

and nape against his breast, she raised her bill straight upward and stretched her neck upward still turning her head slowly and rubbing it against the male's breast.

Prior to mounting, the male stretched his neck upward and forward, then retracted it and jumped to the female's back with a single thrust of his feet. He landed with his neck partly arched and his body at an angle of about 45 degrees. He made several treading motions to establish his balance and his wings slipped free of his flank feathers but remained closed. After once regaining his balance, he did not move his feet. As the female began to draw her head back, the male stood more erect until the axis of his body was approximately 30 degrees from the vertical. His neck was extended and slightly arched, and his bill was tilted slightly downward of straight forward. He then called *quaa aaa aaa*, a short, wavering call, lower than in the other grebes, and not at all excited. There was no apparent movement associated with the call, and his bill was closed. After calling, the male began to retract his head and to lean forward, pushing the female's head down with his breast until he flopped into the water over her shoulders, breast first with his neck doubled back on his shoulders. His tail dipped into the water leaving his white breast exposed for less than half a second. This posture was described for the Great Crested Grebe (Simmons, 1955:248), where it is associated with much rapid water treading. The male Pied-billed Grebe simply righted himself and swam off. He then brought a few loads of weeds to the nest and bathed in the usual way. The female shuffled her wings alternately on her back for a few seconds and then dived into the water and swam off.

Subsequent to McAllister's observations, Storer observed copulation by two pairs of Pied-billed Grebes. The first pair was on a pothole approximately two miles south of Fort Qu'Appelle, Saskatchewan. On 26 May 1959, the nest was under construction. At about 8:35 AM, the male deposited two loads of nest material and then hopped onto the nest to arrange the new material. When the female swam up and moved about on the water near the nest, the male assumed a rearing posture, his throat and crown feathers flattened and his neck with a decided crook in it. While in this posture, he shook his closed wings, then sat down and began to arrange the nest material. Two days later there was one egg in the nest. At 11:20 AM on 28 May, the female hopped onto the nest, removed the material covering the egg, and sat down. Presently she invited, but the male, who was swimming about near the nest did not mount. At 11:32, the male again appeared near the nest and the female invited. This time the male gave a soft version of the *cuk-cuk-cuk-cow-cow-cow* call and mounted. During copulation the female stroked the male's breast with the top of her head as described above. The male dismounted over the female's head, remaining only momentarily in front of her before swimming off to feed. Copulation was also observed at this nest at about 3 PM the same day and between 9:20 and 9:25 the following day (29 May). In both instances, the sequence of events was similar to that observed previously, except that it was noted that after dismounting, the male turned toward the female and remained for a short time in the false bathing posture.

The second pair of grebes was building a nest on Jemmerson Slough, two miles west of the town of Spirit Lake, Dickinson County, Iowa. In the course of approximately seven hours spent watching this pair on 24 April 1960, Storer observed rearing by the male (six times, three times with wing shaking) and by the female (twice, neither time with wing shaking). Only the female was observed inviting (three times), and twice this was followed by copulation, which in most details was similar to that of the two pairs already mentioned. The postcopulatory display of this pair, however, was somewhat different: The male tread water rapidly with his *side* toward the female and after he subsided into the swimming position, he turned to face the female and a bout of intense head-shaking followed. The head shakes were very rapid, much more so than those of other species which we have observed. In the case of one of the copulations, the birds were facing ¾ away from the observer, and it was noted that the female raised her head to stroke the male's breast as cloacal contact was made.

To date, we have not observed inviting by the male, wing-shaking by the female during rearing, or reverse mounting; but in view of our observations on other species, it is highly likely that all these occur. It is interesting that there seems to be more variability in the details of copulatory behavior in grebes than in ducks. With the stronger and longer-maintained pair bond, perhaps there need be less stress on precision of innate copulatory and post-copulatory postures in the grebes.

From these descriptions it is clear that the normal copulatory behavior of the Pied-billed Grebe is essentially similar to that of other grebes. How then, can we interpret the observations of Glover (1953) and Kilham (1954)? In our many hours of watching Pied-billed Grebes, we have only once observed behavior comparable to that described by these authors. On 16 May 1960, Storer was watching grebes at the north end of Cawes Lake, two miles south and three miles east of Ellerslie, Alberta. At 12:30 PM, a small Pied-bill, probably a female, was found foraging along the northwestern edge of the lake. At about 2:15 the bird moved across the north end of the lake, still foraging, and by 2:30 had worked down the east side to where a second, somewhat larger bird (possibly a male) had been feeding. Without any preliminaries, the larger bird grabbed the smaller one by the back of the head or nape, and the smaller bird struggled forward without diving until it escaped. The larger bird again grabbed the smaller one by the nape and they continued to move forward with their heads and part of the larger bird's body above water. After several seconds, the smaller bird escaped, moved away, and resumed foraging. There was no indication that the birds were paired; no calls were heard in the more than two hours during which the birds were within earshot. (Paired Pied-bills call to each other at frequent intervals when separated.)

A similar encounter between two Horned Grebes was filmed by Storer in Saskatchewan in 1959, however, in this instance both birds dived and came up, the uppermost still holding the other bird by the nape. Simmons (1955: 139) has recorded similar behavior in his discussion of aggressive behavior of the Great Crested Grebe.

Our observations of copulation in the Pied-billed Grebe have been limited to nests on small bodies of water on which only two or three birds were found, situations in which little or no territorial defense or other aggressive behavior was observed. Glover studied a large, complex marsh containing at least 44 territories of the species, and he stated that territorial defense was common. Having so many individual grebes under observation and so much conflict, it would not be surprising to mistake aggressive behavior for copulation. This type of behavior is frequent in strongly territorial grebes such as the Great Crested and Horned. Glover's reports that this kind of activity continued throughout the nesting cycle and in gradually decreasing intensity until 5 August strengthens our interpretation of this behavior as aggressive. In our observations, copulation on the nest stopped when the clutch was complete.

Observers familiar with the mating habits of waterfowl too frequently fail to realize that members of the family Anatidae are the only birds which are known with certainty to copulate on the water, a habit made possible by their intromittent organ. The phallus of waterfowl is generally considered a hold-over from a condition common to all ancestral birds (Witschi, 1961:125). Among living birds, only the ratite birds, tinamous, and cracids have similarly well-developed ones. The lack of an intromittent organ in all other swimming birds is strong evidence that copulation on the water is an impossibility for them.

There is additional evidence that the behavior reported by Glover and Kilham and observed by Storer in Alberta is aggressive in nature. In diving birds such as grebes, loons, penguins, and alcids, the species-specific patterns and conspicuous colors are found largely on the head. These areas are focal points during display and quite naturally, for attack as well. (In limited tests by McAllister with paper models, one captive adult Pied-bill pecked the model vigorously and always on the head.) Sexual dimorphism in grebes is slight, the males being somewhat larger, larger billed, and in those species with ornate head plumes, longer crested. Sexual recognition is probably slow in these birds and may occur only after the initial stages of pair formation have taken place. On the basis of Storer's observations on several species, soliciting appears to be initiated early in the season by the male, and mounting by the female often follows. Elaborate, "self-exhausting" displays (in the sense of Huxley, 1914) appear to function as outlets for sexual drives in grebes prior to nest building. In birds with this sort of behavior, "forced copulation" seems an extremely unlikely action. "Forced copulation" is rare among birds. The best known example is in ducks in which the sexes are very different in color and pattern and in which the pair bond is broken at the onset of incubation, forced copulation most frequently taking place after a female has lost her first set of eggs.

The recent report (Southern, 1961) of "copulation" on the water by Common Loons (*Gavia immer*) is subject to the same criticisms as the reports of Glover and Kilham for the Pied-billed Grebe. Two other species of loons (*G. arctica*, Zedlitz, 1913:183; and *G. stellata*, Huxley, 1923:260–261) are known to copulate on land or on nest platforms, and like grebes, all loons lack an intromittent organ. These birds are strongly territorial and lack sexual dimorphism. We predict that when the courtship of the Common Loon has been adequately studied, it will be found that copulation regularly takes place on land and the behavior reported by Southern will prove to be aggressive rather than sexual.

In conclusion, copulation of Pied-billed Grebes, like that of other grebes as far as is known, takes place on the nest or a nest-like platform. It may be preceded by two soliciting displays, rearing (with or without wing shaking) and inviting, and may be followed by "escape bathing" and rapid head-shaking. During copulation, the "passive" bird strokes the breast of the "active" bird with the back of its head, a behaviorism shared by the Little Grebe of the Old World but by no other species so far studied. Observations of "forced copulation" on the water by grebes and loons are best explained as purely aggressive behavior.

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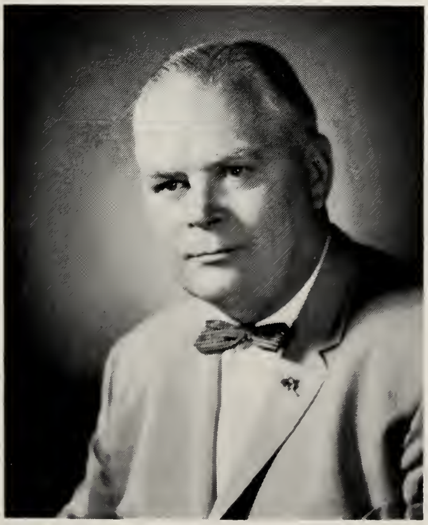
NEW LIFE MEMBER



Charles W. Hamilton, of Houston, Texas, Senior Vice President and Senior Trust Officer of the National Bank of Commerce, is a new Life Member of the Wilson Ornithological Society. Mr. Hamilton received his B.A. degree from Rice University and his M.B.A. degree from the Graduate School of Banking at Rutgers.

Mr. Hamilton, whose ornithological interest is field migration, has been an active member of the Wilson Ornithological Society since 1948. He also enjoys being a "bird watcher chauffeur" for Mrs. Hamilton and Connie Hagar. Also, he is a Charter Member of the Texas Ornithological Society and a member of the AOU.

THE SUPPOSED MIGRATORY STATUS OF THE FLAMMULATED OWL

Ned K. Johnson

At the present time we have little information concerning the Flammulated Owl (*Otus flammeolus*), in spite of the fact that it is a rather common bird in certain mountainous areas of western North America. Most of our understanding of this species has resulted from the development of special nighttime hunting techniques, used first by E. C. Jacot (1931) and later by Joe T. Marshall (1939, 1957) and others, that enable the easy detection of males. The efforts of Marshall in particular have provided our best data on habitat distribution, vocal behavior, and food habits. One issue about which we still know very little, however, concerns the winter home of this owl, and the purpose of this paper is to discuss certain aspects of the life history that relate to this point. It will be soon apparent to the reader that the facts concerning the species are so meager that the discussion will be largely speculative.

Primarily on the basis of the discussion of Phillips (1942), the Flammulated Owl was reported by the Check-list Committee of the American Ornithologists' Union (1957) to be a migratory species that winters chiefly south of the United States. I wish to review the evidence offered by Phillips to support this statement and to discuss certain clues that suggest an alternative view, namely, that this species is a permanent resident on or near the breeding grounds. At the outset it must be stated that there are no banding returns or recoveries in the files of the United States Fish and Wildlife Service (according to records processed as of 30 June 1961—Allen J. Duvall, in litt., 17 July 1962) that either prove or refute the existence of seasonal migratory movements in this species. It is thus surprising that although we have no actual proof of migration, current literature treats the bird as a migrant.

The main evidence presented by Phillips (1942:133) in support of the migratory status was that at the time of his writing all but one of the definitely dated records for the United States and Canada fell between 11 April and 31 October. The exceptional record was that of a specimen taken near San Bernardino, California, on 18 January 1885 (Stephens, 1902). Since then, only two additional midwinter records for the United States have been published, one from along the Mississippi River near Baton Rouge, Louisiana, 2 January 1949 (Lowery, 1955:320), and the other from Phoenix, Arizona, 16 February 1949 (Simpson and Werner, 1958:69). It is now known that in the Santa Catalina Mountains of Arizona the Flammulated Owl "arrives at the end of March . . . and remains until well into October" (Marshall, 1957:7).

An important point to stress here is that the presence of this species is often determined on the basis of aggressive response by males in territorial behavior to imitated calls during the spring and summer seasons. The general lack of such response on breeding areas at other seasons does not necessarily indicate that the birds have migrated; instead, it may merely point to the fact that territorial behavior wanes during the nonbreeding period.

The literature contains a scattering of records made during the season of migration, from lowland or foothill localities, some at a considerable distance from pine-forest habitat that is favored for breeding. These records may be considered as evidence for either a continental migration or for an altitudinal migration from adjacent localities of summer residence. Examples of such records are as follows: Salt Lake City, Utah, 5 April 1959 (Scott, 1959:391) and 27 September 1960 (Scott, 1960:60); Roswell, New Mexico, 27 April 1955 (Baumgartner, 1955:341); Castle Dome Mountains, Yuma County, Arizona, 29 April 1959 (Monson, 1959:392); San Pedro River, 3,000 feet, 5 May, and Huachuca Mountains, 4,500 to 6,000 feet, 22 April to 12 May, both localities in Arizona (Swarth, 1904:9); and Davis, Yolo County, California, 31 October 1935 (Emlen, 1936). However, for such a common owl (Marshall, op. cit.), it is odd that there are no records from lowland or foothill areas in México along a possible "migratory route," if indeed the species migrates. To my knowledge all records from México verifiable as to locality are from or near pine forest, the habitat used for breeding.

The presence of Flammulated Owls on at least certain of their breeding grounds between late March and the end of October is of significance because it requires that this "summer resident" species migrate thousands of miles to and from unknown wintering quarters in a rather limited amount of time. Furthermore, the number of October records for the western United States (Phillips, op. cit.) is suspiciously large for a "migratory" insectivorous species and suggests that the bird is regularly present in that month in the western United States. Although Phillips (loc. cit.:133) states that the record of a dilapidated specimen found in November 1902, at Penticton, British Columbia (Brooks, 1909:61) "hardly constitutes a satisfactory date of occurrence," the original label of the specimen (Mus. Vert. Zool. No. 101700) bears both the notation "Probably killed 2 weeks before," as well as the date, "22 Octo. 01." The fact that it was possible to prepare the bird into a satisfactory study skin, considered together with the notations on the specimen label, suggests that the bird very likely died sometime in October, an unusually late seasonal occurrence at that latitude for a "summer resident" species.

Of the three midwinter records cited above, it is notable that those from southern California and Arizona were made at localities not far removed from known breeding areas. The specimen from near Baton Rouge, the only definite vagrant known to me, at least did not occur along a hypothetical migration route.

When handling fresh specimens of the Flammulated Owl, I have been repeatedly impressed with the delicate build of this form when compared with fresh examples of the powerfully built Saw-whet Owl (*Aegolius acadicus*) and of the Pygmy Owl (*Glaucidium gnoma*). Miller (1936:229) has previously commented on the extreme general frailty and on the "slightly broader, much flatter, and . . . much less developed carina" of the Flammulated Owl in comparison with that of the strong-flying Pygmy Owl. One might justifiably wonder, then, if *O. flammeolus* is physically suited for long migrations, although thoroughgoing studies of comparative anatomy are needed to elucidate the meaning of structural differences in the small owls.

If the hypothesis of migration is rejected, an alternative must be provided that enables the Flammulated Owl to survive the winter on or near breeding areas in pine–oak regions at midlatitudes. It is a species that feeds almost entirely upon foliage and aerial insects, and largely upon those that fly at night (Marshall, 1957:75), to be sure an unpredictable food source even during the summer months in mountainous regions. A switch to a diet containing at least some birds or mammals during periods when insect food is scarce or lacking, a possibility open to the Screech Owl (*Otus asio*), a species that otherwise feeds predominantly on insects, is unlikely because there is no evidence that vertebrate prey items are ever taken by the Flammulated Owl, which is a species with relatively tiny, weak feet and legs (Miller, 1933:210 and 1936:229).

The ability to become torpid could serve as a mechanism by which this species might avoid environmental conditions unfavorable for foraging. Perhaps the Flammulated Owl, along with the Poor-will (*Phalaenoptilus nuttallii*), is a "stubborn homeotherm" as defined by Pearson (1960:93), capable of maintaining a warm body temperature over a wide range of environmental temperatures, but able also to drop the body temperature drastically under the "influence of excessive cold or of hunger." The suggestion that a species of Strigidae may possess the ability to become torpid is at least in keeping with the conclusions of Pearson (op. cit.:101) that the occurrence of torpidity is best documented for certain groups that are considered fairly closely related to one another (and to the owls as well), the goatsuckers, swifts, and hummingbirds.

The storage of fat during periods of food abundance could be a further adaptive means by which energy is available when food is scarce, even during the summer. As evidence for this, four of five males of this species I collected on 7 July 1962, in the Sierra Nevada Mountains of California ranged from moderately to excessively fat, even on this relatively early date. It is not likely that this was premigratory fat, particularly if these individuals would have remained in the mountains until at least early October, as is probable.

In the absence of direct proof of the existence or lack of torpidity in this species, it is important that workers able to obtain live Flammulated Owls attempt experiments on the effects of reduced ambient temperature and fasting on body temperature. Also, ornithologists engaged in nighttime owl hunting should begin to record air temperatures in relation to general activity in this species. Perhaps some of the wide variation in response that one notes on successive nights of hunting in the same place can be more clearly explained on the basis of changes in activity correlated with ambient temperature fluctuations than on amount of moonlight or on the stage of the breeding cycle, factors that have been invoked previously to explain these response differences.

In conclusion, it can be stated that the few threads of available evidence, while not disproving either a partial or complete migration in the Flammulated Owl, also can be interpreted to mean that this species is a permanent resident on or near breeding areas in the western United States and México. Certain records in the spring and fall months for localities removed from preferred breeding habitat can be viewed as evidence for down-mountain movement, perhaps in response to unfavorable foraging conditions in pine forest. If migration does not occur, it is hypothesized that torpidity could be an adaptive mechanism whereby this insect forager could endure periods of food shortage on the wintering grounds.

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ELF OWL REDISCOVERED IN LOWER RIO GRANDE DELTA OF TEXAS

Pauline James and Allan Hayse

Avifaunal papers on the south Texas region have long included several species which were reported or collected in early days, but for which no recent record (within 50 years) exists. Among such species are the Swallow-tailed Kite (*Elanoïdes forficatus*), the Limpkin (*Aramus guarauna*), and the Elf Owl (*Micrathene whitneyi*).

Both visiting and resident observers in the area have been inclined to disregard these and other species in this category which have appeared on such lists. Many believe these birds were mistakenly reported in the first place, or comprised "accidental" records, or were actually collected elsewhere, as in Mexico. Earlier collectors made frequent use of labels with "Brownsville" printed on them, and there is reason to believe that occasionally these labels were inadvertently attached to specimens not in fact taken at Brownsville.

Inclusion of the Elf Owl on the south Texas list (Griscom and Crosby, 1926; Davis, 1955) is based on four specimens taken by F. B. Armstrong before the turn of the century. Sennett (1889) purchased a male specimen collected 5 miles from Hidalgo on 5 April 1889. This specimen (American Museum Collection No. 80966) was designated as the type of the subspecies *idoneus* (now *idonea*) described by Ridgway (1914).

Salvin and Godman (1897) received two specimens taken at Hidalgo from Armstrong. I. C. J. Galbraith (in litt.) reports that these two skins are in the collection of the British Museum (Natural History). Register No. 1890.5.16.99 was collected on 4 April 1889; No. 1890.5.16.100, on 13 April 1889.

The last known specimen collected was a male taken in Brownsville (?) on 14 March 1894. R. M. de Schauensee (in litt.) informs us that this specimen (A.N.S.P. No. 44542) is in the Josiah Hoopes Collection of the Academy of Natural Sciences of Philadelphia. Several Mexican specimens (Ridgway, 1914) in the United States National Museum may also be referable to this form.

Sennett (1889) states that the bird is unexpected in Texas, especially at the low altitude near the Gulf coast. Davis (1955) cites no recent record of the Elf Owl in the delta area. Hence, it would appear worthy of note to report the rediscovery of *Micrathene whitneyi* in what is possibly that very area in which it was first collected by Armstrong almost 70 years ago.

In 1960, the annual spring bird count of the lower Rio Grande delta was held on 1 May. The day proved to be particularly good (260 species recorded) because of a rare combination of ideal weather conditions. However, as may often occur on such counts, certain birds that should have been seen were unreported at the time of the evening tally. Among those was the Ferruginous Owl (*Glaucidium brasilianum*). Knowing that this species was in an area near their residence southwest of Mission, Texas, Mr. and Mrs. Luhe McConnell volunteered to go out that night to look for and to listen for it. The next day Mr. McConnell telephoned to report they had found the Ferruginous Owl and that there was also another little owl with a very different call in the area. He asked that we come over and check the owl to see whether it might possibly be an Elf Owl as Mrs. McConnell suspected.

We arrived at the McConnell residence about 7 PM and almost immediately heard whimpering, puppylike calls in the early darkness. For 10 to 15 minutes we listened and watched one or two small birds fly back and forth between mesquite trees and a storage building on the premises. Several times a bird appeared to go into an old woodpecker hole in a nearby upright timber.

One bird was caught when it flew down the beam of a heavy-duty flashlight and landed on a mesquite limb just above the authors. It was taken inside, carefully examined, measured (total body length 137 mm), and identified as an Elf Owl. It was then released.

About a week later the birds had disappeared from that particular vicinity. Whether their departure was a normal one or was due to frequent observation and some attempted photography is not known. However, they and/or other pairs were subsequently located in the general area. On one occasion at about 9 PM an individual was watched for approximately 10 minutes flying about in a mesquite tree. All of this time the owl carried a mesquite bean which he moved back and forth in his mouth. We assume that the owl was eating ants or other insects from the pod, since mesquite beans normally are heavily infested with various insects.

Elf Owls nested in the area at least a year previous to the 1960 observations. A young one (whose identity was not established at the time) was found by the McConnells in their yard and was kept in captivity for several weeks until it died. We did not know of the incident until 1960. The skin was not saved, but the young bird was photographed by P. B. Myers of McAllen, Texas.

In 1961, Elf Owls were located in four places in the general area and are believed to have nested at three of these locations. One pair raised at least two young in the cavity of the original timber beside the storage building in the McConnells' backyard. We photographed an adult and one of its young. After the second young bird left the nest, the family group stayed in the immediate area for several days.

That the species could occur in such a well-populated area and yet remain undetected for nearly 70 years is rather remarkable. The most probable explanation is that there are relatively few people in the lower Rio Grande delta of Texas who are actively interested in birds. Of those, the even fewer serious-minded bird students usually have a rather limited amount of time at their disposal.

Many ornithologists, both amateurs and otherwise, visit the area annually. Chiefly concerned with adding "new" birds to their list, they contact local people for specific sites where they can locate a particular bird they have heretofore missed. Most of these people visit the national wildlife refuges first (Laguna Atascosa on the Gulf coast and Santa Ana up the Rio Grande River) and often do not have time to go farther west. Until the last few years, only rarely did visitors travel west of Santa Ana just to look at birds. Also, since the Elf Owl has been considered as not occurring in south Texas for so many years, apparently no one has bothered to look specifically for it. Since the habitat of the Elf Owl is so localized and since few people have reason to be in the border brush areas at night, it actually is not too surprising that these little owls have escaped detection for so long.

Of course, it is possible that the Elf Owl has not been here continually since it was originally collected in 1889. Considering all aspects of the situation, however, we feel that it has been inhabiting this same general area since the days of Armstrong and Sennett. The extent of the population of this rare permanent resident has not yet been determined, but certainly it is very small. "Progress" has wiped out most of the brushland in this region. The plots of heavy brush along the river are very few in number and limited in acreage. Each year a little more of the area is cleared. On the Mexican side of the river the land has been cleared even more extensively and completely than on the U.S. side.

Brandt (1951) points out that the Arizona form of the Elf Owl does not hesitate to nest near human habitation. Such also seems to be the case with the Texas race. He suggests that the attraction of night-flying insects to lights may be one of the reasons for this habit. The same assumption seems plausible here, since each of the sites noted in our observations has been located near lights. However, without other more natural habitats it is doubtful that the population can survive indefinitely. One probable factor endangering its survival is the possibility of the birds' feeding on insects that have come in contact with the numerous crop sprays and insecticides that are used heavily in this region. The birds reported were nesting within 100 feet of a cotton field. However. if no further depredations are made upon the habitat or the species, it would appear that the Elf Owl in the lower Rio Grande Valley may possibly survive another 65 years.

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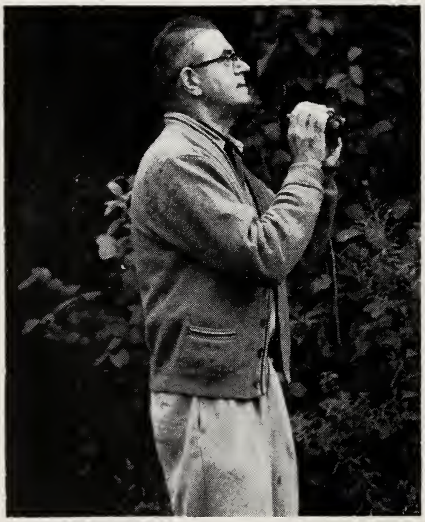
SCIENCE DIVISION, PAN AMERICAN COLLEGE, EDINBURG, TEXAS, 6 AUGUST 1962

NEW LIFE MEMBER



Harvey B. Lovell, of Louisville, Kentucky, an active member of the Wilson Ornithological Society since 1936, is a new Life Member. Dr. Lovell, Professor of Biology at the University of Kentucky, received his A.B. degree from Bowdoin College and his A.M. and Ph.D. degrees from Harvard University. His principal ornithological interests are nesting activities and bird banding.

Dr. Lovell has published papers in four state and four regional ornithological journals, has co-authored two books on ornithology and zoology, and has authored a manual for honey plants. In addition, he is a member of and has taken active roles in the AOU, Sigma Xi, Inland Bird Banding Association, Kentucky Ornithological Society, Kentucky Academy of Science, and Kentucky Society of Natural History.

POLYMORPHISM IN THE SCREECH OWL IN EASTERN NORTH AMERICA

D. F. Owen

My aim in this paper is to provide a description of geographical trends in the occurrence of color forms in the Screech Owl (*Otus asio*) and, in particular, to draw attention to what appears to be an unusual pattern of variation within an animal species. This paper is adapted from part of a recently finished and lengthy study of variation in the Screech Owl.

The Screech Owl is continuously distributed and common over much of North America between about 57° N (southeastern Alaska) and 17° N (Oaxaca). East of about 104° W there are two color forms, one with the plumage mainly gray and the other with the plumage mainly rufous. Similar forms occur in other species of *Otus.* In the Screech Owl it is known that at least in some areas rufous is genetically dominant to gray, but the presence of intermediates indicates that the genetic control of color forms is more complex than this.

The existence of two distinct color forms of the Screech Owl has been known since about 1874 when Ridgway (Baird, et al., 1874) realized that rufous and gray birds were of the same species and that the forms were independent of age, sex, or season. Earlier, rufous and gray birds had been variously interpreted as belonging to different sexes or to different age classes. Ridgway later published in many natural history and scientific journals an appeal for information on the frequency of rufous and gray birds, nesting details, and any other data that might help to solve the problem. The information so obtained was passed over to E. M. Hasbrouck who later published an account of his findings (Hasbrouck, 1893). There are a number of inaccuracies in Hasbrouck's paper, as pointed out at the time in a critical review (Allen, 1893). No one has attempted a full survey of the geography of color forms in the Screech Owl since that date. There have been, however, a number of papers discussing the problem in relatively small geographical areas, such as Ontario (Martin, 1950) and parts of Illinois and Wisconsin (Schorger, 1954). There also has been one somewhat inconclusive genetic analysis in Ottawa County, Ohio (Hrubant, 1955).

GEOGRAPHICAL VARIATION IN RELATIVE FREQUENCY OF RUFOUS SCREECH OWLS

Figure 1 shows the distribution and relative frequency (per cent) of rufous Screech Owls in eastern North America. The percentages are based upon 1,778 specimens in the collections listed at the end of this paper and upon

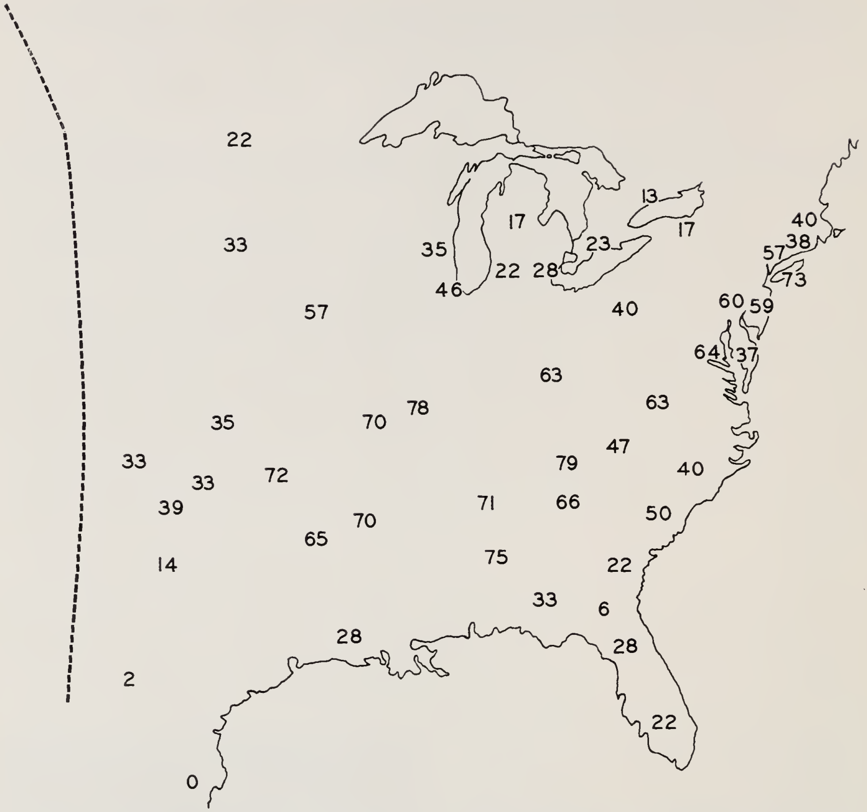


Fig. 1. Relative frequency (per cent) of rufous Screech Owls in North America.

the specimens reported by Schorger (1954) and Stupka (1953). Other published records are omitted because of uncertainty as to their reliability, or because I have re-examined the specimens upon which the reports were based. There is good reason for regarding the sample upon which Fig. 1 is based as representative of the population. Using a series of 2×2 contingency tests, I was unable to detect bias by individual collectors or museums for either rufous or gray birds (details in Owen, MS).

The approximate western limit of rufous Screech Owls in North America is indicated by a broken line in Fig. 1. The Regina region of Saskatchewan is the most westerly point (about 104.6° W) at which rufous birds have been recorded. The southern limit of occurrence of rufous Screech Owls is in Nuevo Leon (or possibly Tamaulipas), Mexico. But there were no rufous birds in a sample of 124 specimens from southeastern Texas (chiefly Cameron County), and it seems likely that the southern limit of regular occurrence of rufous specimens is at about 30° N in Texas. In the Florida peninsula, rufous birds occur south to the Keys. (The species is absent from the West Indies.)

Thus rufous Screech Owls occur throughout the range of the species in eastern North America; but in no area do they comprise the total population, some gray birds are always present. As shown in Fig. 1, the relative frequency of rufous birds forms a somewhat irregular cline from north to south. The lowest frequencies occur at the northern limits of the range of the species: 22 per cent in northern Minnesota and North Dakota, 17 per cent in the upper part of the Lower Peninsula of Michigan, and 13 per cent around Toronto. Between 30° and 40° N rufous birds frequently comprise 60–70 per cent of the population, sometimes more, as in southern Illinois (78%) and eastern Tennessee (79%). In the Florida peninsula and along parts of the Gulf coast there is a decrease in the relative frequency of rufous birds, but this is caused chiefly by a sharp rise in the frequency of intermediates and not by an increase in the frequency of gray birds. I shall discuss this later. Near the western limit of rufous birds there is a sharp drop in their relative frequency: only 2 per cent in Kerr County, Texas, and less than 40 per cent elsewhere. As already mentioned, there are records of rufous birds west of 100°, but there are no data on relative frequency. Some of the irregularities in the cline depicted in Fig. 1 can doubtless be attributed to inadequate sampling, but the high frequency (73%) of rufous birds on Long Island compared with the surrounding mainland (38–59%) must be mentioned because large samples were examined.

BIMODAL VARIATION IN THE SCREECH OWL

As already mentioned, the low relative frequency of rufous Screech Owls in Florida is largely because of an increase in relative frequency of birds intermediate in coloration. In view of this, I set up a graded series of six specimens, ranging from gray to rufous, against which all other specimens were matched. Young, damaged, and dirty birds were excluded, and, after some experience, I had little difficulty in placing each specimen in one of the six color categories. The following are descriptions of the six birds against which all others were matched. The descriptions refer only to those characters used in placing other specimens into categories; other variation is omitted.

1. Upperparts: gray, shafts of body feathers dark brown or black; numerous fine bars and irregular streaks on each feather; a very light rufous suffusion on many of the feathers (this not present in all specimens). Underparts: white; almost all feathers, except some of those of the lower belly, with heavy dark brown or black streaks surrounding and including the shaft; each feather with 1–3 (sometimes more) bars of variable length and width, each making an angle of about 65° with the streak, such that (especially on the belly) the arrow-shaped markings so-formed point toward the posterior of the bird. The streaks vary in thickness from 10 mm on the feathers of the lower

breast to 2 mm on the feathers of the belly, while the feathers around the vent and on the thighs are generally unpigmented. On the breast and throat the main bars are interspersed with smaller bars giving an almost vermiculated appearance. Occasionally there is a small patch of rufous where the bars make an angle with the streak, and many of the wider streaks and bars are lightly edged with rufous, this, however, is apparent only at close inspection. The general appearance of birds in this category is gray.
Example: male, Washtenaw County, Michigan, 16 October 1950 (UMMZ 151952).

2. Upperparts: as in 1, but the whole back more suffused with rufous, especially in the middle and on the crown and forehead. Underparts: as in 1, but the angles between the bars and streaks with more extensive rufous areas, giving the entire underparts a more rufous appearance, but retaining the same basic pattern. Birds in this category are unquestionably gray.
Example: female, Lenawee County, Michigan, 17 November 1934 (UMMZ 125549).

3. Upperparts: as in 2, but more rufous, especially on the back, crown, and forehead. Underparts: as in 2, but rufous areas still more extensive; basic pattern on the feathers of the belly and breast as in 2, unlike the next category (4). Birds in this category appear intermediate between gray and rufous, but are closer to the gray form on account of the pattern of the feathers of the underparts.
Example: male, Benton County, Arkansas, 17 June 1935 (UMMZ 125587).

4. Upperparts: as in 3, but more rufous, especially on the crown and back; rufous now replaces gray as the dominant color of the upperparts. Underparts: streaked as in 3, but on the belly and lower breast the bars on each feather are largely replaced by broad irregular spots of rufous, one or two on each feather; many feathers of the upper breast and throat similarly patterned, but many also as in 3. Birds in this category obviously intermediate, but on the underparts the pattern approaches that found in 5 and 6 rather than that in 1–3.
Example: male, Washtenaw County, Michigan, 20 October 1929 (UMMZ 152081).

5. Upperparts: more rufous and less heavily streaked than in 4, much more uniform in coloration with less indication of patterning. Underparts: the irregular rufous spots on each feather, noted in 4, occur on most of the pigmented feathers of the underparts; fine barring present on only a few feathers; many feathers with just one large rufous spot; black and dark brown shafts still conspicuous.
Example: male, Walsh County, North Dakota, 18 May 1933 (UMMZ 125620).

6. Upperparts: almost all visible parts of feathers bright rufous; streaks less distinct than in 5 (in some specimens there are no streaks). Underparts: most feathers with one, sometimes two, irregular, bright rufous spots; no bars. The general appearance is bright rufous.
Example: female, Benton County, Arkansas, 11 December 1935 (UMMZ 125597).

It was possible to place 1,320 specimens into the above six color categories. The specimens in this sample are from the entire range of the species east of 100°; that is to say, the area where rufous as well as gray birds occur. Birds in categories 1–2 may be conveniently regarded as gray, those in 3–4 as intermediate, and those in 5–6 as rufous. About 54 per cent of the specimens are gray and 38 per cent rufous, while only 8 per cent are intermediate in coloration. Thus, in eastern North America as a whole, the variation in color has a bimodal distribution. But the degree of bimodality varies geographically, as shown in Table 1.

TABLE 1

RELATIVE FREQUENCY OF COLOR CATEGORIES 1–6 IN SCREECH OWLS IN SELECTED AREAS OF EASTERN NORTH AMERICA

Area	*N*	Number of specimens in Color Categories: 1	2	3	4	5	6	Per cent 3–4
Minnesota: Roseau and Beltrami counties	27	17	3	0	0	0	7	0
North Dakota: Walsh County	39	21	8	3	1	3	3	10
Illinois: Will, Cook, and Lake counties	15	7	2	1	0	2	3	7
Kansas: Douglas County	24	11	4	2	0	1	6	8
Michigan: Washtenaw and Livingston counties	77	45	12	0	1	3	16	1
Ontario: York County	42	31	2	1	1	0	7	4
Ontario: Middlesex County	23	13	2	0	0	0	8	0
Ontario: Essex County	14	11	0	1	0	0	2	7
Connecticut: Hartford, Litchfield, Middlesex, and Fairfield counties	40	15	5	2	1	2	15	7
New York: Long Island	43	8	2	1	1	1	30	4
New York: Orange, Rockland, and Westchester counties	30	9	3	0	1	1	16	3
New Jersey: Essex, Bergen, Morris, and Union counties	24	5	3	0	0	0	16	0
Maryland: Prince Georges and Montgomery counties	18	4	2	0	0	0	12	0
Washington, D.C.	44	10	3	3	1	1	26	9
Virginia: Fairfax County	13	4	0	0	0	0	9	0
Georgia: Cobb and Fulton counties	31	5	6	0	1	3	16	3
Arkansas: Washington and Benton counties	38	9	0	2	0	0	27	5
Arkansas: Pike County	21	8	0	0	0	1	12	0
Texas: Kerr County	20	19	0	0	0	1	0	0
Texas: Cameron County	99	83	16	0	0	0	0	0
Louisiana: St. Tammany Parish	12	4	3	2	0	0	3	17
Florida: Duval, Columbia, Nassau, Bradford, Alachua, Clay, St. Johns, Madison, and Taylor counties	16	7	6	2	1	0	0	19
Florida: Levy, Putnam, and Volusia counties	11	2	2	1	0	0	6	9
Florida: Brevard, Orange, Citrus, Seminole, Sumter, and Pasco counties	33	6	8	6	3	5	5	27
Florida: Indian River, Polk, Osceola, and Hillsborough counties	30	7	6	4	8	1	4	40
Florida: Martin, Sarasota, Highlands, St. Lucie, Manatee, De Soto, and Okeechobee counties	25	6	4	2	3	7	3	20
Florida: Collier, Palm Beach, and Lee counties	14	4	5	2	2	1	0	29
Florida: Dade and Monroe counties	16	1	8	3	3	1	0	38

Note: For descriptions of color categories see text.

The frequency of birds classified in Color Categories 1–6 in 28 representative areas is given in Table 1. Throughout eastern North America, except in southern Louisiana and in Florida, intermediates (Categories 3–4) comprise 10 per cent or less of the population. In Florida and in southern Louisiana intermediates are more frequent: in central Florida they comprise 40 per cent of the population. Thus, as shown in Table 1, although both rufous and gray birds occur in Florida, the population lacks the bimodality evident throughout the rest of eastern North America.

DISCUSSION

The existence of bimodal or polymodal variation within a species is often referred to as polymorphism, which may be formally defined as: The occurrence together in the same habitat of two or more distinct genetic forms of a species of animal or plant in such proportions that the rarest of them cannot be maintained by recurrent mutation (Ford, 1940). Differences between the sexes, differences between young and older individuals, and seasonal differences are excluded from this definition. Only bimodal or polymodal variation, in which intermediate forms occur at low frequency or are even absent, is considered as polymorphism. Hence an extremely variable species may not necessarily be polymorphic.

It is extremely unlikely that two or more very different phenotypes would be equally adapted to the environment in which they live; a balance of selective forces must be involved, for if not, one form would rapidly replace the other and there would be no polymorphism (Fisher, 1930). Hence the presence of polymorphism in a species probably represents balanced adaptation of the forms to varying environmental conditions.

Nothing is known of the adaptive significance of the polymorphic forms of the Screech Owl, but the existence of a cline in the relative frequency of the forms (Fig. 1) as opposed to random or irregular distribution supports the view that polymorphism in this species is maintained by selection operating along environmental gradients. The cline is not correlated with any obvious environmental factors, but, with the exception of the extreme South (including Florida), rufous birds are more frequent in warmer areas. An earlier attempt to correlate the cline with relative humidity (Hasbrouck, 1893) was based upon inadequate information and cannot be substantiated with the additional material now available. The absence of polymorphism throughout the range of the species in the West is probably the result of environmental factors which prevent its establishment there.

The existence of two distinct forms with few intermediates throughout much of the range of the Screech Owl in eastern North America is indicative of selection for bimodal variation. In most areas, selection must be continually operating against intermediates, but in Florida, where intermediates are frequent (Table 1), there is presumably a relaxation of selection pressure. The result of this is that while all six color categories occur in Florida, the population is extremely variable, but not polymorphic. Hence in the Screech Owl the unusual situation exists in which polymorphism for color and pattern is maintained over a large geographical area (eastern North America), while in a much smaller area (Florida) the complete range of phenotypes occurs, but the population is not polymorphic. I am not aware of a comparable situation in any other species of animal.

SUMMARY

Throughout most of North America east of about 104° there are two forms of the Screech Owl: one with the plumage mainly bright rufous and the other with the plumage mainly gray. Birds of intermediate coloration also exist, but in most areas they are rare.

The relative frequency of rufous birds varies geographically in the form of a cline from north to south; about a quarter or less of the northern population is rufous, while in the South (the Gulf coast and Florida excepted) up to three-quarters of the population may be rufous.

Screech Owls intermediate in coloration between gray and rufous comprise not more than 10 per cent of the population, except in Florida and the adjacent Gulf coast where they comprise up to 40 per cent. In Florida, Screech Owls are more variable in color and the population lacks the bimodality of other populations in eastern North America. This is probably the result of relaxed selection pressure.

The geography of polymorphism in the Screech Owl appears to be an unusual pattern of variation within an animal species.

ACKNOWLEDGMENTS

I examined specimens from the following collections: American Museum of Natural History, New York; Carnegie Museum, Pittsburgh; Chicago Natural History Museum; Florida State Museum, University of Florida, Gainesville; Kalamazoo College Biology Department, Kalamazoo, Michigan; Louisiana State University Museum of Natural History, Baton Rouge; Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; Michigan State University Museum, East Lansing; Peabody Museum of Natural History, Yale University, New Haven, Connecticut; Royal Ontario Museum, Toronto; United States National Museum, Washington, D.C.; University of Kansas Museum of Natural History, Lawrence; The University of Michigan Museum of Zoology, Ann Arbor; University of Minnesota Museum of Natural History, Minneapolis; University of Oklahoma Museum of Zoology, Norman.

I am grateful to the curators of these collections for providing working facilities or for sending specimens to Ann Arbor for my examination. My visits to museums were aided by grants from the Frank M. Chapman Memorial Fund of the American Museum of Natural History, the Van Tyne Memorial Fund of the American Ornithologists' Union, and the Karl P. Schmidt Fund of the Chicago Natural History Museum.

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THE UNIVERSITY OF MICHIGAN MUSEUM OF ZOOLOGY, ANN ARBOR, MICHIGAN,
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AN EXAMINATION OF SOME INTERPRETATIONS OF MOLT WITH ADDED DATA FROM PROGESTERONE AND THYROXINE

Mary Juhn

A recent and extensive review by Assenmacher (1958) is devoted to hormonal mechanisms as the determinants controlling molt in birds. Although the problem is presented as being as yet incompletely clarified, surges of thyroidal activity are thought on the whole to set molt in motion, although these surges may trace to factors further back. There is most ample evidence that exogenous thyroid administration will initiate new feather growth in the greater number of cases studied; there is far less proof that the bird's own thyroid exhibits comparable and measurable activations at the appropriate period. These lacks have caused Assenmacher to suggest that a time prior to the onset of molt may be of greater importance than the molt period itself in an evaluation of endogenous thyroid physiology.

Such hypotheses of prior increases in circulating thyroid levels cannot be examined in the feathering where the onset of the molt is violent and spreads with rapidity over the entire plumage since the time of effect could well be restricted to activation of the papillae alone. These rapid molts may occur but they are not the rule. In general, the molt is prolonged, assuring a coincident series of feathers in various stages of regeneration, and of various papillae coming into function. Feathers during their growth are demonstratively susceptible to some hormonal alterations and furnish records of these events when later collected. Witschi (1936), for example, could show in this manner that the nuptial plumage of a weaver finch, *Pyromelana franciscana*, traces to the pituitary luteinizing hormone. Certain feathers of the domestic fowl give a peculiarly clear and unmistakable reaction to thyroid hormone administration and they do this toward dosages far below those effectively stimulating molt (Juhn and Barnes, 1931). Lacy feather portions being laid down in treated fowl are displaced by barbulated areas; where the bird happens to be parti-colored, the pigmentation shifts in correspondence to structure but this is secondary. Feather series grown during the normal molt period never show the least evidence of such modifications and surely these should be expected if the bird's own thyroid were hyperactive then. This same reasoning was taken to speak against progesterone-caused molt as *via* the thyroid (Shaffner, 1954), but the point seems not to have been quite clear (Assenmacher, 1958:261). Accordingly, an illustrative test was set up whereby progesterone and thyroxine are compared in birds so prepared that feathers in growth were present while molt stimulation in other standing parts of the plumage was effected by either compound.

EXPLANATION OF FIGURES 1–4

Comparison of the feather type regenerated by adult White Rock capons under progesterone and under thyroxine dosages similarly effective in molt as measured in the number of primaries experimentally shed and replaced.

FIG. 1 (UPPER LEFT). Normal control saddle hackle.

Progesterone amounts anticipated to give about maximal response were set against a range of dosages for thyroxine. The amounts employed were estimated from earlier experience and allowance was made for the far heavier body weights, average 5.47 kg, of the birds in the present series. These were White Plymouth Rocks, surgically castrated at about eight weeks of age. Treatment was made at about 15 months of age, during midsummer. The capons were housed by pairs in large adjacent cages; each had a square patch of plumage removed from the left saddle. Three weeks later all individuals were found in suitable regeneration for feather record—treatment by single injection was made as follows:

Pair 1, 50 mg repositol progesterone in 2 ml, intramuscularly;
Pair 2, 100 mg progesterone in 2 ml sesame oil, subcutaneously;
Pair 3, 0.5 mg thyroxine in 1 ml distilled water, subcutaneously;
Pair 4, 5.0 mg thyroxine in 1 ml distilled water, subcutaneously;
Pair 5, 10.0 mg thyroxine in 1 ml distilled water, subcutaneously.

There were no ill effects to be noted at any treatment level. Heavy molt became evident within 14 days or somewhat less with progesterone in either carrier and with 0.5 and 10.0 mg thyroxine. The 0.5 mg dosage caused little response to be clearly differentiated from the sporadic small feather loss common to the castrate. The saddle hackles in enforced regeneration during the respective injections were collected when growth was approximately completed. Samples were photographed and grouped on the basis of similarity in the number of primaries experimentally renewed. Figure 1 is from an untreated control; Figs. 2 and 3 are from repositol progesterone and progesterone in oil; Fig. 4 is from 5.0 mg thyroxine. The thyroxine-treated feather shows the expected usual structural responses; the absence of similar modification in the progesterone cases is clear.

If the positive action of progesterone upon molt in the castrate were indeed through an increased output of the bird's thyroid secretions, one should reasonably look for some approximation at least of the specific structural changes experimentally produced by thyroxine: there was none. Questioning the occurrence of "thyroidal surges" in no way detracts from the gland's normal role in differentiation; this attribute may explain the experimental effectiveness in feather papilla activation. It is a property not shared by the

Fig. 2 (Upper Right). Saddle hackle regenerated under repositol progesterone treatment; 8 primaries experimentally renewed.

Fig. 3 (Lower Left). Saddle hackle regenerated under progesterone in oil administration; 6 primaries experimentally renewed.

Fig. 4 (Lower Right). Saddle hackle regenerated under thyroxine administration (5.0 mg); 8 primaries experimentally renewed.

metabolism stimulation of dinitrophenol: unpublished data from this laboratory showed that the drug's administration to adult cocks, carried in graded doses to the lethal level, affected neither the regenerating feather structure nor caused molt.

The responsiveness of the regenerating feather may be applied to similarly guided considerations of the molt period in the normal adult hen. For this aspect no new tests need be devised since the pertinent data have long been in the literature, although not necessarily planned toward this end. The annual molt generally averages from 8 to 10 weeks during which a completely new set of feathers develops in the different feather tracts (Hays, 1957). At this time there is an interruption of lay and the oviduct regresses considerably from its functional development. The state of the oviduct especially suggests a sharp diminution, perhaps even a temporary interruption of oestrogen secretion by the hen's ovary. However, this is not borne out in the feathering regenerated during this period of so-called quiescence. The numerous ovariotomy studies, separately pursued in various laboratories, invariably proved that with complete glandular removal, the original female feathering became displaced by a new and sharply differing type. This castrate plumage is identical in the operated fowl of either initial sex and identical, too, with the plumage worn by the normal cock (Domm, 1924; Goodale, 1916; Pézard, et al., 1925). Further, and this is pertinent here, differences between the hormone requirements of the various feather tracts were early suspected. The suggestions were based on observations that the development of feminized plumage in successful grafts to the male (Zawadowsky, 1926), or its return in ovarian regeneration (Domm, 1931), was a gradual process, a serial spreading. When modification through injected oestrogen became feasible, regionally effective dosages could be established and with this an approach to quantitative appraisals (Juhn and Gustavson, 1930). Effects in the large wing feathers which served in later analyses by Fraps (1938) are particularly relevant to this aspect. Since the feathering formed during her molt by the hen is entirely female, it is clear that all the demonstrated regional demands were being met fully. Hence the ovary must have continued a secretory activity during that period; in fact, to some considerable degree. Perhaps the regenerating plumage may be preferentially avid of circulating oestrogen and so deprive other target organs, such as the oviduct. This, however, is speculation and of no immediate bearing here.

A consideration of the points raised in the preceding discussion suggests some reserve in accepting any one mechanism employed as the determinant of the normal adult molt. In fact, the very range of experimental manipulations that will initiate activation (see Assenmacher, 1958, for reference to which prolactin—Juhn and Harris, 1958—should be added) speaks against this. Instead, it seems probable that molt is essentially an autonomous process, the primary seat of the cyclical renewals being the feather papilla proper. From this point of view there would be no fundamental distinction between the juvenile and the adult molts, either of which would occur ultimately. The difference present is that between the extreme, although slackening velocity, with which the juvenile replacements follow upon each other and the periods of rest that are interposed in the adult. These differences are, however, of first importance. When a biological activity proceeds at its maximal or near maximal capacity as in the juvenile molts, there is no good prospect of further acceleration. Spontaneously developing gradual declines and renewals on the other hand afford an approach to the various experimental hastening that has been so successfully practiced.

The positive results obtained with hormone treatments have reasonably suggested internal fluctuations of similar nature in explanation of the normal molt. The case for this interpretation is, though, no longer as persuasive as once thought. Within limits, one or another environmental factor could well participate as seasonal trigger. This, however, need not necessarily be because of secretory surges but because of an autonomously changing physiology of the feather papilla which at this time exposes the organ to previously ineffective levels. There is good experimental evidence that increasing sensitivities accompany spontaneous preparatory activations within the papilla: such associations would in any event be reasonable. Van der Meulen (1939), for instance, has found that ever less thyroid substance will stimulate the papilla the closer the treatment is made to the anticipated date of the normal molt. Entirely comparable observations were made by Harris and Shaffner (1957) when progesterone was employed, also, in the domestic hen.

Returning the source of molt in the first place to the papilla makes the adaptive "bunching" or prolongation of the regenerative periods more readily understood; it also speaks against the importance of ascribing pacemaker activities to any particular set of circumstances. These may, in fact, vary from species to species and the problem remains whether an experimental effectiveness in one or another case can be taken as mirroring the normal event.

SUMMARY

It is known that feathers during their growing period will lay down records of certain fluctuations in the hormonal milieu, normal or experimentally caused. This information was used to compare progesterone and thyroxine dosages adequate for induced wing molt in White Plymouth Rock capons with reference to the respective effects in regenerating saddle hackles. Thyroxine caused the well-known structural differentiation in lacy areas; this response was absent with progesterone. The findings support the view that progesterone molt in the fowl is not through an activation of the bird's own thyroid.

Since thyroxine induces the specific feather response with doses far smaller than found essential to experimental molt, lack of its development during the normal molt tends to

discount thyroidal surges at this period. Conversely, the female feathering laid down during molt of the hen is evidence of continued ovarian activity during that time. These considerations, together with the number of manipulations experimentally effective in molt, seem to speak against any one environmental mechanism as causal in all cases. Instead, gradual and spontaneous activations within the papilla, associated with increasing sensitivities, are suggested as the primary seat, the periodicities being adaptive and variable.

ACKNOWLEDGMENTS

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POULTRY DEPARTMENT, UNIVERSITY OF MARYLAND, COLLEGE PARK, MARYLAND, 21 JULY 1962 (SCIENTIFIC ARTICLE NO. A996, CONTRIBUTION NO. 3384, MARYLAND AGRICULTURAL EXPERIMENT STATION)

NEW LIFE MEMBER

John H. Foster, of Wayne, Pennsylvania, an active member of the Wilson Ornithological Society since 1952, is a new Life Member. Mr. Foster is President of Diamond Glass Company in Rayersford, Pennsylvania. His principal interests in ornithology are bird identification and bird photography.

In addition, Mr. Foster enjoys fishing, has served two terms in the Pennsylvania House of Representatives, and presently is a commissioner of his home township. He is a Life Member of the AOU and National Audubon Society, a Charter Member of the Anglers Club of Philadelphia, and a member of the BOU, Cooper Ornithological Society, Florida Audubon Society, Massachusetts Audubon Society, Valley Forge Audubon Society, Wilderness Club of Philadelphia, Explorer's Club of New York, Anglers Club of New York, and Adventurers Club of New York.

GENERAL NOTES

A Royal Tern choked by a fish.—On Saturday, 20 October 1962, I found a Royal Tern (*Thalasseus maximus*) in distress in the edge of the surf on the north end of Tybee Island, Chatham County, Georgia. When first seen it was waving its wings feebly, but by the time I got to it, it was practically lifeless. There was a feeble heart-beat, which soon ceased. There was no external indication of the cause of death.

Later in the day, when it was skinned out carefully, the bird was found to have a fish, an Atlantic Croaker (*Micropogon undulatus*), firmly lodged in the pectoral arch. It was just too large to pass through. The pectoral arch, bounded by the branches of the furcula and the bony framework superior to it, is roughly triangular and nonexpandable. The fish also was roughly triangular in cross section back of the head. The bony spines of the dorsal fin had prevented the bird from disgorging the fish. The fish was 175 mm long and weighed 27 grams.

It is believed that the bird's death was caused by the closure of the windpipe and the blood vessels to the head. When skinning, I noted considerable serous fluid in the tissues of the neck and head, a condition often found in birds that have been killed by "squeezing" the thorax. Perhaps this condition follows the shutting off of the blood to the head.

The tern was an adult female, in good flesh, and with much subcutaneous fat. It weighed 567 grams.

This kind of happening is rare, for Royals Terns are numerous, and this mile of beach has been patroled often and very few dead gulls or terns found. Several shrimp trawlers were operating a mile offshore, and perhaps this fish was thrown out with other trash fish. The gulls and larger terns gather around these trawlers in flocks when the trash fish from the nets are being discarded.—Ivan R. Tomkins, *1231 East 50th Street, Savannah, Georgia, 11 November 1962.*

Fulvous Tree Ducks in Michigan.—During the waterfowl hunting season three Fulvous Tree Ducks (*Dendrocygna bicolor*) were shot from a flock of ten on 14 October 1962, by Edwin Sobota and Gary Schwalbe of Monroe, Michigan. They gave two of the specimens to John Minick, a conservation officer, who in turn presented them to The University of Michigan after James Foote contacted me. I do not know the fate of the third duck.

All three birds were taken on North Cape (= Woodtick Peninsula) near the Consumers' Power Plant in Section 23, T8S, R8E, Monroe County, Michigan. The two specimens, which are now in The University of Michigan Museum of Zoology, were both females. The immature weighed 580 grams, had little fat, had an ovary 18 × 7 mm, had a bursa of Fabricius 16 × 6 mm, and had the gizzard one-third filled with unidentified seeds. The adult female weighed 590 grams, had little fat, had an ovary 13 × 4 mm, and had no bursa of Fabricius; the gizzard was not examined.

No mention whatever of the Fulvous Tree Duck is made in Barrows (1912. "Michigan Bird Life"), Wood (1951. "The Birds of Michigan"), or Zimmerman and Van Tyne (1959. "A Distributional Check-list of the Birds of Michigan"). It has occurred in Missouri and Minnesota as accidental, according to the A.O.U. Check-list of North American Birds (1957). The Check-list account does not include Michigan as having even accidental occurrences of this species. Thus, the present specimens constitute a unique record for Michigan and the surrounding region.—George S. Hunt, *School of Natural Resources, The University of Michigan, Ann Arbor, Michigan, 12 November 1962.*

A tropical feeding tree.—In the Department of Izabal, eastern Guatemala, 3 miles south of Matias de Galvez (Santo Tomás), I noted an unusual amount of bird activity in a particular fruiting tree in dense Caribbean rain forest. From late June to early August 1961, dozens of species of tropical birds were seen feeding on the red clusters of fruit and the associated insects. Other species seemed to be attracted to the area by the general activity.

The tree, identified as *Miconia trinervia* (Sw.) D. Don by Velva E. Rudd, associate curator at the United States National Museum, belongs to the family Melastomataceae, a group with only one genus (*Rhexia*) north of the tropics. About 75 feet tall, the tree stands on a small ridge in rich forest characterized by palm and ceiba trees. Rainfall in this area averages close to 200 inches annually.

Observations were made almost daily from 6 to 9 AM and occasionally later in the day. The greatest activity was noted in late June at the beginning of the observation period, with a progressive decline during the summer. Just after dawn was the preferred time but eruptions of activity occurred sporadically during the day, usually announced by the arrival of a band of Black-cheeked Woodpeckers (*Centurus pucherani*).

Following is a list of the species seen at the "feeding tree." The asterisk indicates forms observed eating the fruit of the tree. Parentheses indicate species recorded in the brush and on the forest floor at the base of the tree but not in the tree itself. With the exception of *Crypturellus soui*, *Heliomaster longirostris*, *Aulacorhynchus prasinus*, *Terenotriccus erythrurus*, *Cyanocorax yncas*, and *Ramphocaenus rufiventris*, specimens of each of these species were taken in the general area during the summer. No birds were collected while in the feeding tree.

(*Tinamus major*
Great Tinamou)
(*Crypturellus soui*
Little Tinamou)
Ortalis vetula
Plain Chachalaca
**Columba nigrirostris*
Short-billed Pigeon
**Claravis pretiosa*
Blue Ground-dove
Aratinga astec
Olive-throated Parakeet
Piaya cayana
Squirrel Cuckoo
(*Phaethornis superciliosus*
Long-tailed Hermit)
(*Phaethornis longuemareus*
Little Hermit)
Florisuga mellivora
White-necked Jacobin
Amazilia candida
White-bellied Emerald
Heliomaster longirostris
Long-billed Star-throat
**Trogon citreolus*
Citreoline Trogon
Aulacorhynchus prasinus
Emerald Toucanet
Pteroglossus torquatus
Collared Araçari
Ramphastos sulfuratus
Keel-billed Toucan
Celeus castaneus
Chestnut-colored Woodpecker
**Centurus aurifrons*
Golden-fronted Woodpecker
**Centurus pucherani*
Black-cheeked Woodpecker
Dendrocincla homochroa
Ruddy Woodcreeper
Xiphorhynchus flavigaster
Ivory-billed Woodcreeper
Microrhopias quixensis
Dot-winged Antwren
Attila spadiceus
Bright-rumped Attila
Rhytipterna holerythra
Rufous Mourner
Pachyramphus polychopterus
White-winged Becard
**Tityra semifasciata*
Masked Tityra

Pipra mentalis
Red-capped Manakin
**Manacus candei*
White-collared Manakin
**Myiodynastes luteiventris*
Sulphur-bellied Flycatcher
**Megarynchus pitangua*
Boat-billed Flycatcher
**Pitangus sulphuratus*
Great Kiskadee
Myiarchus tuberculifer
Dusky-capped Flycatcher
Terenotriccus erythrurus
Ruddy-tailed Flycatcher
Myiobius sulphureipygius
Sulphur-rumped Flycatcher
Oncostoma cinereigulare
Northern Bent-bill
**Psilorhinus morio*
Brown Jay
Cyanocorax yncas
Green Jay
(*Henicorhina leucosticta*
White-breasted Wood-Wren)
**Turdus grayi*
Gray-colored Robin
(*Ramphocaenus rufiventris*
Long-billed Gnatwren)
Hylophilus ochraceiceps
Tawny-crowned Greenlet
Hylophilus decurtatus
Gray-headed Greenlet
Cyanerpes cyaneus
Red-legged Honeycreeper
**Zarhynchus wagleri*
Chestnut-headed Oropendola
Dives dives
Melodious Blackbird
**Icterus prosthemelas*
Black-cowled Oriole
**Tanagra gouldi*
Olive-backed Euphonia
**Tangara larvata*
Golden-masked Tanager
**Thraupis episcopus*
Blue-gray Tanager
**Thraupis abbas*
Yellow-winged Tanager
Ramphocelus passerinii
Scarlet-rumped Tanager
Phlogothraupis sanguinolenta
Crimson-collared Tanager
(*Habia gutturalis*
Red-throated Ant-Tanager)
Saltator atriceps
Black-headed Saltator
**Caryothraustes poliogaster*
Black-faced Grosbeak
**Sporophila torqueola*
White-collared Seedeater
(*Arremon aurantiirostris*
Orange-billed Sparrow)

Of these 57 species, *Centurus pucherani* was the most common, often being present in flocks of a dozen or more individuals. Other regulars included *Columbia nigrirostris*, *Pitangus sulphuratus*, *Cyanerpes cyaneus*, and *Tanagra gouldi.* Since the feeding tree was only a few hundred yards from some abandoned brushy fields, it is not surprising to find several species feeding here that are characteristic of more open areas.—Hugh C. Land, *Department of Biological Sciences, Northwestern State College, Natchitoches, Louisiana, 12 December 1962.*

Mockingbird nesting in Spanish moss in Orange County, Florida.—For several days I noticed a Mockingbird (*Mimus polyglottos*) sitting in a myrtle tree that held a large clump of Spanish moss. Upon searching, I found that this bird had built a nest in the moss unsupported by any limbs of the tree. The nest contained only a very few sticks, and the cavity was formed of the usual rootlets, string, and a couple of strips of old rags. The entire nest was built down in a fold or pocket in the moss formed by a limb partly breaking off. Entrance was made through an opening in the side of the moss which made this nest invisible from all angles except when viewed through the opening. On 18 June 1962, this nest contained four fresh eggs.—Charles E. Carter, *1339 30th Street, Orlando, Orange County, Florida, 10 November 1962.*

A second probable hybrid between the Scarlet and Western Tanagers.—In 1950, I had the pleasure of figuring an unusual male tanager in postnuptial molt taken in Anoka County, Minnesota, on 17 August 1949. Subsequently, H. B. Tordoff (1950. *Wilson Bull.*, 62:3–4) indicated that the bird probably was a hybrid between the Scarlet (*Piranga olivacea*) and Western (*Piranga ludoviciana*) Tanagers. On 18 September 1951, Burt L. Monroe, Sr., took another unusual male tanager (Fig. 1) at Anchorage,

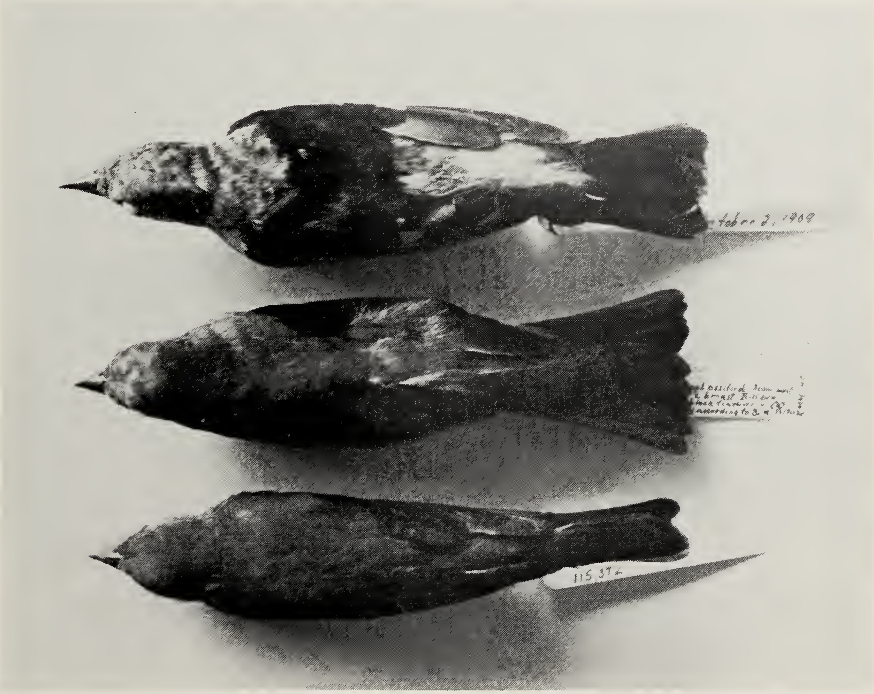

FIG. 1. Dorsal aspect of three adult male tanagers in fresh autumn plumage: from bottom to top, Scarlet Tanager; probable Scarlet × Western Tanager; Western Tanager.

Jefferson County, Kentucky, and kindly turned the bird over to me for preparation and study (R. M. M. original field catalogue No. 1409; specimen ultimately to reside in The University of Michigan Museum of Zoology). This specimen weighed 31.7 grams, was moderately fat, had the skull fully ossified, and showed some traces of molt (evident from inside the fresh skin) on the crown, upper back, and breast. Unlike those of the Minnesota specimen, the fresh flight feathers were all fully grown, and the contour feathers, whether or not quite full grown, were entirely fresh and of the incoming, or adult winter plumage (= definitive basic plumage of Humphrey and Parkes, 1959. *Auk*, 76:16). The testes were small, measuring approximately 2 × 1 mm.

As does the Minnesota bird, the Kentucky specimen resembles the Western Tanager in certain respects, although both clearly show more resemblance to the Scarlet Tanager. The pertinent points of difference between the (presumed) parent species in fresh autumn plumage, with the condition of the corresponding characters in the two specimens here discussed, are shown in Table 1.

TABLE 1

CERTAIN DIFFERENCES BETWEEN SCARLET AND WESTERN TANAGERS, WITH INDICATION OF INTERMEDIACY SHOWN BY TWO PUZZLING SPECIMENS

Region	*Piranga olivacea*	*Piranga ludoviciana*	Minnesota male	Kentucky male
Crown	Uniformly olive or olive-gray	Clear yellow, tinged anteriorly with orange-red; feathers sometimes tipped with blackish or dusky	Indications of incoming feathers are that the crown would have been uniformly olivaceous, but with some dusky-tipped feathers	Olive-gray blotched anteriorly with orange-yellow; faint traces of dusky tips on some feathers
Interscapular area and rump	Uniformly olive or olive-gray	Black, from near bend of wing to upper rump; rump clear yellow	Olivaceous, broadly blotched with black; rump yellowish	Olivaceous, some feathers lightly tipped with scattered black; rump blotched with light orange-yellow
Underparts	Pale lemon yellow, tinged with olive on flanks and sides of breast; dull olivaceous band across breast	Bright cadmium yellow, tinged on throat, jugular area, and upper breast with orange; no breastband	Incoming feathers indicate pale yellow; breastband indistinct if present	As in *olivacea*, but with blotches of orange-yellow on throat, breast, and flanks; breastband obsolete
Inner secondaries (tertials)	Black	Black, broadly tipped with white	Outermost tertial (only) with narrow white tip	Black
Middle secondary coverts	Black*	Entirely bright yellow	Narrowly tipped with olive-yellow	Black
Tip of tail	Black	Narrowly tipped with white	Black	Black
Depth of bill at base	8.9–9.7 mm (avg. of 14, 9.4 mm)**	7.0–8.6 mm (avg. of 12, 8.1 mm)**	8.1 mm	9.0 mm

* Occasional specimens have these feathers narrowly tipped with cadmium yellow (such are University of Kansas Museum of Natural History No. 16765, Douglas County, Kansas, 9 May 1927; and K.U. 12498, "Yucatan, G. F. Gaumer," no other data). It is commonly stated that the occasional occurrence of this character is "normal" for the species, but I am not aware that its geographic distribution or frequency of occurrence has been ascertained.

** Ridgway, *U.S. Nat. Mus. Bull.* 50, Pt. 2, 1902, pp. 89, 93.

Considering the points of the table where either bird shows intermediacy, we see that the Minnesota specimen more nearly approaches the Western Tanager in the interscapular area and in depth of bill, whereas the Kentucky bird more nearly resembles it in the condition of the crown and underparts. The Minnesota bird, additionally, shows some approach to *P. ludoviciana* in the marking of the tertials and middle coverts, where the Kentucky bird does not. The specimen from Kentucky is intermediate, therefore, in three characters, while the Minnesota bird, being intermediate in five, must be adjudged as morphologically somewhat closer to *P. ludoviciana.* An additional point concerning the Kentucky bird is that, according to Monroe, its call notes were distinctly odd for a Scarlet Tanager. Although the songs of the Scarlet and Western Tanagers are rather similar, the call notes, as rendered by Peterson (1960. "A Field Guide to the Birds of Texas," Boston; pp. 235–236), differ, being *pi-tac* or *pit-i-tic* in the Western Tanager, and the familiar *chip-burr* well known to most eastern ornithologists (including Monroe) in the Scarlet Tanager.

No further reports of this presumed cross have come to my attention, and only the above-mentioned published record was listed by A. P. Gray (1958. "Bird Hybrids," Bucks, England, Commonwealth Agric. Bur.; p. 243).

We can, of course, only guess at the events resulting in the two birds discussed. The totality of their characters suggests to me that, if resulting from hybridization, which I think probable, they are not first-generation hybrids. It is more probable that they resulted from backcrossing or even more remote genetic interchange. Taken together, they reinforce the obvious probability that, like various other North American east–west allopatric pairs of species, the Scarlet and Western Tanagers are descendants from a common ancestor of the not-too-distant past. It is therefore possible not only that occasional hybrids occur, but also that random mutations of appropriate alleles could produce phenotypes in either species resembling the other in various characters.—Robert M. Mengel, *Museum of Natural History, University of Kansas, Lawrence, Kansas, 18 February 1963.*

Interspecific relations among Red-bellied and Hairy Woodpeckers and a flying squirrel.—While watching a pair of nesting Red-bellied Woodpeckers (*Centurus carolinus*) during May and June 1962, about 2 miles south of Carbondale, Illinois, conflict between them and a southern flying squirrel (*Glaucomys volans*) was observed. Concurrent with this conflict but also considered important was continual competition between this pair and a pair of Hairy Woodpeckers (*Dendrocopos villosus*).

The pair of Red-bellied Woodpeckers had completed excavation and had laid their eggs before the Hairy Woodpeckers showed an interest in nesting in the same snag (about 10 feet above the cavity of the former pair). During subsequent observations (covering a span of 38 days) of the incubation and nesting periods of both species, the Red-bellied Woodpeckers were subject to constant harassment by the Hairy Woodpeckers, but did not respond similarly. Grimes (1947. *Fla. Nat.*, 21:1–13), however, has reported a probable case of destruction of nestling Hairy Woodpeckers by a male Red-bellied Woodpecker.

One morning halfway through the nestling period of the Red-bellied Woodpeckers, the male, after feeding the young, moved up the trunk and midway between his cavity and that of the Hairy Woodpeckers began to pull dead grass and leaves from an old excavation that had been broken through at the bottom. Immediately, he was attacked by a flying squirrel roosting there. The bird, however, returned to his young when the squirrel started down the tree in that direction. When the female came to feed the young, the male again attacked the squirrel at its cavity. At one point, he grabbed the mammal by its tail and threw it off the tree—a fall of about 30 feet. The squirrel immediately returned to its hole. The male bird then broke off the altercation while he and his mate dodged repeated attacks by the Hairy Woodpeckers. Subsequently, he and his mate flew off to scold a third Red-bellied Woodpecker that had started calling nearby. Presently, the female returned and then she, too, attacked the mammal at its cavity. Finally, after she had also tossed the squirrel from the tree, it scampered up the snag and glided off to the north. Throughout this observation the squirrel was not attacked by the Hairy Woodpeckers. During a half-dozen subsequent observation periods, over the next 11 days, the flying squirrel was not seen again.

Reports of aggressive behavior of Red-bellied Woodpeckers toward other species of woodpeckers are numerous. McGuire (1932. *Wilson Bull.*, 44:39) described a conflict with a Yellow-bellied Sapsucker (*Sphyrapicus varius*) over food. Grimes (loc. cit.) reported competition with Red-cockaded Woodpeckers (*Dendrocopos borealis*) as well as Hairy Woodpeckers over cavities. Selander and Giller (1959. *Wilson Bull.*, 71:107–124) described conflicts with the closely related Golden-fronted Woodpecker (*Centurus aurifrons*) over territories. Kilham (1961. *Wilson Bull.*, 73:237–254) noted aggressive behavior of Red-bellied Woodpeckers directed toward a female Pileated Woodpecker (*Dryocopus pileatus*) under confined conditions. I have observed aggressive behavior of Red-bellied Woodpeckers directed toward Yellow-shafted Flickers (*Colaptes auratus*) over both nesting and roosting holes.

On the basis of this information, one wonders why the observed pair of Red-bellied Woodpeckers tolerated the Hairy Woodpeckers while not tolerating the flying squirrel. It may be speculated that the relative distances of the other two species from their nest hole was a factor. However, flying squirrels frequently compete with woodpeckers for their holes and occasionally eat nestling birds (Calahane, 1947. "Mammals of North America." Macmillan Co., N.Y.:421–422). Therefore, the relative distances of the three species from one another could not be the only factor controlling the described relationships.—David W. Stickel, *Zoology Department, Southern Illinois University, Carbondale, Illinois, 4 January 1963.*

Le Conte's Sparrow wintering in northern Illinois.—On 16 January 1954, I collected a male Le Conte's Sparrow (*Passerherbulus caudacutus*) in a fallow oat-stubble field about 1 mile south of Glenwood, Cook County, Illinois. Although the species is common during fall migration in this area, it has never been noted there in midwinter before.

Ford (1956. "Birds of the Chicago Region," *Chicago Acad. Sci. Spec. Publ.* No. 12:88) lists 15 October as the latest fall migration record for the Le Conte's Sparrow and, according to Nice and Clark (1950. "William Dreuth's Study of Bird Migration in Lincoln Park, Chicago," *Chicago Acad. Sci. Spec. Publ.* No. 8:26), 12 October is Dreuth's latest fall date for the species. Although the Fifth Edition of the A.O.U. Check-list records the Le Conte's Sparrow as wintering occasionally in southern Illinois, Smith and Parmalee (1955. "A Distributional Check-list of Birds of Illinois," *Ill. State Mus. Popular Sci. Series*, 4:56) regard it only as a migrant. It appears, then, that this is the first and heretofore only record of the Le Conte's Sparrow wintering in northern Illinois.

The specimen is now deposited in the United States Fish and Wildlife Service Collection, U.S. National Museum.—Seymour H. Levy, *Route 9, Box 960, Tucson, Arizona, 30 October 1962.*

Behavior of Peruvian Martins on warm surface.—At 2 PM on 29 October 1961, more than 30 Peruvian Martins (*Progne modesta*) circled about the plaza in Chorrillos, a seaside municipality adjoining Lima, Perú. Singly, with on-the-wing dips (and sips?), they breasted gently welling water of a fountain bowl, flew toward the sunny side of a building on the plaza, and alighted on a stucco ledge about 6 inches wide that crossed the two-story wall 4 feet below the roof line.

Some 20-odd birds were on the ledge in various sunning attitudes (Hauser, 1957. *Wilson Bull.*, 69:78–90), as others came and went. Noisy wrangles broke out when new arrivals sought places. Birds did not appear wet, but an arriving bird would scratch (indirectly) and pick at itself momentarily, then suddenly spread out as flat as space permitted. Or, it might roll sideward, fluffing breast and belly toward the light, bill open and eye to the sun.

Individuals made three or more posture changes, including complete collapse (neck and bill tip, folded wings and tail, all, lax upon the ledge). Many rested with tail fanned and head either uplifted or resting on substratum. So narrow and crowded was the shelf that birds in full spread lay with most of one wing extended down over the edge and the other one stretched up at a right angle against the wall. Seldom did a bird find room to spread its wings along the ledge with tail out nearly full-length over space.

They posed with little movement. There were impressive moments when the whole posturing company lay stone still. Some were timed motionless 1½ minutes. The contour feathers were raised in all poses and breast and belly feathers invariably were close upon the warm surface. Contact of median skin seemed likely when, as viewed from below with binoculars, belly plumage was parted lengthwise over the edge of the ledge.

Birds perching on nearby wires preened but never postured. The flat rooftops were ignored. I watched the martins 20 minutes, making notes and sketches. Activity continued as I left. At 4 PM, I found 2 feet of the ledge in leaf shadows and the remainder shaded by a building. In that spot of partial sun seven martins preened without posturing. Otherwise, the shelf was vacant, and few birds remained in the area.

Whether surface temperature is more important than light in releasing such behavior, already known for Hirundinidae, seems a moot point (Whitaker, 1960. *Wilson Bull.*, 72: 403–404). In this case the air was cool; concrete surfaces in sun were very warm but not uncomfortably so. Lima, on a coastal plain cooled by the Humboldt Current, has annual temperature extremes of about 56–81 F. October and November initiate the sunny season, with temperatures of 57–72 F. At this latitude (12° S) the sun is strong.—LOVIE M. WHITAKER, *1204 West Brooks Street, Norman, Oklahoma, 18 January 1963.*

Late spring record of the Common Redpoll in northern Illinois.—On 10 May 1956, a female Common Redpoll (*Acanthis flammea flammea*) was collected in a weed field about 1 mile south of Glenwood, Cook County, Illinois. The specimen is now in the Fish and Wildlife Service Collection, United States National Museum.

Although the Common Redpoll is a fairly regular winter visitor to northern Illinois, records of late spring occurrence are rare. While Ford (1956. "Birds of the Chicago Region," *Chicago Acad. of Sci.*, Spec. Publ. No. 12:85) lists 6 May as late for the species, Smith and Parmalee (1955. "A Distributional Check-list of Birds of Illinois," *Ill. State Museum*, Popular Sci. Series 4:54), and Clark and Nice (1950. "Wm. Dreuth's Study of Bird Migration in Lincoln Park, Chicago," *Chicago Acad. of Sci.*, Spec. Publ. No. 8:26) give 7 March and 3 March, respectively, as the last spring date recorded.—SEYMOUR H. LEVY, *Route 9, Box 960, Tucson, Arizona, 20 January 1963.*

Ruffed Grouse from the Pleistocene of Saskatchewan.—Through the courtesy of Bruce McCorquodale, Curator of Paleontology at the Saskatchewan Museum of Natural History, I have identified several fossil bones of the Ruffed Grouse (*Bonasa umbellus*) collected by Bernard De Vries of Ft. Qu'Appelle, Saskatchewan, from a gravel pit in the Qu'Appelle valley near the town of Ft. Qu'Appelle. Specimens include the proximal portions of a left and right scapula, left and right coracoids, left radius and ulna, and the shaft of a right humerus (SMNH 1188–1194) probably from a single individual. The fossils came from a sand deposit intercalated between overlying till and the underlying Echo Lake gravels. The age of the deposit is considered not older than Sangamon and maybe Wisconsin. Associated mammals include the Pleistocene muskox, horse, mammoth, camel, and bison. The presence of the Ruffed Grouse suggests woodland conditions near the site of deposition.

Few fossil birds are known from Canada and this is the first record for the Province of Saskatchewan. Previously the Ruffed Grouse was known fossil only from the Pleistocene of Arkansas, California, Maryland, Pennsylvania, Tennessee (Wetmore, 1956. *Smiths. Misc. Coll.*, 131 (5):52; Wetmore, 1959. *Wilson Bull.*, 71:182), and Florida (Brodkorb, 1959. *Bull. Fla. State Mus.*, 4:276). Dr. E. R. Hall of the Kansas Natural History Museum, Dr. Horton Hobbs, Jr., of the U. S. National Museum, and Kenneth E. Stager of the Los Angeles County Museum kindly loaned comparative material. —Robert D. Weigel, *Illinois State Normal University, Normal, Illinois, 2 August 1962.*

ORNITHOLOGICAL NEWS

On 14 December 1962 Dr. Roger Tory Peterson, currently First Vice-President of the WOS, received an Honorary D. Sc. from Ohio State University (Columbus, Ohio). The citation describes Dr. Peterson as a "conservationist and student of nature whose dedication, observation and artistry have enriched the lives of men by opening to the world the joys of an informed appreciation of birds and other wildlife." The citation then lists his awards and books, and closes: "Largely because of this man, the study of nature has become the pursuit and hobby of millions of persons in many countries. His distinguished work has been a major force in bringing diverse peoples more closely together in mutual appreciation of nature and of each other."

The National Science Foundation announces that the next closing date for receipt of basic research proposals in the life sciences is 15 September 1963. Proposals received prior to that date will be reviewed at the fall meeting of the Foundation's advisory panels, and disposition will be made approximately four months following the closing date. Proposals received after the 15 September 1963 deadline will be reviewed following the winter closing date of 15 January 1964.

The next closing date for receipt of proposals for renovation and construction of graduate-level research facilities is 1 December 1963.

Inquiries should be addressed to the National Science Foundation, Washington 25, D.C.

The Forty-fifth Annual Meeting of the Wilson Ornithological Society will be held at Western Michigan University in Kalamazoo, Michigan, from 30 April to 3 May 1964.

NEW LIFE MEMBER

Thomas R. Howell, of Los Angeles, California, an active member of the Wilson Ornithological Society since 1947, is now a Life Member. He received his B.S. degree from Louisiana State University and his M.A. and Ph.D. degrees from the University of California at Berkeley. Dr. Howell, an Associate Professor of Zoology at the University of California, is interested in avian taxonomy and distribution (of birds of Nicaragua, at present), behavior, and physiological ecology.

Most of Dr. Howell's papers have appeared in *The Condor*, but some were published in *The Auk*, *The Wilson Bulletin*, and *The Ibis*. He is currently President of the Board of Governors of the Cooper Ornithological Society, a Fellow of the AOU, a member of the Council of the AOU, and a member of the BOU and of the Deutschen Ornithologen-Gesellschaft.

KIRTLAND'S WARBLER MANAGEMENT

Robert Radtke and John Byelich

The Kirtland's Warbler (*Dendroica kirtlandii*) is a rare and perhaps vanishing songbird. Like the Ivory-billed Woodpecker and the California Condor, it has become adapted to certain environmental conditions that are now limited in extent. This warbler is perhaps the first songbird on which a census of the entire population was conducted throughout the nesting range (Mayfield, 1953:17–20; 1962:173–182). It is also the first songbird for which intensive forest management has been applied.

The objective of this paper is to report what is currently being done by the Michigan Department of Conservation and the U.S. Forest Service to assist the Kirtland's Warbler. Two major topics are covered here: One, how special management areas for the bird fit into the overall resource programs of the Conservation Department and Forest Service and, two, how silvicultural and land management practices are being modified to assist this bird.

We are indebted to Mr. Harold Mayfield, the late Josselyn Van Tyne, and others mentioned in Mayfield's report (1963) for their research on this species. Their studies have provided much essential background information required to develop and maintain suitable habitat for the birds.

MANAGEMENT OBJECTIVES

The primary objective for the establishment of special management areas is to maintain, continuously, areas of forest land to provide for the habitat requirements of the Kirtland's Warbler during the nesting season. Normally, the range of this songbird is limited to blocks of extensive natural jack pine stands over 80 acres in size. It may inhabit red pine or jack pine plantations. Almost without exception, this songbird can be found only in homogeneous blocks of jack pine varying from 5 to 15 feet in height and occurring in a "patchy" condition of dense stands interspersed with nearly an equal area of small openings. "The crucial requirement appears to be not the *height* of the trees, but the presence of living pine-branch *thickets* near the ground" (Mayfield, 1960: 14).

These habitat requirements of the bird created a few problems. How can proper interspersion of openings and various densities of jack pine be arranged in an area of sufficient size for the Kirtland's Warbler? And, at the same time, how can the entire unit be managed on the basis of sound forestry practices?

Basically, any suitable area should be subdivided into a series of management units, each at least 80 acres in size, and on which even-aged coniferous stands can be managed on a commercial rotation. The areas should be managed for a sustained yield, or continuous supply of suitable habitat.

Although the objectives of both agencies will be the same, that of producing desirable warbler nesting habitat, the methods each will use to accomplish this goal varies somewhat. Both will coordinate the wildlife objective (suitable warbler nesting habitat), with timber production, watershed protection, and recreation. The establishment of these areas has not eliminated the production of other forest resources. In fact, commercial harvest of timber makes possible the economic development of these special areas. Thus, the areas represent good examples of multiple use, a basic principle guiding the use of both state and federal lands.

MANAGEMENT

The primary difference in approach used by the State Conservation Department and the Forest Service is the method by which jack pine regeneration will be accomplished. Special planting techniques will be used on state lands to produce the desired habitat. The Lower Michigan National Forest will attempt to create the essential habitat primarily by controlled or "prescribed" burning. Today it is not known whether one management system will be more effective than another. These separate approaches, however, should result in valuable information concerning future habitat management practices. A brief description of the major habitat management efforts is offered here, together with comments on evaluating the need for reducing competing cowbirds and maintaining cooperation of the public to help insure survival of the Kirtland's Warbler.

MANAGEMENT AREAS

The Kirtland's Warbler nests in scattered locations in the northeastern part of Michigan's Lower Peninsula. Much of this warbler's existing range lies within public lands administered by the Michigan Department of Conservation or the U.S. Forest Service. Both agencies are in an excellent position to adjust forest management practices on portions of their lands to maintain suitable nesting habitat for this songbird.

In 1957 the Michigan Conservation Commission formally established three warbler management areas. Each one is four square miles (total of 7,680 acres) in size. Several areas, located in a number of counties and having different types of habitat, were designated to provide better chances for success and to obtain information for future management. All areas have been mapped in detail showing tree species, density of stands, size of trees, uniformity of cover, approximate time for harvest, and acreage of each type.

The field survey indicates the Ogemaw County area presently contains the best Kirtland's Warbler habitat, attracting 58 singing males. All of the birds were recorded in the south half of the area.

The Crawford County area is predominately open grassland with a few scattered stands of medium-sized jack pine. Warblers occur in limited numbers. Habitat is underdeveloped and requires improvement through planting.

The Oscoda County area supports a heavy stand of older jack pine. In the past this area carried a good population of Kirtland's Warblers, but there are none there today. This stand requires severe disturbance to improve the habitat.

In 1962, the 4,010-acre Kirtland's Warbler Management Area was established by the Lower Michigan National Forest. The area contains various-age jack pine timber, and has a good warbler population of 32 singing males on approximately 600 acres of suitable breeding habitat. The combined 11,690 acres of public land provide sites where this warbler will be given special encouragement in future years.

These State and Federal lands are established as management areas. They are not what we normally think of as a preserve or sanctuary. Each management area is large enough to maintain portions in varying successional stages, ranging from openings to merchantable trees. A part of each area should always provide suitable warbler breeding habitat.

CONTROLLED BURNING

Historically, wildfires have been the most important factor in the establishment of natural jack pine. The jack pine "plains" of northern Michigan were undoubtedly created by fire. Extensive areas of slash were produced during the turn of the century when lumbering was at its peak. Unimpeded fires swept through this slash, burning over

Fig. 1. Jack pine plains following the 1946 forest fire in the Mack Lake Area, Oscoda County, Michigan. The area does not provide breeding habitat for the Kirtland's Warbler.

much of the northern Lower Peninsula of Michigan. These early fires also played an important part in preserving this bird since, "under natural conditions, the habitat of the Kirtland's Warbler is produced only by forest fires" (Mayfield, 1960:23).

Serious efforts to control forest fires in Michigan began in 1927. The average Michigan fire burned more than 300 acres. Today this figure has dropped to less than 15 acres. Intensive forest management requires greater fire protection. Although the possibility of a large fire always exists, modern detection and control methods greatly curtail the chances of any large-scale forest fire. For example, only one large fire has occurred on the Huron National Forest since the early 1930's. In 1946, a series of fires occurred early in April, as a result of very strong winds and unusual burning conditions. These fires produced much of the suitable habitat that now exists (Figs. 1–4). In a few years, the habitat created by these fires will no longer be suitable for this warbler.

What then is the future of the Kirtland's Warbler in light of future forest fire control objectives? Few fires are likely to reach such size that they will create suitable nesting habitat for Kirtland's Warblers.

Although "wild" fires are undesirable, fire used at the proper time and under controlled or prescribed conditions can be a useful tool to the forest manager. The use of controlled burning in the regeneration, or modification, of certain timber types has become of increasing interest to the forester and wildlife biologist. It is being used more and more in efforts to regenerate jack pine following harvest of the mature timber. The Michigan Department of Conservation has pioneered in the use of fire for the improvement of game habitat.

Jack pine will not grow under dense shade. It is also a "fire species." Most cones of this tree exhibit the characteristic known as serotony. The cones do not open under normal temperature conditions; to release seeds for regeneration, high temperatures, such as those produced during a forest fire, are necessary to open them. Through fire,

Fig. 2. Jack pine "snags" left standing after the 1946 Mack Lake Forest fire, Oscoda County, Michigan. The cones have opened and released their seed. Regeneration of jack pine has begun. This early successional stage is of little value to the Kirtland's Warbler as breeding habitat.

the seeds are released from the cones and permitted to germinate. Competition from other plants is also reduced by the fire.

To be a useful tool, however, controlled burning must release the seed, but not destroy its viability. With adequate precautions, controlled burning can be accomplished with safety to achieve regeneration. The Kirtland's Warbler Management Area was set up by the U.S. Forest Service to facilitate controlled burning operations. Twelve units of about 320 acres each, cut on a 55–60 year rotation, have been established so that one unit will be cut every five years. Selected seed trees (15–20 per acre) are now being marked in two units. Cutting began during the winter of 1962–63. Controlled burning operations have been scheduled for the spring of 1964. This area should provide suitable habitat before the existing habitat in the adjoining areas becomes unacceptable to the warblers.

SILVICULTURE

Jack pine occupies nearly one million acres of forest land in Michigan. It is an economically important tree, used chiefly for the production of paper products. Many cut-over jack pine stands have failed to regenerate within a reasonable length of time. Although these sites can be planted, it is an expensive program, costing $25.00 to $30.00 per acre. The most economic solution lies in successful regeneration through new and improved management techniques, including controlled burning.

At present, controlled burning is not a regular management tool. Research now in progress could lead to its use as a management technique in the future, which in turn might provide additional nesting habitat. The Kirtland's Warbler has never been found in an area which has been kept free of fire following timber cutting. More important, present logging operations do not occur over large solid blocks, but are generally

Fig. 3. Natural regeneration of jack pine six years after the Mack Lake fire, Oscoda County, Michigan. Trees are 3 to 5 feet high, and just beginning to provide Kirtland's Warbler breeding habitat.

distributed in units ranging in size from 40 to 80 acres. Different timber types or age classes of jack pine exist in most cutting units. The residual stand, following normal cutting practices, contains numerous non-merchantable trees. These residual trees, and the variety of timber types which exist in an area, make normal timber cutting areas unsuitable for the Kirtland's Warbler. Thus, it was necessary to establish special management areas for this songbird.

PLANTING

The Kirtland's Warbler has, at times, nested in extensive jack and red pine plantations. Existing plantations which now provide suitable habitat will soon pass the stage of growth acceptable to this warbler. Extensive open areas, suitable for planting, no longer exist.

Natural jack pine stands are preferred to planted jack or red pine. Jack pine occurs in dense "thickets" interspersed with small openings. These stands maintain their lower branches, providing cover near the ground. Such areas may provide habitat as early as 5 years and as late as 20 years of age. When the trees are 15 to 20 years old (about 15 feet high) the lower branches begin to die and the area is no longer used by the warbler.

Plantations at their normal spacing of 6×6 feet do not produce suitable thickets where branches touch until they are 6 to 7 feet tall (about 10 years old). In forest plantations there are few openings. Shortly after the plantation becomes dense enough to provide suitable habitat the lower branches begin dying and the area is no longer used.

Planting configuration and density, however, can be altered to provide nesting cover that should persist as long as natural stands (10–15 years). Portions of two of the three state management areas have been planted in an effort to duplicate conditions found in a natural stand. Other species of conifers are being planted to determine if this warbler

FIG. 4. Nine years after the forest fire in the Mack Lake Area, Oscoda County, Michigan; jack pines are 6 to 8 feet in height, dense, with lower branches reaching the ground. Scattered openings exist. The area provides optimum Kirtland's Warbler breeding habitat.

will nest in spruce thickets, for example, as readily as jack pine. "It seems probable that plantings of other needle-bearing trees might be equally acceptable to the warbler. As Odum (1945:197) has pointed out about birds in general, the requirement of the Kirtland's Warbler probably is a certain 'life form,' not a species of plant" (Mayfield, 1960: 16).

The state management areas contain primarily young growth, which at present, is too small to provide ideal nesting habitat. These areas should begin to provide ideal habitat in the near future.

COOPERATION

The development of these management areas is dependent upon funds to undertake the necessary improvement work. Fortunately, they can be managed for multiple-use benefits. Adjustments in the normal timber cutting methods can be made with minimum loss to timber value. Therefore, much of the development can be accomplished under normal timber sale procedures. Special jobs, such as the removal of non-merchantable trees, hardwood brush control, and controlled burning, which ordinarily is not a part of normal jack pine management, will be the responsibility of the wildlife management programs of the state and the U.S. Forest Service. The U.S. Forest Service has suggested that a special project of this nature be assisted by groups primarily interested in the survival of this bird. The Michigan Audubon Society, Pontiac Audubon Society, Detroit Audubon Society, and the Michigan Natural Areas Council have signed a Cooperative Agreement to assist the U.S. Forest Service in the development of this area.

The question might arise whether or not dedicating these special areas might create excessive use by the public and be detrimental to this warbler. We do not believe this will happen. The type of person who may be willing to make a special trip to see this bird is likely to be well informed about birds, and an "ultra-conservationist" in his viewpoint. The individual observer would probably do little or no harm. Of some concern would be large groups, or photographers, who, if not careful, could cause the abandonment of nests.

The Kirtland's Warbler Management Area, on National Forest lands near Mio, will be marked with signs. People will be allowed access, but only by permit. It is not the intent of the U.S. Forest Service to prohibit access, but to control large groups, photographers, or use of the area which might be detrimental to this bird. Another objective will be to secure some accurate visitor-use data for the area. Restrictions on the Kirtland's Warbler Management Area will apply only during the nesting season (1 May to 15 August). The area will be adequately posted—including several large rustic-type signs which will outline the objectives of the area, and list the cooperating groups. A small brochure is planned for distribution by the Department of Conservation and U.S. Forest Service to satisfy the numerous requests for information about this bird.

COORDINATION

Projects of this nature require coordination between the other forest resources. Some of the coordination with timber and fire control, has already been mentioned. Several other important considerations involve mineral leasing and recreational use of the land.

Special use development, such as mineral leasing, must necessarily be limited in these areas. Oil and gas lease permits have been prohibited on federal lands where active Kirtland's Warbler colonies are known to exist. Of invaluable assistance are the data from the 1961 warbler census, since the location of all nesting birds is known. Minerals, such as oil and gas are important resources. Their removal by such means as directional drilling can be permitted, since this will not conflict with the primary purpose for which these areas are to be managed.

Scenic roadside zones, which are a normal management consideration along routes of travel, will be eliminated on these areas. This is necessary to permit the extensive homogeneous tracts desired by the bird. Hunting and other recreational uses, such as blueberry picking, which occur after the warbler's breeding season will not be restricted. The Game Division feels that creating and maintaining these management areas will also benefit deer by the openings provided.

Although this warbler is not now threatened with extinction, because of lack of suitable nesting territory, it is very rare (about 1,000 birds). Changing conditions might reduce this bird toward the vanishing point in the future. It is the hope of both the Michigan Department of Conservation and the U.S. Forest Service that these management areas will provide some measure of assurance that this species will not disappear.

COWBIRD CONTROL

Cowbird parasitism is a major deterrent to warbler survival. ". . . the cowbird causes the loss of about 43 per cent of all Kirtland's Warbler eggs between laying and fledging, in nests not destroyed or abandoned" (Mayfield, 1960:177). Some control of the cowbird is anticipated, although there are, as yet, no definite plans. Research is needed to find an adequate method of control.

SUMMARY

The Kirtland's Warbler is a rare and possibly vanishing songbird. It will probably always remain rare because of its exacting requirements for nesting habitat.

Management areas have been established by the Michigan Department of Conservation

and the U.S. Forest Service where habitat will be developed to maintain areas attractive to the Kirtland's Warbler. These areas will be managed on sound multiple-use and sustained-yield principles, with recognition being given to the various other forest resources.

Special planting and controlled burning techniques will be employed to produce the required nesting habitat on a portion of each management area. With the cooperation of various conservation groups it is hoped that these areas will provide some measure of assurance that this songbird will not become extinct.

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U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, MILWAUKEE, WISCONSIN, AND MICHIGAN DEPARTMENT OF CONSERVATION, MIO, MICHIGAN, 15 FEBRUARY 1963

ESTABLISHMENT OF PRESERVES FOR THE KIRTLAND'S WARBLER IN THE STATE AND NATIONAL FORESTS OF MICHIGAN

Harold F. Mayfield

The recent establishment of areas in northern Lower Michigan by the Michigan Department of Conservation and the U.S. Forest Service to be managed for the benefit of the Kirtland's Warbler (*Dendroica kirtlandii*) is perhaps the first such step anywhere in the world for a single songbird species. Therefore, an account of this unique accomplishment may be helpful to others planning a similar move elsewhere.

The Kirtland's Warbler is a bird of exceptional interest. It is distinctive in appearance and voice. Although a member of a large and successful family, the North American wood warblers, the species is extremely rare (about 1,000 individuals). In the nesting season it inhabits such a narrow and transitory habitat niche that the slightest alteration in conditions holds instant threat to the existence of the bird. Indeed, the march of civilization has brought threatening changes.

First, the clearing of the original forests for agriculture probably made possible the advance of the Brown-headed Cowbird (*Molothrus ater*) from its ancestral home in the grasslands of the mid-continent to the Michigan nesting grounds of the Kirtland's Warbler during the latter part of the last century. This social parasite takes a toll from the warbler at every stage of the nesting process—through loss of eggs removed by the cowbird, through reduction of hatching success of warbler eggs in the presence of the larger cowbird eggs laid in the warbler nests, and through lowered survival of warbler nestlings in the presence of much larger cowbird nestlings. The Kirtland's Warbler seems to have developed no defense against this new enemy.

Second, better control of forest fires is steadily reducing large burns that in the past have produced extensive tracts of young jack pine (*Pinus banksiana*), which provided the nesting habitat of the Kirtland's Warbler.

Third, modern lumbering and tree-planting practices do not promise to reproduce a suitable habitat for the Kirtland's Warbler. Tracts are seldom cut clean and the ensuing growth is not all of one size; and the areas planted at one time are usually smaller in extent than those required by the warbler. Also there is uncertainty that repeated cutting and planting, without fire, will keep the ground cover between the trees at the low level required by the warbler.

The bird winters only in the Bahama Islands, but its problems of survival there are totally unknown.

The move to create a preserve for this bird began in 1955. In July and again in August of that year, I wrote Josselyn Van Tyne, Curator of Birds at the University of Michigan Museum of Zoology, who was the leading student of the Kirtland's Warbler, suggesting that certain State Forest lands be set aside as Kirtland's Warbler preserves. Among the arguments I advanced were the following: We should not leave the future of the Kirtland's Warbler to the chance occurrence of forest fires nor the shifting practices of forestry; if a disastrous change in habitat conditions occurred, it might not be recognized in time to set in motion the slow processes of repair; a management area would provide exceptional opportunities for experimentation with habitat; various public agencies would take more interest in this bird if they were actively participating in a program on its behalf; it would be desirable to provide an observation area so that interested people could see the bird easily and so that more people could become aware of its esthetic value and survival problems (a view not shared by all my friends).

Van Tyne replied that men in the Game Division of the Michigan Department of Conservation had already mentioned to him the feasibility of controlled burning for this purpose, and he felt they would view favorably a further suggestion from him in this direction. But Van Tyne began to fail in health not long afterward (he died 30 January 1957), and I do not believe he was able to follow through with this approach.

MICHIGAN STATE FORESTS

Among the other friends with whom I discussed this idea was Fenn M. Holden, who spends his summers near Grayling, Michigan, in the Kirtland's Warbler region. In June 1956, he wrote that he had been at a dinner party with George A. Griffith of Grayling, member of the Michigan Conservation Commission, and that he had broached this idea to Griffith, who immediately expressed interest in presenting it at the July meeting of the Commission. At Holden's suggestion, I wrote Griffith, outlining the proposal in more detail.

I regarded this step merely as the planting of a seed. In fact, I had expressed the opinion to Van Tyne that an idea of this kind might require years for digestion and for mobilizing of favorable sentiment.

Therefore, I was astonished to receive a letter on 23 July 1956, from G. S. McIntire, Chief of the Forestry Division, stating that the proposal to create a preserve for the Kirtland's Warbler had been adopted unanimously by the Commission and that his Division had been given the responsibility for carrying it out. He asked for further suggestions.

At this time Donald W. Douglass, In Charge, Advisory and Technical Staff, Game Division, a friend of long standing with a deep interest in the Kirtland's Warbler, began serving unofficially as our guide among the various agencies of the Conservation Department. His counsel was invaluable in many ways. He urged that a bridge to the public be established and suggested that the Michigan Audubon Society appoint a committee to advise the Conservation Department on this project. President Edward M. Brigham of that society asked me to continue my efforts as chairman and named the following additional members: Andrew J. Berger, Verne Dockham, Fenn M. Holden, and Josselyn Van Tyne. In September 1957, after Van Tyne's death, Lawrence H. Walkinshaw and Douglas S. Middleton, long-time students of the bird, joined the Kirtland's Warbler Preserve Committee, and this group continues to serve at the present time.

I met with officials of the Department of Conservation in Lansing in October, and soon thereafter the committee set to work to choose the most promising sites. Dockham, conservation officer at Mio near the center of the Kirtland's Warbler region, was assigned by the Department to conduct reconnaissance. But, as he retired from the Department at the end of 1956, John Byelich and Lawrence Ryel of the Game Division lent their assistance. Finally, in June 1957, these men, with Holden, went over the most promising areas again and made their recommendations to the committee. All of the other members, including Walkinshaw and Middleton, who were to be appointed to the committee in September, were able to visit the chosen areas in the course of field work during the summer.

The committee submitted a formal report to McIntire on 25 July 1957, suggesting three areas in separate counties and forest districts: (1) Crawford County near Lovells (Sec. 5, 6, 7, 8, T28N, R1W); (2) Oscoda County near Red Oak (Sec. 11, 12, 13, 14,

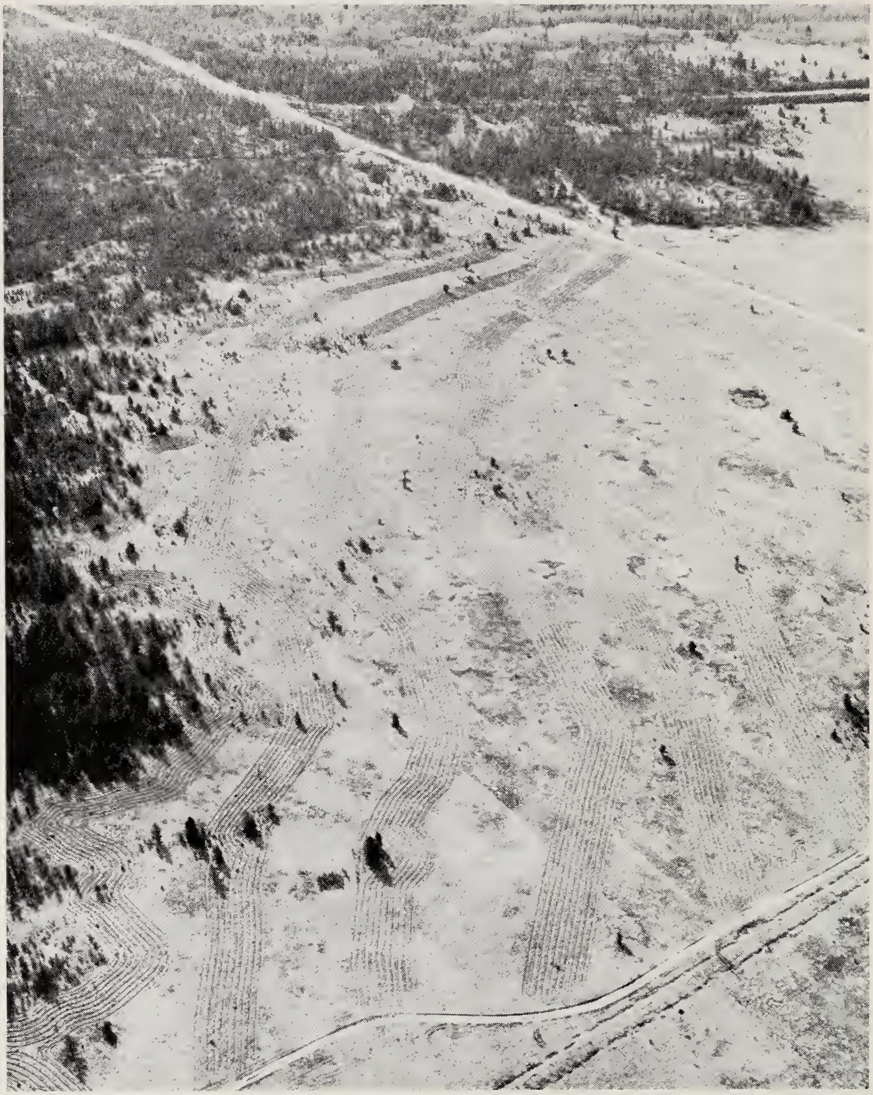

Fig. 1. Pine plantings at the Kirtland's Warbler area on State Forest lands in Crawford County, Michigan, spring 1958. Rows of seedlings are 6 feet apart and each strip consists of ten rows, with open grasslands between strips. Michigan Conservation Department Photograph.

T27N, R1E); (3) Ogemaw County near the Ogemaw Game Refuge (Sec. 21, 22, 27, 28, T24N, R1E).

The Forestry Division decided to take steps the following spring in the Crawford and Ogemaw areas, where there were open grasslands available for planting adjacent to stands of jack pine among which Kirtland's Warblers were nesting. Attention to the Oscoda area was to be deferred because many of the pines there were approaching harvestable size. Under the direction of Glenn M. Schaap, plantings were made in the Crawford area (Fig. 1, eastern part of Sec. 5) and Ogemaw area (central and northern parts of Sec. 27) in April and May 1958. In all, 267,400 jack pines, 2,000 red pines (*Pinus resinosa*), and 1,950 white spruces (*Picea glauca*) were planted. Trees were placed 4 feet apart in rows 6 feet apart, 10 rows planted and 15 rows skipped (to provide openings, which are just as important to the warbler's habitat as trees of the right size), and rows curved to follow the edge of any nearby stand of larger trees. Deep furrowing was avoided to minimize the disturbance of ground cover. The intention is to maintain tracts in three age groups seven years apart, by burning and replanting of those tracts where the trees have become 21 years old.

Resolutions were adopted by the American Ornithologists' Union meeting at Cape May, New Jersey, in September 1957, and again at Washington, D.C., in October 1961, commending the Michigan Conservation Department for setting aside areas in the "State Forests to be managed permanently for the benefit of the Kirtland's Warbler."

HURON NATIONAL FOREST

The Huron National Forest lies in the very heart of the Kirtland's Warbler nesting range. Forest Service officials in Lower Michigan, over a period of years, had considered informally what steps might be taken to help the bird, and this interest was encouraged by the modern trend toward "multiple use" of public lands—that is, recreational and other uses in addition to the traditional objectives of growing trees. The Kirtland's Warbler was one of the topics for discussion at a meeting of representatives of the U.S. Forest Service and Michigan Department of Conservation in late August 1957. This meeting was attended by Byelich, who had been active in the establishment of preserves for this bird on State Forest lands.

These plans began to take definite form in 1960, and L. A. Pommerening, Forest Supervisor of the Lower Michigan National Forests, sent me a tentative draft of a management plan for the Kirtland's Warbler in January 1961. In the following month I met in Cadillac with the staff members of the Lower Michigan National Forests, Robert E. Radtke (Wildlife), Horace O. Nixon (Lands), and Wayne B. Worthington (Recreation), who jointly prepared the Management Plan as finally approved. Also present at this meeting were representatives of the regional staff in Milwaukee.

Formal submission of the plan was delayed in order to incorporate some of the findings of the census of Kirtland's Warblers in June 1961. Radtke participated in that part of the census covering the site proposed for the management area.

In the fall of 1961, to demonstrate public support, the Michigan Audubon Society, the Detroit Audubon Society, the Pontiac Audubon Society, and the Michigan Natural Areas Council signed Cooperative Agreements with the Lower Michigan National Forest, and made grants of $100 each, with the intention of continuing their assistance in the future. In October 1961, the American Ornithologists' Union meeting in Washington, D.C., transmitted a resolution to the Chief of the National Forest Service requesting that agency "to set aside and manage a preserve for the benefit of this endangered species."

The Management Plan was approved 19 July 1962. The area includes 4,010 acres in the Huron National Forest southeast of Mio in Oscoda County, just north and east of Mack Lake (Sec. 1, 2, 3, 11, 12, 13, T25N, R3E, and Sec. 7, 18, T25N, R4E).

This area will be treated in 12 management blocks of about 320 acres each. Cutting and controlled burning will be used to create the desired conditions. Ultimately, one block will consist of pines 5 years old; the next, 10 years old; and so on up to 60 years, at which time the oldest block will be harvested. Then if regeneration is not accomplished by controlled burning, it will be replanted. Thus, at least two blocks (the 10- and 15-year blocks, for example), amounting to about 640 acres, will be at optimum size for the Kirtland's Warblers at all times.

In none of these plans is there any specific provision for the control of the cowbird. However, such control is not ruled out, and might be conducted fruitfully as a part of a research project by some student of the cowbird. The cowbirds occur here in moderate numbers and are conspicuous in this terrain; so it would seem possible to remove nearly all of them from a study area in the nesting season. But the best methods of doing so and the rate of replenishment from the surrounding country would be worthy subjects of study.

RIVER ROAD, R.F.D., WATERVILLE, OHIO, 8 FEBRUARY 1963

NEW LIFE MEMBER

Charles Ellsworth Huntington, of South Harpswell, Maine, is Assistant Professor of Biology at Bowdoin College and Director of Bowdoin Scientific Station. Dr. Huntington, a new Life Member of the Wilson Ornithological Society, received his B.A. and Ph.D. degrees from Yale University and is interested in population dynamics of sea birds. Since 1955 he has been studying a population of Leach's Petrel.

His published papers on the Purple Grackle and Herring Gull have appeared in *Systematic Zoology* and *Acta XI Congress for International Ornithology*. Dr. Huntington, an active member of the WOS since 1950, is President of NEBBA and Vice President of the Maine Audubon Society. Also, he is a member of the AOU, BOU, British Trust for Ornithology, Cooper Ornithological Society, EBBA, Sigma Xi, AAAS, Society for the Study of Evolution, and Society of Systematic Zoology.

ORNITHOLOGICAL LITERATURE

STRUCTURAL ADAPTATIONS OF THE HEAD AND NECK IN THE BLACK SKIMMER *RYNCHOPS NIGRA* LINNAEUS. By Richard L. Zusi. Publications of the Nuttall Ornithological Club No. 3, 1962: 6 × 9¼ in., viii + 101 pp, 44 figs., 5 tables. Cloth, $3.00. (Order from the Museum of Comparative Zoology, Harvard University, Cambridge 38, Mass.)

Many weird feeding adaptations have appeared during the evolution of birds, but none is stranger than the skimmer's method of catching fish while flying back and forth over still bodies of water with the immersed, blade-like lower mandible serving as a narrow, but efficient "snare" for fish. Although this peculiar feeding method was long known, Dr. Zusi's study provides the first accurate, detailed investigation of the mechanism of skimming and of the associated morphological adaptations of the head and neck. Throughout, the Black Skimmer is compared with the Gull-billed Tern (nondiver), Royal Tern (diver), and Laughing Gull. An excellent account is given of the skimming method, using motion-picture film as the basis for the detailed descriptions and the figures. Zusi showed that the skimmer's head is snapped down and back when the mandible hits an underwater object or a fish; in the latter case, the jaws are closed on the fish as the head moves backward. The upper jaw is elevated greatly to increase the gape while the bird is skimming; the nasal-frontal hinge and other parts of the bony palate and upper jaw are modified to permit greater protraction than in other larides. Inclusion of the several ligaments associated with the mandible-quadrate articulation renders the entire consideration of cranial kinesis particularity meaningful; these important structures are usually omitted in studies of the skull and its kinetic upper jaw. The jaw muscles are described first in the Royal Tern which serves as the basis for comparison for those in the Black Skimmer. This method is used to emphasize the structural modifications in the Black Skimmer; however I find that this system makes the descriptions somewhat difficult to follow. Coverage of the jaw muscles is complete and accurate with special attention given to the tendons of origin and insertion. Nevertheless I am not convinced that Zusi's subdivisions of the *M. adductor mandibulae externus* and of the *M. pterygoideus* give a true picture of the actual situation, and the actions of the muscles, in spite of most being completely reasonable, should have been reported as possible functions as the deductions of these actions are based upon morphological observations, not on actual functional observations and experiments. The major conclusion reached by Zusi is that adaptation for skimming has been achieved with only moderate change in the pattern of the jaw muscles characteristic of gulls and terns. This conclusion is well supported by his evidence and appears most reasonable. Zusi shows that the important adaptational unit for skimming includes the neck as well as the head. He presents an excellent discussion of the structure and possible functions of the cervical vertebrae and muscles, showing how these structures are integrated into a functional unit adapted to counteract the strong, backward forces on the head, especially those occurring when the head is doubled under the body when an object is struck or a fish is caught. This treatment of the neck muscles is especially welcomed in view of the scarcity of papers covering this most difficult part of avian anatomy.

Zusi's paper is an excellent example of functional-adaptational analysis of structure based upon careful field observations and shows how much sound information can be gathered using this approach. Some of the functional conclusions may have to be modified after further investigation in the laboratory, but this is of minor importance. The major contribution of Zusi's study, in addition to his excellent analysis and interpretation of the skimming mechanism, is that he demonstrates how a wealth of valuable information pertaining to functional-anatomical studies can be obtained in the field. Good descriptions of feeding methods, running, climbing, flight, and other daily activities of birds are very scarce in the literature although essential to functional morphological studies. Here is an area in which the amateur ornithologist, using a minimum of equipment, can contribute much to the scientific study of birds.—WALTER J. BOCK.

BIRD STUDY. By Andrew J. Berger. John Wiley & Sons, Inc., New York, 1961: 6 × 9½ in., xii + 389 pp., 178 figs. incl. photos., many tables. $7.50 (text edition).

The proof of the suitability of a textbook is, like that of the pudding, in how avidly it is devoured, the degree to which it is digestible, and to what extent it fulfills the needs of the consumer. The reviewer has consequently delayed his review of "Bird Study" until it could be put to the test of being used for a semester as a textbook in an elementary college course in ornithology for liberal arts students—the primary audience for whom this book was geared by its author. I have taught such a course for close to thirty years and know first-hand thc need that long existed for a truly suitable text. I therefore welcomed Berger's "Bird Study" for seemingly here was a text that when used jointly with Pettingill's "Laboratory Manual" and Peterson's "Field Guide" would provide the college instructor with all that he needed. Now I am not so sure that my original enthusiasm was altogether justified. Many of the chapters in the book are eminently satisfactory, others are less so, mainly because I too frequently detect a dogmatism on the part of the author, sometimes in areas in which he himself would be the last to claim to be an expert. Perhaps, though, this notion on my part reflects a fundamental difference with the author in pedagogy. Should the pros and cons of ideas be presented to the beginning student, or should certain viewpoints be expressed dogmatically on the presumption that the pros and cons can come later? Since Berger is an expert anatomist, it is surprisingly dogmatic for him to state on page 13 that "most authors," presumably himself included, consider the three remaining fingers of birds to be digits I, II, and III, instead of II, III, and IV, as shown by the researches of Holmgren and Montagna. No less an authority than Libbie Hyman, even without benefit of the knowledge adduced by recent studies, states that the question must be regarded as open to debate. The reader of the present text is not even made aware of what alternative theories exist.

More serious, though, is a philosophy of the author as revealed by the following excerpt from his chapter on Systematics, a branch of the science on which he is certainly no expert: "The subspecies concept is a cherished one, especially by those who like to see their own name perpetuated as part of the scientific name of a bird, and by those who revel in examining bird skins and then giving free reign to their imagination. This approach has certain advantages because one deals primarily with theories and is not hampered by considering facts." Such an unwarranted degradation of systematists working at the level of subspecies certainly has no place in a textbook ostensibly designed for college use.

"Bird Study" is divided into eleven chapters and each contains a wealth of information about birds, probably more than most liberal arts students with little or no biological background can possibly absorb in a single semester. Despite the shortcomings mentioned, the book is still far superior, in the reviewer's opinion, to any previous text on the biology of birds available for use in a college course in ornithology.—GEORGE H. LOWERY, JR.

THE ROUGH-WINGED SWALLOW, *STELGIDOPTERYX RUFICOLLIS* (VIEILLOT): A Study Based on Its Breeding Biology in Michigan. By William A. Lunk. Publications of the Nuttall Ornithological Club No. 4, 1962: 6 × 9¼ in., viii + 155 pp., 19 figs., 3 pls.

Data for this comprehensive life history were gathered from 97 nests by Dr. Lunk during four breeding seasons (1949–52) in southeastern Michigan. Much of the introduction is devoted to a discussion of the family Hirundinidae and the taxonomic position of *Stelgidopteryx ruficollis serripenis*, the principal subject of the book. This is the only subspecies of the monotypic genus found in the United States, except for a small area in the extreme southwest. The structure and function of the most important generic character—the outer web of the outer primary characterized by recurved barbs without barbules—is discussed in the introduction and in a later section.

Methods and materials are mentioned in Part I. Included is an interesting description of artificial nest tubes used successfully during the study. Ninety per cent of the tubes were used by swallows at least once during the three years they were made available. The author suggests using such containers to attract Rough-winged Swallows about buildings, banks, and other structures.

The text is divided into six well-organized and concisely written parts which comprise an outstanding, although typical, life-cycle study. The Parts are: I. Preliminary Considerations (Study area, methods, general characteristics and behavior, etc.); II. Prelaying Stages (nesting sites, colonialism, territorial behavior, mating, nests, nest-building); III. Eggs and Incubation (rhythm of laying, desertion, renesting, hatching); IV. Later Stages (brooding of young, roosting, feeding and food of nestlings, growth and development of young, postnesting activities); V. General Analyses (timing of nesting season, nesting success, mortality and nest failure, gregariousness); VI. Conclusions (position and status).

The figures are well prepared and clearly supplement the text. Plates II and III lack the contrast necessary for displaying feather tracts and general development of nestlings.

Dr. Lunk is to be congratulated on this fine work.—WILLIAM E. SOUTHERN.

PRAIRIE SPRING. Volume VII of the "Sounds of Nature" Series. Recorded by William W. H. Gunn; narrated by Thom Benson. Federation of Ontario Naturalists in Association with Cornell Laboratory of Ornithology, 1962: 12-inch record, 33⅓ r.p.m. $5.95. (Order from F.O.N., Edwards Gardens, Don Mills, Ontario.)

To a person with prairie experience Dr. Gunn's new recording, "Prairie Spring," really takes you "by ear" back onto the western grasslands. And for the neophyte on the prairies it is an excellent introduction with plenty of "come on," inviting exploration of this fascinating wide-open territory. One hears many comments about the monotonous prairies with nothing to see but grass to the horizon. Perhaps this is true, for persons without the eyes to see and the ears to hear what really is there to enjoy. For these uninitiated travelers "Prairie Spring" will be a real audio-revelation. The fragmented trumpeting of a horde of Sandhill Cranes; the weird tooting of the courting Sharp-tailed Grouse and the "Prairie Bells" as Seton called the distant musical tinkling songs of the Western Meadowlark, Chestnut-collared Longspur, and Baird's Sparrow and even the whistling of ground squirrels and the coyote chorus certainly rival anything the forests can produce. I am sure you will enjoy accepting Bill Gunn's invitation to better audio-recognition of the prairie wildlife, altogether 64 bird and four mammal species.

The little leaflet of supplementary notes is a valuable aid to interpreting what one hears on the record. In this the activities of the animals are described as they occurred while the sounds were being recorded. Otherwise certain sounds would surely overtax the inexperienced person's ability to "see" what was really going on. The slapping of the swan's wings on the water at takeoff puzzled me a bit before reading the notes. These explanations make up in part for one of the weaknesses of recorded songs and sounds which is that one is never sure about how far away the animal is when a given sound is produced. Is this a loud call audible at some distance or is it a weak call recorded with the microphone close to the caller?

The record has spoken identifications throughout and is divided into bands for ease in locating a particular call. Also, the bands serve to divide the series of calls into ecological groupings, some of which are: swans in migration, geese moving out at dawn, ducks of the sloughs and potholes, waders, a gathering of cranes, prairie bells, a dancing ground, the river valleys, sage country, and parklands and bluffs (referring to prairie groves). I felt it was unfortunate that the Long-billed and Short-billed Marsh Wrens were separated by the Black Tern series of calls. The contrast of the two wren calls would be better brought out if one had immediately followed the other. Likewise the marsh-living Yellow-headed and Red-winged Blackbirds are separated. I was a little surprised not to find in the printed comments that the very obvious thumping sounds in the Sharp-tails' dancing sequence were made by the rapid pounding of the feet on the ground. Also it might well have been pointed out that the Sora call recorded, although common, is not the best recognition call of a series of descending notes so frequently heard when the bird is disturbed.

These certainly are minor criticisms, however, and I could without reservation recommend this record as a most valuable aid to a better recognition of the wildlife sounds of the prairies.—W. J. Breckenridge.

This issue of *The Wilson Bulletin* was published on 25 June 1963.

SUGGESTIONS TO AUTHORS

Manuscripts intended for publication in *The Wilson Bulletin* should be neatly typewritten, double-spaced, and on one side only of good quality white paper. Tables should be typed on separate sheets. Before preparing these, carefully consider whether the material is best presented in tabular form. Where the value of quantitative data can be enhanced by use of appropriate statistical methods, these should be used. Follow the AOU Check-list (Fifth Edition, 1957) insofar as scientific names of United States and Canadian birds are concerned unless a satisfactory explanation is offered for doing otherwise. Use species names (binomials) unless specimens have actually been handled and subsequently identified. Summaries of major papers should be brief but quotable. Where fewer than five papers are cited, the citations may be included in the text. All citations in "General Notes" should be included in the text. Follow carefully the style used in this issue in listing the literature cited; otherwise, follow the "Style Manual for Biological Journals" (1960. AIBS). Photographs for illustrations should be sharp, have good contrast, and be on gloss paper. Submit prints unmounted and attach to each a brief but adequate legend. Do not write heavily on the backs of photographs. Diagrams and line drawings should be in black ink and their lettering large enough to permit reduction. Authors are requested to return proof promptly. Extensive alterations in copy after the type has been set must be charged to the author.

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The Wilson Bulletin is not as large as we want it to be. It will become larger as funds for publication increase. The Society loses money, and the size of the *Bulletin* is cut down accordingly, each time a member fails to pay dues and is put on the "suspended list." Postage is used in notifying the printer of this suspension. More postage is used in notifying the member and urging him to pay his dues. When he does finally pay he must be reinstated in the mailing list and there is a printer's charge for this service. The *Bulletin* will become larger if members will make a point of paying their dues promptly.

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THE WILSON ORNITHOLOGICAL SOCIETY

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The Josselyn Van Tyne Memorial Library of the Wilson Ornithological Society, housed in the the University of Michigan Museum of Zoology, was established in concurrence with the University of Michigan in 1930. Until 1947 the Library was maintained entirely by gifts and bequests of books, reprints, and ornithological magazines from members and friends of the Society. Now two members have generously established a fund for the purchase of new books; members and friends are invited to maintain the fund by regular contribution, thus making available to all Society members the more important new books on ornithology and related subjects. The fund will be administered by the Library Committee, which will be happy to receive suggestions on the choice of new books to be added to the Library. William A. Lunk, University Museum, University of Michigan, is Chairman of the Committee. The Library currently receives 104 periodicals as gifts and in exchange for *The Wilson Bulletin.* With the usual exception of rare books, any item in the Library may be borrowed by members of the Society and will be sent prepaid (by the University of Michigan) to any address in the United States, its possessions, or Canada. Return postage is paid by the borrower. Inquiries and requests by borrowers, as well as gifts of books, pamphlets, reprints, and magazines, should be addressed to "The Josselyn Van Tyne Memorial Library, University of Michigan Museum of Zoology, Ann Arbor, Michigan." Contributions to the New Book Fund should be sent to the Treasurer (small sums in stamps are acceptable). A complete index of the Library's holdings was printed in the September 1952 issue of *The Wilson Bulletin* and newly acquired books will be listed periodically.

THE WILSON BULLETIN

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CONTENTS

FOOD STORING OF RED-BELLIED WOODPECKERS

LAWRENCE KILHAM

RED-BELLIED Woodpeckers (*Centurus carolinus*) store food to a varying extent the year around, but the habit is most pronounced in fall months when the storing and re-storing of berries and acorns may occupy a good deal of their time, as I have observed over the course of eight years in the vicinity of Seneca, Maryland. It is not always apparent under field conditions what these woodpeckers are actually doing. Observations on the manner of storage, in which the tongue is used with considerable skill, have been aided by six Red-bellied Woodpeckers which I have raised by hand and maintained in an aviary.

FIELD OBSERVATION

C. carolinus frequently stores poison ivy (*Rhus radicans*) berries during the fall, as illustrated by an observation made on 13 October 1957. A female would pick 2 to 7 berries while clinging upside down on a cluster, then fly out to several different storage trees. An old willow was visited with particular frequency. Its trunk was encircled by a poison ivy vine attached to the bark by masses of matted rootlets. The woodpeckers stored numerous berries under these rootlets. On 24 October 1960, I watched a male working in a similar manner for eight minutes. This individual perched on a branch as it reached out repeatedly to seize berries, then pushed them into nearby crevices. He didn't swallow any until about to fly away. The above episodes illustrate the fact that *C. carolinus* usually uses storage places which are readily available and require no excavation.

Acorns may be handled differently from small berries if they have to be hammered into small pieces. Pin oak (*Quercus palustris*) acorns are small enough to be stored directly. Thus, on 18 October 1958, I watched a male fly against a cluster of pin oak leaves, pick an acorn, swoop down to a dead stub, and then hammer the acorn into a hole, only to pull it out and lodge it in another place before flying back to the oak. This pattern of behavior was similar to that described elsewhere for Red-headed Woodpeckers (*Melanerpes erythrocephalus*) (Kilham, 1958). *C. carolinus* may fly hundreds of yards to pick an acorn, then bring it back for storage. One captive individual had a peculiar habit of spearing extra large acorns in order to fly with them. Brooks (1934) has described a similar situation for *M. erythrocephalus*, one of which starved to death when unable to extricate its bill.

C. carolinus appears to have knowledge of where stores are hidden, a knowledge which is doubtless reinforced by habits of re-storing. On 25 December

1953, I was standing in an open pasture when one of these woodpeckers alighted on a nearby fence, pulled out an acorn, then stored it again in an adjacent post. The nearest tree was 100 yards away.

Territorialism.—Red-bellied Woodpeckers occupy individual areas after separation of family groups, parents and young, in September (Kilham, 1961). In the course of successive week-end visits, during fall and winter months from 1957 through 1960, I always found a male in one part of Creek Wood, with two females occupying adjacent areas on either side. The individual areas were three to four acres in extent, as judged by the usual flights of the birds occupying them. By way of contrast, the four acres comprising the actual extent of Creek Wood had contained the winter storage territories of 12 Red-headed Woodpeckers in 1956–57 (Kilham, 1959).

Relations with other birds.—While *M. erythrocephalus* was continually aggressive in driving a variety of birds from its territories, *C. carolinus* usually appeared indifferent to the presence of potential competitors for food stores, such as Blue Jays (*Cyanocitta cristata*) and Downy Woodpeckers (*Dendrocopos pubescens*). On 16 November 1957, for example, I noticed a jay working on a rotten stub. A male *C. carolinus* flew over, replaced the jay, then took out a morsel of food and flew to re-store it in another place. He made four successive trips to bring away stores from the stub, paying no attention to the jay which remained close by. I witnessed a similar episode in relation to a Downy Woodpecker on 12 December 1953. The smaller woodpecker rested only three feet away. Reasons why *C. carolinus* may be successful at storing food are presented in a final discussion. It should be said, however, that Pileated Woodpeckers (*Dryocopus pileatus*) are possibly the only birds which are able to reach the deep-lying stores of Red-bellied Woodpeckers with any regularity. I have noted *D. pileatus* investigating likely storage places on repeated occasions. Thus, on 10 January 1960, a Pileated Woodpecker had been feeding for five minutes in a natural depression in a sycamore limb when a Red-bellied Woodpecker flew up and waited several minutes within a foot of the larger bird. There was no excitement. I had opportunities to observe similar events in the aviary, where a Pileated had obviously learned to visit places used by a captive Red-bellied Woodpecker for storing food.

Interspecific conflicts.—Although *C. carolinus* is generally unaggressive during fall and winter months, it may have occasional conflicts, particularly with Starlings (*Sturnus vulgaris*) and with Yellow-bellied Sapsuckers (*Sphyrapicus varius*). A woodpecker will not infrequently attack and drive a Starling away from a suet holder. Conflicts with more variable outcome were observed on three occasions when a *C. carolinus* was getting sap from sapsucker holes on favorable days. I have seen a *C. carolinus* drive a sapsucker away from its drill holes as early as 25 December. On 22 February 1958, however, I saw a sapsucker attack a Red-bellied Woodpecker which had come to feed on sap from a pin oak. The two birds grappled and fell to the ground. The woodpecker then flew away. Another encounter took place on 4 April 1957, when a sapsucker, which had been drilling fresh holes in a maple, dropped downward to attack a Red-bellied Woodpecker feeding on sap. Results were rather surprising, for the woodpecker, in striking back, was able to seize the sapsucker in its bill, by the back of the neck, and to hold its victim dangling helplessly for a few moments. The sapsucker then flew away, apparently unhurt. Both birds could have felt possessive about the maple which was situated in the center of the woodpecker's winter area as well as being one in which the sapsucker had done much drilling in preceding months.

OBSERVATIONS ON CAPTIVE BIRDS

Use of tongue.—Observations on six genera of woodpeckers kept in an indoor aviary made it apparent that the various species used their tongues in different ways for different purposes. The tongue of *C. carolinus* was relatively long and protrusible. While not as long as those of *D. pileatus* or Yellow-shafted Flicker (*Colaptes auratus*), it appeared to function more adroitly in maneuvering objects at a distance, within crevices. Neither *S. varius* nor the *M. erythrocephalus* had any such long-distance control. A tame female Red-bellied Woodpecker would put her bill through the wire of the aviary, within a foot of my face, to retrieve a morsel of bread placed several inches away. The tip of the tongue, which extended 1 to 1½ inches beyond the tip of her bill, always went over and to the back of the object, starting it to jiggle toward the wire by means of a rapid back and forth motion. This skill in manipulation could also operate in vertical crevices. On one occasion, a male *C. carolinus* flew across the aviary with a piece of bread crust which he dropped down the split of an upright post. His subsequent behavior was somewhat amusing to watch (Fig. 1). Thus, he would thrust his bill down the crevice and make the crust dance like popcorn in a popper as he worked it upward with his long tongue, only to let it fall and try the operation over again. Figure 2 shows one of these woodpeckers storing food under more usual circumstances. It is obvious that a field observer will find it nearly impossible to discover what such a bird is doing when the tip of its tongue and bill are buried from view.

Storage of miscellaneous objects.—The captive *C. carolinus* often stored miscellaneous objects of no apparent value. When I gave one female a bent, 3-inch nail, she spent five minutes trying to insert it into various holes, hunching her shoulders forward as she did so. Toothpicks, clips, or even small wads of paper elicited similar behavior. The woodpeckers would also store objects of their own, particularly a male, which would sometimes loosen a sliver of

Fig. 1. Captive Red-bellied Woodpecker using tongue to recover piece of bread from vertical cleft.

wood several inches long, arrange it to point straight forward in his bill, then fly over the aviary in search of a storage place. This same male was preparing to store another and smaller chip on 6 April 1960, when his mate

Fig. 2. Two positions of a Red-bellied Woodpecker storing an acorn. Action of tongue not apparent under field conditions.

flew up, took the chip in her bill, and flew off with it. The nesting of this pair has been described elsewhere (Kilham, 1961).

Hunching of shoulders.—All of the species of woodpecker maintained in the aviary, with exception of *D. pileatus*, had a similar method of preventing bits of food from falling to the ground, whether their aim was to store or to hammer the morsels into pieces which could be swallowed. This consisted in pushing the belly flat against the tree trunk, while rounding their shoulders forward. The hunched shoulders were surprisingly agile in guiding bits of acorn or of dismembered insect, so that they were trapped against the belly where the woodpecker could retrieve them. This maneuver, as performed by the Great Spotted Woodpecker (*Dendrocopos major*), has been filmed by Sielmann (1958).

Use of tongue in locating prey.—*C. carolinus* spends almost no time excavating holes when in search of grubs and other prey, but appears to accomplish the same objective by using bill and tongue to explore natural crevices. When I brought rotting logs from the woods to the aviary, the Pileated, Downy, and Hairy (*Dendrocopos villosus*) Woodpeckers, as well as the Yellow-shafted Flicker, and to a lesser extent, the sapsuckers, were immediately interested and each began pecking or hewing, in its individual style, to get ants,

Fig. 3. Red-bellied Woodpecker exploring rotten log with long tongue in search of grubs. (Adapted from high-speed photographs taken in aviary.)

termites, or whatever might turn up. The strategy of *C. carolinus* was effective in this competitive situation. As illustrated in Fig. 3, this species explored the logs with its tongue, occasionally twisting its head upside down to do so. In this manner it sometimes pulled out beetle larvae 1–2 inches long before any of the other woodpeckers had dislodged prey of any size. It may be that the tongue-probing of *Centurus*, in contrast to pecking and hewing methods, enables it to come upon its victims quickly and without disturbance.

COMPARISONS WITH OTHER SPECIES

The food storing of *C. carolinus* depends on an ability to manipulate objects at a distance with its tongue and thus lodge and retrieve morsels deep within crevices, behind bark, or at the broken ends of branches, beyond reach of its usual food competitors, which include Tufted Titmice (*Parus bicolor*), White-breasted Nuthatches (*Sitta carolinensis*), and Blue Jays. Four other species of woodpeckers lodged food in the indoor aviary. These were the Yellow-bellied Sapsucker, and the Downy, Hairy, and Red-headed Woodpeckers, the latter species having been the only one to store food in any persistent manner. None of the four species displayed a lingual agility comparable to that described above for *Centurus*. Although *Centurus* and *Melanerpes* are closely related genera and may inhabit the same areas in fall and winter months (Kilham, 1959), their methods of storing and protecting stored food offer points of contrast which are summarized in Table 1.

TABLE 1
CONTRASTING FALL AND WINTER BEHAVIOR OF RED-BELLIED AND RED-HEADED WOODPECKERS

	C. carolinus	*M. erythrocephalus*
Method of hiding stores	Manipulated into deep crevices with long tongue	Sealed in with slivers of damp wood or other material
Excavation of holes for storage	None, uses natural cavities	May enlarge natural cavities or dig pits for separate acorns, etc.
Aggressiveness vs. rivals for stores	None observed	Very aggressive to all rivals, inter- and intraspecific
Aggressiveness vs. other rivals	May attack Starlings at suet or sapsuckers at drill holes	Tolerant when feeding with sapsuckers
Territorial behavior (nonbreeding)	Occupies individual areas, 3 to 4 acres in exent; boundary disputes not observed	Small, sharply defined individual territories; boundary disputes common
Migratory habits	None; much the same areas winter and summer	Mobile opportunities; may overwinter in numbers in localities with unusually heavy acorn or other crops

The habit of storing miscellaneous objects is peculiar to several species. A male Yellow-bellied Sapsucker, for example, tried to store a chip of wood in six different holes in the aviary before finding one that was suitable. Three genera of woodpeckers, *Sphyrapicus*, *Centurus*, and *Melanerpes*, have thus been observed in this performance. *M. erythrocephalus*, however, is apparently the only one to have developed the practice into a regular habit by which it seals its acorns and other winter food into cavities in an apparent effort to hide them from various predators (Kilham, 1958).

Storage of miscellaneous objects has also been described for Acorn Woodpeckers (*Melanerpes formicivorus*). Ritter (1921) gave his opinion of the habit in this species by stating that "the [storing] instinct sometimes goes wrong to the extent of storing pebbles instead of acorns, thus defeating entirely the purpose of the instinct." It is not always easy, however, to perceive the purpose of what animals are doing. "Play," for example, may not be a case of "instincts" gone wrong so much as a way of developing and practicing skills against a time when an animal may need them for survival. Storage of odd objects could be a form of "play" which is developmental in the life histories of woodpeckers. A further interpretation might be that the behavior exemplified response to subnormal stimuli because of high specific action potentials for storage in a situation where storable food was available in only limited amounts.

SUMMARY

Red-bellied Woodpeckers are skillful in lodging and removing bits of food from storage places 2 to 3 inches deep within natural crevices by use of their long tongues. The depth of this storage appears to give protection against jays, titmice, and other competitors. Storing is done particularly in the fall. Red-bellied Woodpeckers occupy individual areas three to four acres in extent at this season and are unlike the related Red-headed Woodpecker in being unaggressive in relation to stored food. Field observations were aided by observations on hand-raised individuals maintained in an aviary. Extraction of insect larvae from rotten logs, storage of miscellaneous objects, and other activities in which the tongue was used are described.

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BIRDS IN A RED PINE PLANTATION

Donald H. Messersmith

In recent years plantations of pine trees have been established on lands unsuited for agriculture. These trees soon form dense stands which afford good cover for birds. A casual June survey of a 28-acre red pine plantation in Michigan indicated that birds were frequenting it extensively; thus it seemed worthwhile to determine which species were using it, for what purposes, and to what extent.

The plantation is about one mile east of Pellston in Emmet County, Michigan. Its east end is about 200 feet from a stream called Maple River. Except for a few rows of jack pine (*Pinus Banksiana*) along the western border, the plantation consists of a pure stand of red pine (*Pinus resinosa*). It is divided into two parts, based upon the direction of the rows. Thirty-two rows extend in an east–west direction for about one-half mile parallel to Robinson Road (Section A) and 102 rows extend in a north–south direction for about 1,066 feet adjacent to the northwestern part of the 32 rows (Section B). See Fig. 1 for a map of the plantation and its surroundings. All the trees in the 28 acres of the plantation were planted in 1950, but for reasons that are not clear, vary in height from less than 1 meter to about 5 meters.

The so-called Pellston Flats, on which the plantation is located, are 680–700 feet above sea level and have a soil of Rubicon sand which is a minimal Podsol. Apparently the Flats were once subjected to frequent burnings in the years following the cutting of the original timber. No trees reestablished themselves. According to Gates (1930), not even aspens could survive under such conditions. A photograph taken by him in 1917 shows the area adjacent to the plantation covered primarily with Kentucky bluegrass (*Poa pratensis*), as it is today. Ground cover in the plantation consists mostly of grasses and bracken fern (*Pteridium aquilinum*).

PROCEDURE

The entire plantation was searched systematically for birds and nests by walking slowly along the aisle between two rows while scanning each tree to the right and left from top to bottom. Each nest discovered was marked. Two complete searches were made in this manner. The first search was made from 26 June to 7 July, the second from 24 July to 7 August. On 9, 11, and 12 August I took linear measurements, removed markers, and found by chance a few more nests.

As I discovered each nest in Section A, I marked the tree in which it was built by tying a strip of cheesecloth to a branch (usually at a level somewhere below the nest). Then I walked in a perpendicular line across the rows to

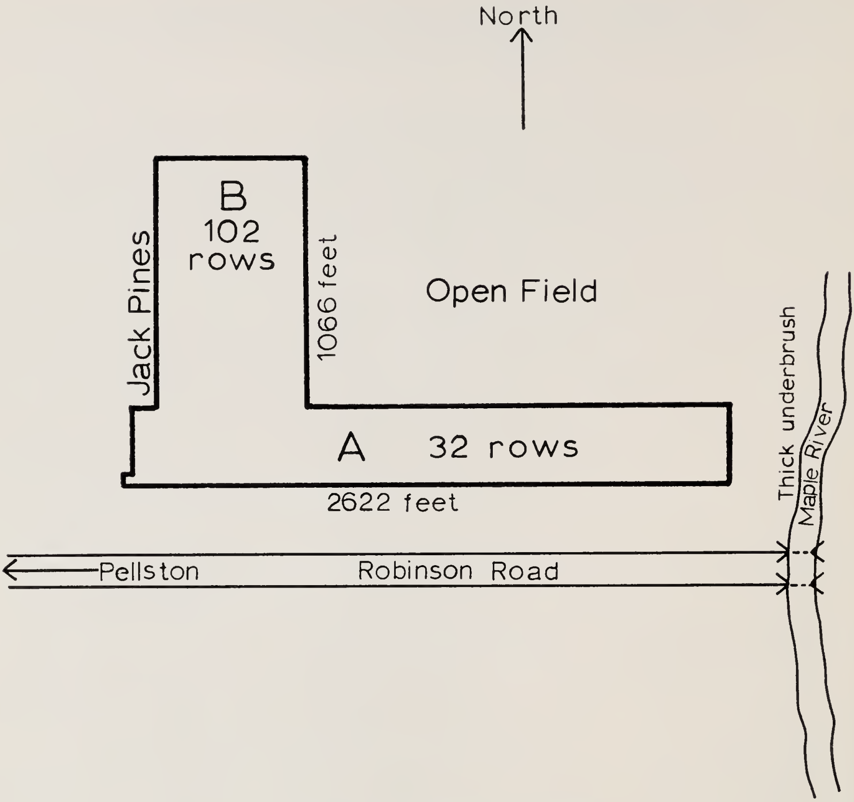

Fig. 1. Map of red pine plantation.

the row nearest the road, where another cheesecloth marker was tied to a branch. A tag was tied to this marker, and the type of nest, row number, and nest contents were written on it. The same procedure was followed in Section B except that the first tree at the south end of a row was marked to indicate that a nest was in that row.

During the second search, I measured the height of the bottom of each nest from the ground, and I also measured the height of the tree.

During these survey trips I kept records of all bird species seen in the plantation, whether they were known to be using it for nesting or not.

RESULTS

I found 100 nests; those remaining from previous years are not included.

Table 1 summarizes the data on these nests. The Chipping Sparrow (*Spizella passerina*) was the species found nesting most frequently, accounting

TABLE 1
A SUMMARY OF NEST AND TREE HEIGHTS (IN METERS)

Species	Number	Average		Range	
		Nest height	Tree height	Nest height	Tree height
Mourning Dove	2	2.09	4.20	1.60–2.57	3.79–4.61
Black-billed Cuckoo	5	1.61	3.55	0.81–2.85	2.62–4.80
Brown Thrasher	2	0.62	1.59	0–1.24	–
Robin	8	1.52	3.55	0.62–2.15	2.88–4.30
Cedar Waxwing	27	1.94	3.66	1.27–2.80	2.42–4.60
Purple Finch	4	2.43	3.79	2.20–2.74	3.46–4.59
Chipping Sparrow	47	1.66	3.19	0.87–3.19	1.33–4.87
Clay-colored Sparrow	2	1.26	2.47	1.21–1.31	2.42–2.51

for almost one-half of the nests observed. Cedar Waxwings (*Bombycilla cedrorum*) accounted for approximately one-fourth of the nests. The remaining nests were divided among nine other species: Mourning Dove (*Zenaidura macroura*), Black-billed Cuckoo (*Coccyzus erythropthalmus*), Yellow-shafted Flicker (*Colaptes auratus*), Eastern Kingbird (*Tyrannus tyrannus*), Brown Thrasher (*Toxostoma rufum*), Robin (*Turdus migratorius*), Purple Finch (*Carpodacus purpureus*), Clay-colored Sparrow (*Spizella pallida*), and Song Sparrow (*Melospiza melodia*). The Eastern Kingbird and the Song Sparrow are not included in the table because only one nest of each was found. The kingbird built its nest 2.32 meters up in a tree 4.07 meters high, whereas the Song Sparrow nest was on the ground under a pine tree.

Each species selected trees that were high enough to meet its usual nesting requirements (Fig. 2). The Mourning Dove, Eastern Kingbird, and Purple Finch built their nests high in the highest trees. All other species placed their nests below two meters; the Brown Thrasher and Clay-colored Sparrow were the lowest tree nesters.

A nest of the Yellow-shafted Flicker was found within the study tract but it is not included with the other nest data because it was located 1.55 meters high in a stub of a dead aspen 2.05 meters high in the midst of the plantation.

Brown-headed Cowbirds (*Molothrus ater*) must also be included with those species using the pine plantation for nesting. Their eggs were found in four Chipping Sparrow nests. To my knowledge only one juvenile cowbird fledged. The other three nests were abandoned after cowbirds laid eggs in them.

In addition to those species nesting in the pines, at least nine others used the plantation as a feeding area: American Woodcock (*Philohela minor*), Traill's or Least Flycatcher (*Empidonax* sp.), Black-capped Chickadee (*Parus atricapillus*), Yellow Warbler (*Dendroica petechia*), American Redstart (*Setophaga ruticilla*), Indigo Bunting (*Passerina cyanea*), American Goldfinch

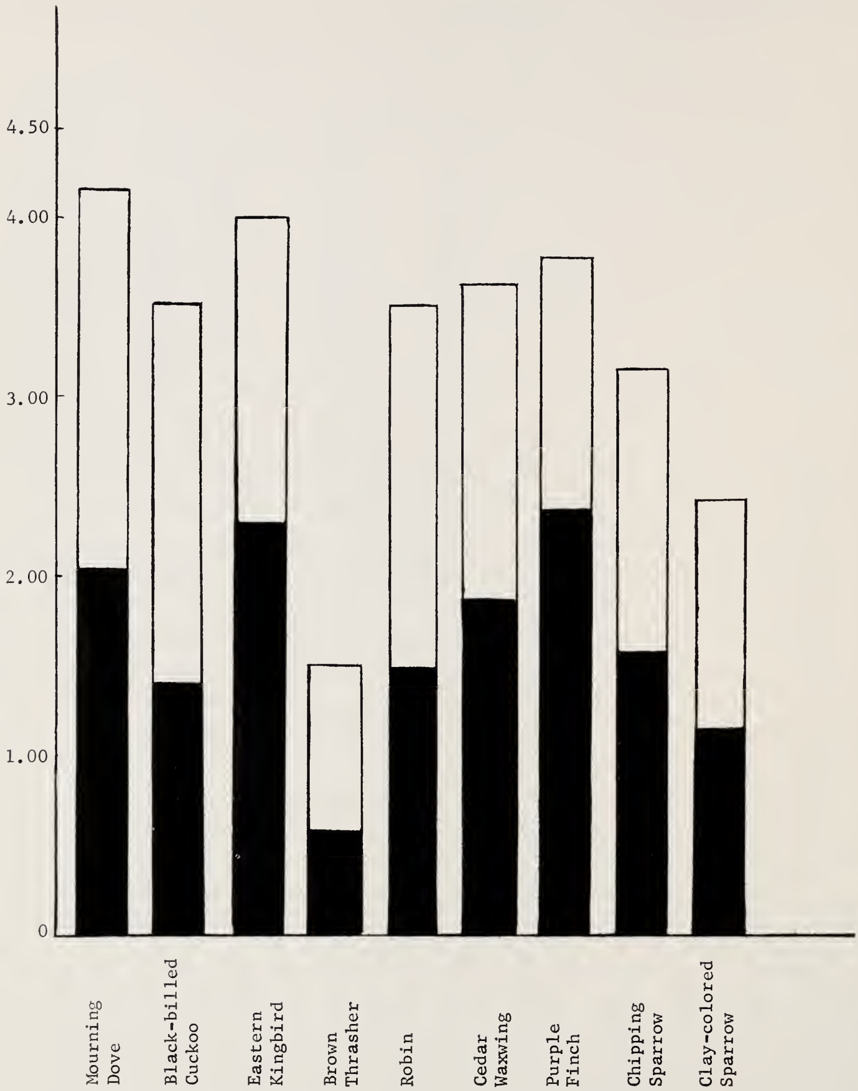

Fig. 2. Average heights of nests and trees in a red pine plantation.

(*Spinus tristis*), Rufous-sided Towhee (*Pipilo erythrophthalmus*), and Vesper Sparrow (*Pooecetes gramineus*). The last two mentioned species were seen frequently at the east side of Section B and very possibly were nesting there.

The distribution by height of all the nests and all the trees containing nests is summarized in Tables 2 and 3. The large number of Chipping Sparrow and

TABLE 2

NUMBERS OF NESTS AT VARIOUS HEIGHTS

Tree heights (in meters)	Number of nests
4.5 to 5.00	0
4.0 to 4.49	0
3.5 to 3.99	0
3.0 to 3.49	1
2.5 to 2.99	8
2.0 to 2.49	18
1.5 to 1.99	46
1.0 to 1.49	21
0.5 to 0.99	3
0.0 to 0.49	2

Cedar Waxwing nests make the 1.50- to 1.99-meter range the most favorable. The 3.00- to 4.00-meter tree size was most frequently utilized.

It is interesting to note that all the nests, except the flicker nest and the two ground nests, were placed against the trunk of the tree, thus receiving increased protection.

DISCUSSION

It is quite evident that red pine plantations may, depending on their height and density, provide an excellent habitat for certain bird species. The pine tract studied was 11 years old and seemed to be particularly well-suited to the nesting requirements of Chipping Sparrows and Cedar Waxwings, while providing acceptable sites for some other species. The Chipping Sparrows preferred trees about 3 meters in height and usually placed their nests about

TABLE 3

VARIOUS HEIGHTS AND NUMBERS OF TREES USED FOR NESTING

Tree heights (in meters)	Number of trees
4.5 to 5.00	6
4.0 to 4.49	9
3.5 to 3.99	28
3.0 to 3.49	32
2.5 to 2.99	14
2.0 to 2.49	6
1.5 to 1.99	0
1.0 to 1.49	2
0.5 to 0.99	0
0.0 to 0.49	2

1 to 2 meters from the ground. Cedar Waxwings placed their nests a little higher in taller trees.

Several authors have shown that "artificial" habitats attract rather high populations of birds. S. C. Kendeigh (*in* Hickey, 1937, 1938, 1939) recorded densities varying from 10.9 to 15.9 birds per acre on a country estate in Ohio. A report by W. Goodman (*in* Hickey, 1940) revealed 19.8 birds per acre on a Kansas farm. A summary of a series of American and European censuses of "island" gardens was presented by Lack (1937). Pitelka (1942) reported 23 breeding birds per acre in an isolated beach village in California. Young (1949) studied a 5-acre park in Wisconsin and found a total nest density of 32.8 per acre. My study area supported 7.1 breeding birds per acre. This lower density compared to the above figures can be explained on the basis of two facts. (1) The pine plantation was not an "island" habitat in the sense of being an isolated unit, because suitable nesting sites were available to all the breeding birds in adjacent areas. (2) Large parts of the plantation were not preferred by these birds because the tree growth was rather uniform and dense, almost to the point of being impenetrable. Several of the species are "edge" birds which prefer to nest near open areas, a situation certainly not extant in the interior parts of either section of this plantation, except in the eastern part of Section A. However, it is noteworthy that although several of these nesters are "edge" birds, they did not necessarily choose sites near the edge of the plantation. Nests were found in every row of Section A and in every part of it, although as mentioned below, not with equal frequency throughout the tract.

The matter of nest height has been of interest to other authors, such as Preston (1946), who plotted the heights of nests of Brewer's Blackbird (*Euphagus cyanocephalus*), Catbird (*Dumetella carolinensis*), and Robin. Preston and Norris (1947) analyzed the nesting heights of a number of species of birds in a woods and grassland area of 90 acres in Pennsylvania. They concluded that birds prefer to nest on or near the ground, a habit which hearkens back to their reptilian ancestry, but are forced to higher sites by "disturbances" on the ground. This is especially true in suburban areas where disturbances are very great because of prowling cats and other human-associated creatures. Wooded areas relatively free from such disturbances in the form of predators yield more nests at or near ground level. Three nests of a red squirrel (*Tamiasciurus hudsonicus*) were the only evidence of a predator in the study plantation and it seems quite likely that some of the bird nests were destroyed by this animal.

Averill (1922) presented a "law" relating the height of the nest to wing length minus tail length. He notes for instance, that the Chipping Sparrow is the longest-winged sparrow and it nests a few feet up, while other, shorter-

TABLE 4
PREFERRED NESTING HEIGHTS OF BIRDS (IN METERS)

Species	Preferred heights	Authority	Nest height in pine plantation
Mourning Dove	0–3.05	Chapman (1932)	1.60–2.57
	1.22–6.42	Preston and Norris (1947)	
Black-billed Cuckoo	2.76–3.05	Preston and Norris (1947)	0.81–2.85
Eastern Kingbird	4.58–7.64	Chapman (1932)	2.32
Brown Thrasher	0.00–2.44	Preston and Norris (1947)	0.00–1.24
Robin	1.53–9.15	Chapman (1932)	0.63–2.15
	0.61–9.15	Preston and Norris (1947)	
	3.66–7.03	Brackbill (1950)	
Cedar Waxwing	1.53–6.10	Chapman (1932)	1.27–2.80
	1.83–3.36	Preston and Norris (1947)	
	2.43–7.90	Lea (1942)	
Chipping Sparrow	1.53–6.10	Chapman (1932)	0.87–3.19
	0.30–0.91	Preston and Norris (1947)	
Song Sparrow	ground and bushes	Chapman (1932)	ground
	0.00–2.44	Preston and Norris (1947)	
	0.91–1.83	Brackbill (1950)	

winged sparrows prefer the ground or low shrubs for locating their nests. I found only two nests on the ground, but there may have been others.

A few authors have recorded the heights of nests of the species found nesting in the pines. They are listed in Table 4 with a comparison to my figures.

It can be seen that the birds nesting in this "artificial" pine habitat found nesting sites to their liking at heights comparable to those of birds nesting in more natural situations. The only significant exception is the Eastern Kingbird, which built its nest at a height lower than that given by Chapman (1932). However, I have observed this bird nesting at heights lower than Chapman's.

By dividing the plantation into 500-foot sectors, I found certain other factors evident. Thirty nests were located in the sector at the east end of Section A. Here the trees were about 3 meters high, not closely arranged (there were a number of small open areas scattered throughout this sector), and it was nearer water, all of which provided good cover and an abundant food supply. In the middle sectors the trees were uniformly above 4 meters high with branches intermingled, hence quite dense and difficult to penetrate. Nests were sparsely distributed in these sectors. The western sector of Section A provided considerable edge, but was far from water and its attendant benefits, so it was only moderately favorable as a nesting area.

In Section B, east side, the trees were less than 2 meters high and widely separated by scattered aspen clumps. This sector was the least favorable situation for nesting according to my findings. In the western half of Section B the trees were 4 meters or more high (at least in the part used for nesting), but the lower branches were not so densely intermingled as in the middle of Section A, so more birds used it.

We may therefore conclude that the most favorable situation for birds in a red pine plantation is one which has trees 3–4 meters high and not densely planted, contains scattered openings within the plot, and is located relatively near water. This is a situation favored by the "edge" birds noted in this study.

Worthy of note is that no birds used Row 32 on the field side, only two used Row 1 on the road side of Section A, and no birds used the outside rows of Section B for nesting sites. Evidently a "buffer" row or more next to their nest is preferred by most birds.

It is probably reasonable to conclude that this tract will not be used for many more years by the Brown Thrasher and Clay-colored Sparrow, which prefer to nest on or near the ground. As the trees grow taller they will become unsuited to the needs of these birds. The lowest branches will die, thus decreasing their value in providing cover for the low nesters, not to mention the increase in density of the higher branches. The Clay-colored Sparrow will be especially affected because it prefers to nest in shrubs in relatively open areas. The discovery of only two nests of each of these birds, as compared to the large number of Chipping Sparrow and Cedar Waxwing nests, is strong evidence that the area is already unfavorable to them. On the other hand, the area may become more favorable to high nesters, such as the Purple Finch, as the trees grow taller.

SUMMARY

A red pine plantation in northern Michigan was surveyed for birds' nests. This 11-year-old plantation yielded 100 nests of 11 species; Chipping Sparrows and Cedar Waxwings were the most abundant. These birds preferred parts of the tract where the trees were about 3 meters high and relatively open.

Nine other species were noted feeding in the plantation. The only known predator was a red squirrel, which probably destroyed some eggs.

It is concluded that a red pine plantation provides a very suitable habitat for birds.

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I wish to express my sincere appreciation to Dr. Olin Sewall Pettingill, Jr., who first suggested this project and who offered many valuable suggestions during the course of it. I also wish to thank William L. Foster for his assistance in measuring the plot. Finally, I am grateful to The University of Michigan Biological Station for the use of equipment and supplies.

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RADFORD COLLEGE, RADFORD, VIRGINIA, 5 SEPTEMBER 1962 (CONTRIBUTION FROM THE UNIVERSITY OF MICHIGAN BIOLOGICAL STATION)

IS THE BLACK VULTURE MIGRATORY?

Eugene Eisenmann

On a recent visit to Panama, while engaged in other studies, I observed during many days in November 1962, groups of Black Vultures (*Coragyps atratus*) moving eastward, seemingly toward South America. These movements occurred both morning and late afternoon in the same direction, and the manner of flight was that characteristic of migrating raptors—high soaring in upward spirals alternating with long glides. I have failed to find any published report of observed group migration in this species. In most of the current literature the Black Vulture is stated, without qualification, to be "resident" within its vast breeding range from southern United States to Argentina and Chile (1957. A.O.U. Check-list of North American Birds; 1950. Friedmann et al., *Pac. Coast Avif.*, 29:47). This is in contrast to the Turkey Vulture (*Cathartes aura*), which, although much less gregarious than the Black Vulture during the breeding season, is known to migrate in large flocks.

C. W. Townsend (*in* Bent, 1937. U.S. Natl. Mus. Bull. 167:28) characterized the Black Vulture as "a resident throughout its breeding range, except in the extreme northern parts," adding that "a marked spring migration does not occur." This might seem to imply autumnal migration, but the account failed to include any information as to migration, fall or spring. Most publications relating to eastern United States near the northern limit of the breeding range indicate that Black Vultures are present all the year, e.g., Maryland (Stewart and Robbins, 1958. *N. Amer. Fauna*, 62:106–107), Ohio (Thomas, 1928. Ohio St. Mus., *Sci. Bull.*, 1(1):29–35). However, in the southwest, Black Vultures are reported to disappear in winter from the northern sector of the breeding territory, e.g., northern Texas (Wolfe, 1956. "Check-list of the birds of Texas," p. 18), and northern Oklahoma (Nice, 1931. *Publ. Univ. Okla. Biol. Surv.*, 3(1):67); but group migration seems not to have been reported Perhaps in the arid southwest winters cause a relatively greater reduction in vulture food, necessitating withdrawal.

Even Turkey Vultures are said to be usually out of New Mexico by mid-October (Ligon, 1961. "New Mexico birds and where to find them," p. 57). Yet farther north, Turkey Vultures, although at least partially migratory, are present in winter at or near the northern limit of most of their breeding range, e.g., Connecticut (Mackenzie, 1961. "Birds of Guilford, Connecticut," p. 38), New Jersey (Fables, 1955. "Annotated list of New Jersey birds," p. 25), California (Grinnell and Miller, 1944. *Pac. Coast Avif.*, 27:94).

OBSERVATIONS IN PANAMA

The vulture observations were made in or near Panama city, where the twist of the isthmus places the Pacific Ocean immediately to the south, and

South America toward the east. The observation site (unless otherwise indicated below) was the garden of my brother's home in an eastern suburb located about a half mile north of Panama Bay and roughly midway between two favorite feeding places of the vultures, the fishermen's harbor of Panama to the west, and a garbage dump at Old Panama, some three miles to the east. This is mentioned because I considered the possibility that the vultures might be moving between these places, until I found that the movement was eastward and well north of the dump. My site was in level, open country, formerly savanna, with hills rising to the north; in all directions it afforded a sky view, which was practically unobstructed toward the east and northeast.

I arrived in Panama on 3 November and left on 20 December, but was away from the observation area during part of November and almost all of December. Shortly after my arrival I noticed groups of Black Vultures overhead. At first I gave no attention to them, for I assumed that they were engaged in ordinary gregarious soaring. Such soaring I had often noted in Panama, at all seasons during sunny middle hours of the day, especially between 10:30 AM and 2 PM. The "normal" circling flocks may include frequently one or more Magnificent Frigatebirds (*Fregata magnificens*), an occasional Turkey Vulture, and, during the northern hemisphere winter, very rarely a northern *Buteo* or two.

Differences in the November situation soon attracted my attention. The vulture flocks often included *Buteo* hawks, apparently of migratory North American species. The manner of flight, high upward circling alternating with long glides in a distinctly eastward direction, seemed unlike ordinary soaring. The unidirectional character of the movement, both morning and late afternoon, was highly suggestive of migration. The flight direction did not correspond with wind direction, so far as I could determine. November is a comparatively windless month in Panama. On two occasions I tested the slight breeze at ground level and found it was from the south to southeast, while vultures were moving (high above, to be sure) essentially toward the east, with a northeast inclination.

The flight route of the vultures agreed generally with that taken by Barn Swallows (*Hirundo rustica erythrogaster*) migrating in numbers through the area during the entire month of November. These swallows flew much lower, tended to follow the coastline more closely, and began and ended their flights earlier in the day. The general direction was also that taken earlier in the season by the larger migrating flocks of Turkey Vultures and Swainson's and Broad-winged Hawks (*Buteo swainsoni* and *B. platypterus*), except that these migrants often use the updrafts along the mountain ridges, so that along the Pacific slope flights usually are somewhat more inland. On the eastern

Caribbean slope, where ridges approach the sea, vast October flights of migrant raptors occur over the coast.

As the inference of Black Vultures migration is admittedly based on inconclusive data, the evidence is given from my notes in some detail (including mention of Turkey Vulture migration to the extent noted during the same period). It is hoped that information from other students may be elicited.

On any days not mentioned below I either was absent from Panama city or, if present, made no observations on Black Vultures. For completeness the brief observations of 5, 6, and 8 November and of 4 and 20 December are included, although I failed to determine the direction (if any) of flight. The birds seen circling on 6 November, in the late morning of 20 November, and during December may well have been engaged in ordinary soaring.

5 November. Late afternoon, circling Black Vulture groups (direction of movement, if any, not noted).

6 November. 11 AM, high circling flock of Black Vultures including two immature frigatebirds (direction of movement, if any, not noted).

8 November. Late afternoon. High circling Black Vulture group (direction of movement, if any, not noted).

9 November. 9:30–10 AM, several high spiraling flocks of 40–50 Black Vultures glided in an eastward, somewhat northeastward, direction. The first flock, seemingly migrating, included six *Buteo* hawks, the second two, some of which showed the distinct tail banding of Broad-winged Hawks.

4:35–5 PM, three flocks of migrating Turkey Vultures, each of about 50 (including one or two Black Vultures and two or three *Buteo*), spiraling high and gliding eastward and somewhat northeastward.

20 November. 10:15–10:30 AM, two flocks, each of about 100 Black Vultures, each including one *Buteo*, spiraled very high and then glided eastward. At the same time a Turkey Vulture (not a member of the flock) was sailing much lower, tending to go westward. Later in the morning, groups of 10–30 Black Vultures (including one frigatebird) soared high, seeming to drift westward not eastward, not suggesting migration.

5:30–6 PM. From 5:40–5:58, two Black Vulture flocks (20–30 in each) spiraled high then glided eastward, followed at same altitude and direction by four laggard birds. During the same period some Black Vultures (seemingly local birds) were flying well below these flocks and drifting westward. At 6 PM, a single Black Vulture cruised low in no particular direction.

21 November. Chepo (about 30 miles east of Panama city); midmorning: group of 15–20 Turkey Vultures traveling eastward very high with two *Buteo* hawks, seemingly *B. swainsoni.* At the same time two undoubtedly adult, light phase, Swainson's Hawks were cruising very low (one had a hanging foot) and also perched. Black Vultures seen in area were not traveling.

22 November. 4–6 PM. From 4:15–5:35, flocks of 12–30 Black Vultures spiraled and glided eastward, the two flocks before 5 PM, flying high, included one or two *Buteo* hawks seemingly *swainsoni*, and also one very big raptor, mainly dusky with white on lower underparts, larger than the Black Vultures and having a greater wingspread than a Turkey Vulture, with oblong flat wings and short head and tail (probably an immature King Vulture, *Sarcoramphus papa*). There were no Turkey Vultures in these flocks, but one or two individuals cruised below them until shortly after 5 PM.

29 November . At Old Panama (observations at the shore); 9–10 AM. Between 9:15–

9:50, several Black Vulture flocks spiraled in from the west and sailed northeastward. The flocks included several *Buteo* hawks. One *Buteo* had the conspicuous tail banding of a Broad-winged Hawk, and four, with all white underparts (except tips of flight feathers), lacking evident banding on the short tail and having half the bulk of a Black Vulture, suggested the light phase of the Short-tailed Hawk (*B. brachyurus*). Independently, flying high (not soaring) eastward, somewhat farther inland, was a flock of nine Wood Ibis (*Mycteria americana*).

Between 5–5:45 PM, at the usual suburban observation point in Panama city, several groups (averaging about 20) of Black Vultures were observed spiraling high and sailing eastward.

30 November. 9–9:30 AM, several groups of Black Vultures spiraling high and gliding eastward. One group included five *Buteo* hawks, most of which suggested Swainson's Hawks; at least one bird apparently melanistic; another like a light-phase Short-tailed Hawk.

4–6 PM, many successive groups of Black Vultures (10–40 in a group), between 4:15–5:50 PM, spiraling and gliding eastward. For the afternoon alone my estimate of migrating Black Vultures exceeded 250. One to three Turkey Vultures drifted low over the area but in no distinct direction.

4 December. Old Panama; 9–11 AM. At about 10 AM (while observing other birds) noticed a soaring flock of Black Vultures, including one Osprey (*Pandion haliaetus*) over seashore, but failed to note whether there was directional movement. The Osprey was one of two wintering individuals.

17 December. 4:30–5:35 PM; clear afternoon. Watched especially for Black Vultures. No spiraling or gliding eastward observed. The only Black Vulture flock seen consisted of 20, at 5:20 PM, noticed at a distance circling over Old Panama, apparently over the garbage dump. This flock broke up and the individuals drifted westward, flying rather low—presumably going to roost.

20 December. Old Panama; 9–11AM, while at the seashore, noticed, at about 10 AM, a circling flock of Black Vultures, but observation of other birds prevented me from determining whether the vultures were moving in any particular direction.

DISCUSSION

The manner of flight of the Black Vultures and their eastward direction, both morning and afternoon during November, strongly suggested migration. It may seem puzzling that movements of this sort have not been reported previously if they are regular. However, Panama in November does not attract ornithological observers, for much rain falls and few birds are breeding. Students give little attention to Black Vultures, and their habit of soaring in groups all year makes it easy to overlook migrating flocks. To distinguish between gregarious soaring and migratory spiraling would usually require an extensive sky view, which is hard to get in wooded areas. It is possible, of course, although I think it unlikely, that what I saw was a local movement. Certainly Black Vultures were commonly present throughout Panama during my entire stay. Some were probably even breeding in November.

This is inferred because C. Koford (in litt.) found two "nearly fledged young" in a cave at Portobelo, Panama, on 9 February 1957, and in this species the period between laying and fledging is reported to require well over three months (Bent, op. cit.:33-34).

Nevertheless, part of a population may be breeding while another part may be traveling. (This seems true of the Turkey Vulture in the United States, where the peak of egg laying is in April [Bent, op. cit.:28], when flocks, presumably of northern birds, are still migrating through Panama. Although most migrating flocks in Panama are noted in March, extreme dates run from 24 February to 30 April.)

The numbers of Black Vultures passing through Panama in November suggest that they originated much farther north, possibly in a region that becomes more arid during the northern winter. This is not inconsistent with "permanent residence" of the species as such. Adults might well remain on or near the breeding grounds while juvenals might be migratory. The return migration in the spring might be less conspicuous, involving fewer individuals, if young birds remained near winter quarters for a year or more, until they approached breeding age. I have found no published information as to the age at which Black Vultures first breed, but the scant data available as to certain other Cathartidae (Koford, 1953. "The California Condor," p. 80) suggest that breeding would probably not occur until they are several years old. Immatures of a number of North American birds that do not breed the first year are known to remain in the tropics for at least a year; this is certainly true of the Osprey and of many gulls, terns, and shorebirds (see Eisenmann, 1951. *Wilson Bull.*, 63:181–185). Moreover, in a number of nonpasserine species birds of the year regularly migrate much farther than adults. The presence of a species in an area throughout the year may create a deceptive impression as to the extent of migration. For example, the Herring Gull (*Larus argentatus*) as a species may seem a permanent resident on the Atlantic coast of northeastern United States; yet banding data show that young birds migrate long distances, even to tropical waters, and that adults may move about (Gross, 1940. *Bird-Banding*, 11:129–155).

Additional observational information would be useful, but definite confirmation of Black Vulture migration will probably require collecting—not too easy with birds flying high. Determining *exact* place of origin is not practicable except through recovery of marked individuals. Distinguishing northern migrants from the tropical natives may be feasible by specimen examination. Recently Wetmore (1961. *Smith. Misc. Coll.*, 145(1):1–4) reported that northern Black Vultures (from the United States and northern Mexico) can be separated by size and color from those breeding in the tropics. Whether these distinctions hold for first-year birds is not expressly stated. However, juvenal specimens can be distinguished from older birds, and if evidence were obtained that the flocks moving in the direction of South America consisted mainly of first-year birds, that would itself be strongly indicative of migration.

SUMMARY

The Black Vulture is generally stated to be a resident species; published information seems lacking as to any group migration. Observations made in Panama during November 1962 of groups of Black Vultures moving eastward (apparently in the direction of South America), often accompanied by migratory *Buteo* hawks, suggest that this species may be partially migratory.

The possibility is advanced that younger birds may be migratory, while breeding individuals may be essentially sedentary.

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NEW LIFE MEMBER

M. Graham Netting, of Pittsburgh, Pennsylvania, an active member of the Wilson Ornithological Society since 1941, is a new Life Member. Dr. Netting received his B.S. degree from the University of Pittsburgh, his M.A. degree from The University of Michigan, and his Sc.D. degree from Waynesburg College. Since 1922 he has been associated continuously with the Carnegie Museum, rising through the position of Curator of Herpetology to his present post, Director of the museum. In addition, he is Associate Professor of Geography at the University of Pittsburgh. His ornithological interests include ecology and conservation.

Dr. Netting, a photographer, is widely known as a museologist, herpetologist, and conservationist. Scores of his scientific papers and other articles have appeared in scientific journals, magazines, and newspapers. Some of the organizations to which he belongs are: Sigma Xi, Phi Beta Kappa, Phi Sigma, American Society of Ichthyologists and Herpetologists (former secretary and past president), Association of Science Museum Directors (past chairman), National Parks Association (trustee), Nature Conservancy (governor and life member), Soil Conservation Society of America (past president of Keystone Chapter), Pittsburgh Zoological Society (director), Recreation, Conservation, and Park Council of Allegheny Conference on Community Development (chairman), and Western Pennsylvania Conservancy (director and secretary). Also, he is past chairman of the United Smoke Council of the Allegheny Conference, the citizen's group instrumental in promoting the smoke control program in Pittsburgh and Allegheny County.

AN INVESTIGATION OF FALL-MIGRATING DOWITCHERS IN NEW JERSEY

Joseph R. Jehl, Jr.

During July and August, the Short-billed Dowitcher (*Limnodromus griseus*) is one of the commonest of the shorebird migrants along the Atlantic seaboard. Two populations, the nominate race, *griseus*, and the interior race, *hendersoni*, are known to migrate coastally (Pitelka, 1950) but their relative abundance has not been investigated thoroughly. Pitelka suggested that on the central and southeast coast *griseus* outnumbered *hendersoni* by 2 or 3 to 1, but that north of Chesapeake Bay the proportion of *griseus* increased rapidly. Specimen data from Massachusetts (Griscom and Snyder, 1955) suggest that *griseus* may be more than twenty times commoner there than *hendersoni*. Griscom and Snyder also considered all July migrants as the nominate race and implied that *hendersoni* was a later migrant, arriving in August after the peak of *griseus* migration. Their conclusion was tentative, however, for they emphasized that "local specimens of supposed *griseus* are quite inadequate and badly need supplementing."

The Long-billed Dowitcher (*L. scolopaceus*) is generally thought to be a late September and October migrant along the east coast, but its exact status is uncertain. In examining virtually all dowitchers in American collections for his monograph, Pitelka (1950) found that "on the basis of specimen evidence, *griseus* and *hendersoni* together outnumber *scolopaceus* on the Atlantic coast by about 10 to 1"; Massachusetts specimens alone show a 5 to 1 ratio (Griscom and Snyder, 1955). Most field workers in the northeast would consider these ratios very highly biased in favor of *scolopaceus*.

The reason for this discrepancy is probably twofold: (1) unfamiliarity of field workers with *scolopaceus*, and (2) highly selective collecting. These alternatives are not mutually exclusive. However, I believe that the second is more important, and that the ratios from the specimen data are untenable. Moreover, we must note that the race *hendersoni* was not proposed until 1932, and that perhaps the bulk of east coast specimens were taken before that date. It follows that earlier collectors, in selecting for the larger, brighter, longer-billed *scolopaceus*, unwittingly took many examples of the then undescribed *hendersoni*. Therefore, the proposed *griseus* : *hendersoni* ratio is also open to question. Regardless of the actual ratio, Pitelka's (1950) finding that the proportion of *griseus* to *hendersoni* decreases southward along the Atlantic coast is valid beyond question.

This paper presents the results of a brief investigation of fall-migrating dowitchers along the New Jersey coast, which attempted to determine: (1)

the relative status of the races of *L. griseus*, (2) the status of *L. scolopaceus*, and (3) the basis for inferring that races of the short-bill migrate at markedly different times.

METHODS

This report is based mainly upon a small series of dowitchers collected from the barrier beach and tidal mud flats of Ocean County, New Jersey, during the summers of 1958 and 1959. Some field work and supplemental collecting were continued in this area through 1961. Adult dowitchers in breeding plumage were taken throughout the summer, commencing with their arrival in early July. The end of the collecting period, in mid-August, was determined by the departure of adult birds, and the assumption of winter plumage. Winter plumaged short-bills are identifiable to race only on mensural characters (Pitelka, 1950), in which there is a great deal of overlap.

Nearly all specimens were taken nonselectively by firing into small flocks, but there was some slight, conscious selection for individuals of *hendersoni*. Counts of dowitchers present at several localities were made weekly, and the *griseus* : *hendersoni* ratio was visually estimated.

In the summer of 1962, field work was confined to the brackish Hackensack River marshes near Lyndhurst, Bergen County, New Jersey. These extensive marshes are dominated by vast stands of *Phragmites*. A few selected specimens were taken here.

Identification.—Using Pitelka's (1950) criteria, I found little difficulty in separating breeding–plumaged adults of *griseus* and *hendersoni* in the field. Very briefly, *hendersoni* may be distinguished from *griseus* on the basis of extended reddish on the underparts, reduced ventral spotting, and the more golden dorsum, a reflection of the wider, buffier feather edgings in this race. Immature dowitchers are easily distinguished from adults, but even in the hand a great many cannot be named to race.

Adult Long-billed Dowitchers may be distinguished from *hendersoni* by the deeper salmon red of the underparts, the barred throat, and the dark dorsum. My field observations agree with Rowan's (1927) findings that *scolopaceus* often retains its breeding plumage longer than either *griseus* or *hendersoni*. Many, if not most, long-bills reaching the Atlantic coast in mid-August are still in this plumage; they are easily separated from short-bills, which by this time are decidedly gray. Replacement of the head feathers apparently takes place early in *scolopaceus'* postnuptial molt. The result is that adult long-bills in late August take on a very *gray-faced*, red-bellied appearance, which is distinctive.

Juveniles of *L. scolopaceus* may be distinguished from young *L. griseus* under favorable field conditions, the former being darker above and grayer below, especially on the neck and chest. Adults in winter plumage are difficult to separate by morphological characters. Bill length, except in extreme cases, is not a valid field mark, for some female short-bills have longer bills than some male long-bills. (For a full discussion of this problem see Pitelka, 1950.)

Voice.—Although some earlier writers (e.g., Nichols, 1920) reported that they were unable to separate the dowitchers on the basis of call notes, most recent workers (Nisbet, 1961; Peterson, 1961; Small, 1958) agree that the calls of the two species are diagnostic. A whistled *tu-tu-tu*, reminiscent of the call of the Lesser Yellowlegs (*Totanus flavipes*), is characteristic of *griseus*, while a single-noted *keek* is ascribed to *scolopaceus*. Agreement on the value of this character is not universal (cf. Eisenmann, 1961, 1962; Bull, 1962). Eisenmann (1961) cogently observes: "So far as I am aware, nobody has demonstrated by collecting an adequate series of calling dowitchers that it is *scolopaceus* and *only scolopaceus* that utters the single 'keek.' Quite possibly *scolopaceus* may have calls that are recognizably different from nominate *griseus*, but for all we know that may also be true of *hendersoni*."

In my experience, the distinct call notes constitute the most reliable basis for separating the species in the field. The following observations are relevant. First, the familiar *tu-tu-tu* of the short-bill is the only call issuing from the tremendous flocks of dowitchers along the New Jersey shore from early July through mid-August, the peak migration period for *L. g. griseus*. Moreover, it is the only call heard in this region during the spring migration, when long-bills do not occur. Second, the race *hendersoni*, many individuals of which may be identified under field conditions, is a common July and August migrant; its call, to my ear, is indistinguishable from that of nominate *griseus*. Later-migrating, immature short-bills give identical calls. Third, the single, strident note, which I have generally recorded as *kee*, is not usually heard before mid-August, the beginning of *scolopaceus*' migration period, and even then only rarely from the tidewater regions. I have identified many individuals of *scolopaceus* in breeding plumage which have given only this call. When the birds are alarmed, the call is often trebled or drawn out into a long *kee-kee-kee*. . . . Immature birds give identical calls. Fourth, Dr. Pitelka writes (pers. comm.) that on the Alaskan breeding grounds difference in call note between *scolopaceus* and *L. g. caurinus* is similar to that described above.

In summary, the *tu-tu-tu* call of the short-bill seems to be independent of age, season, or race, while only long-bills, adult or immature, are known to utter the single *keek*. Field work in the nesting regions may determine whether the long-bill has some notes which resemble those of the short-bill. However, in my opinion, there is no reasonable doubt that the *keek* note is confined to *scolopaceus*.

STATUS IN NEW JERSEY IN FALL

L. g. griseus.—Specimens taken: adults, 45; immatures, 3. Dates: 30 June–26 August.

The eastern short-bill is the commonest dowitcher along the tidewater. Cruickshank (1942) found that migrants begin to arrive in late June in the New York City region and that "numbers rapidly increase until maximum abundance for the entire year is reached during the last two weeks of July. During August numbers gradually drop off, but there is often a noticeable influx in early September."

My field work indicates that some nonbreeders summer each year. These birds often have undergone incomplete molts; their mixed plumage easily distinguishes them from the early July migrants.

Weekly censuses have shown that there are three, not two, peaks in fall migration. A few birds may arrive in early July, but the first real influx comes with a tremendous rush, usually about 10 July, with hundreds of birds arriving almost simultaneously. Maximum numbers for the year are reached immediately; the highest count is 10,000 ± 1,500, at Brigantine Refuge, Atlantic County, 9 July 1960. These first migrants remain for up to two weeks, and numbers are usually greatly diminished by the end of July. The second influx, which occurs in late July or early August, is not as pronounced as the first. The beginning of this movement may not always be evident to the field observer because some birds from the first movement linger along the coast. Birds arriving in this movement also linger for a week or two, but most depart by mid-August.

Numbers build up again in mid-August with the arrival of birds of the year. Occasionally a juvenile may occur as early as 8 August, but generally it is not until the fifteenth that they appear in small flocks. Young continue to arrive into early September. Because this movement is protracted, numbers involved are never so great at any one time as in either earlier movement. Only a few stragglers remain by the end of September.

Migrants arrived in the Hackensack River marshes on 4 July 1962, and a flock of 250 was present by mid-July. Nearly all of these birds were referable to *L. g. griseus*. The first young birds were seen on 12 August.

L. g. hendersoni.—Specimens taken: adults, 12; immatures, 1. Dates: 30 June–14 August.

A few examples of this race have been found summering at Beach Haven, Ocean County, recently (one specimen), and undoubtedly several summer each year. The arrival of postbreeding birds coincides with the first arrival of *L. g. griseus*, although the main flight appears to average several days to a week later. Weekly field estimates in Ocean County indicate that about 10 per cent of the adults observed were probably referable to this race. The highest percentage noted was 30 per cent (of 450 birds at Beach Haven, 18 July 1959), but this may be an artifact caused by a somewhat earlier emigration of *L. g. griseus.* The highest count for this race is about 1,000 (10 per cent of the estimated 10,000 at Brigantine, 9 July 1960).

L. g. hendersoni is extremely rare in the Hackensack marshes. Only about 1 per cent of the dowitchers observed there could be definitely ascribed to this race. I suspect that this is a significant reflection of the migration route (see below), but no firm statement can be made on the basis of one summer's observations.

The arrival of juveniles is probably synchronous with the arrival of young *griseus*; one juvenile *hendersoni* was taken in the Hackensack marshes on 14 August. Further collecting will probably do little to clarify this point, for only extremely large individuals of *hendersoni* can be identified in the hand in juvenile plumage.

I would suggest that the adult *griseus* : *hendersoni* ratio is about 8 or 10 to 1 in Ocean County. The immature ratio is underminable.

My data do not support the suggestion that *hendersoni* is a later migrant than *griseus.* Furthermore, Pitelka (1950) lists mid-July specimens of this race from Long Island to Florida. Evidently, postbreeding adults which migrate in July and early August move directly to the mid-Atlantic coast, and occur only rarely north of the mid-Jersey coast. The New England records, however, are concentrated in late August and early September (Pitelka, 1950; Griscom and Snyder, 1955) during the migration period of the young birds. It is reasonable to assume that these records actually refer to birds of the year, which in most species studied, follow less precisely defined migration routes than do adults.

I have detected no differences in habitat utilization between *griseus* and *hendersoni.* Any suggestion that *hendersoni* lingers along the northeast coast later than *griseus* is speculative. Scattered reports of short-bills inland in the northeast probably refer to this race.

L. scolopaceus.—Specimen taken: adult, 1. Date: 13 August.

Since the preference of this western species for fresh-water ponds is well documented, it is not surprising that I was unable to collect any long-bills from the Ocean County flats. In fact, on only the rarest occasions was I able to identify this species in the area. The bulk of my collecting, though not observing, was completed prior to the usual arrival period of this species.

However, long-bills do occur with some frequency on the impounded brackish ponds of the Brigantine Refuge. In 1959 and 1961, I encountered flocks of 35 and 55 birds there on 15 August, a date which would be considered unusually early by most observers. These flocks consisted largely of adults in breeding plumage, although one flock contained several immatures. There were no short-bills in either of these flocks, yet many were present elsewhere on the refuge. It is quite possible that these birds had just arrived, for there was no obvious difference in the feeding areas.

Most sight records are from September and early October (Kunkle et al., 1959) and probably refer to birds of the year (see Pitelka, 1950).

In the Hackensack region long-bills freely associated with short-bill flocks. The first bird was observed on 21 July, and a few birds were seen through 14 August, with a peak of about 10 on 13 August. No birds were seen between 14 August and 1 September, at which time I had to cease observations.

Extensive efforts were made to collect this species, but the birds were extremely wary. One male in heavy molt, including primaries, was taken on 13 August.

It should be obvious that the question of the *griseus* : *scolopaceus* "ratio" in fall along the northeast coast is largely academic, because it assumes that the entire migration periods of both species are in synchrony. This is not so. *Scolopaceus* probably cannot be expected with any regularity until mid-August. Prior to this time there is essentially no ratio—all birds may be assumed to be *griseus* subspecies. What is relevant to the field worker is the ratio after *scolopaceus* begins to arrive (the actual "migration period" of *scolopaceus* may begin several weeks earlier, since the birds must travel over 4,000 miles to reach New Jersey from the Alaskan breeding grounds). This ratio still cannot be determined satisfactorily. Long-bills occur in varying numbers each year, and the number of short-bills lingering fluctuates with the fall weather conditions. Perhaps the most definite statement that can be made is that even after 1 September *scolopaceus* is the much less common form along the coast. There is no justification for assuming later migrants to represent the western species simply on the basis of date.

Differential migration by sex and age in L. g. griseus.—As noted above, there are three peaks in fall migration. Bent (1927) suggested that "probably the first arrivals are birds that, for one reason or another, have failed to raise broods of young, for the time elapsing between late-spring migration and the early fall flight is not sufficient for successful breeding."

The sheer numbers of early migrant dowitchers should have warned against any such conclusion. It is now clear that the composition of each migratory peak is highly characteristic (Fig. 1). The first is composed largely of post-breeding adult females; that these birds have actually laid eggs is evidenced by the presence of unresorbed blood on the ovarian follicles of over 90 per cent of the females collected in early July. A few males with small testes are mixed in with these flocks, and it may be that nonbreeding males migrate

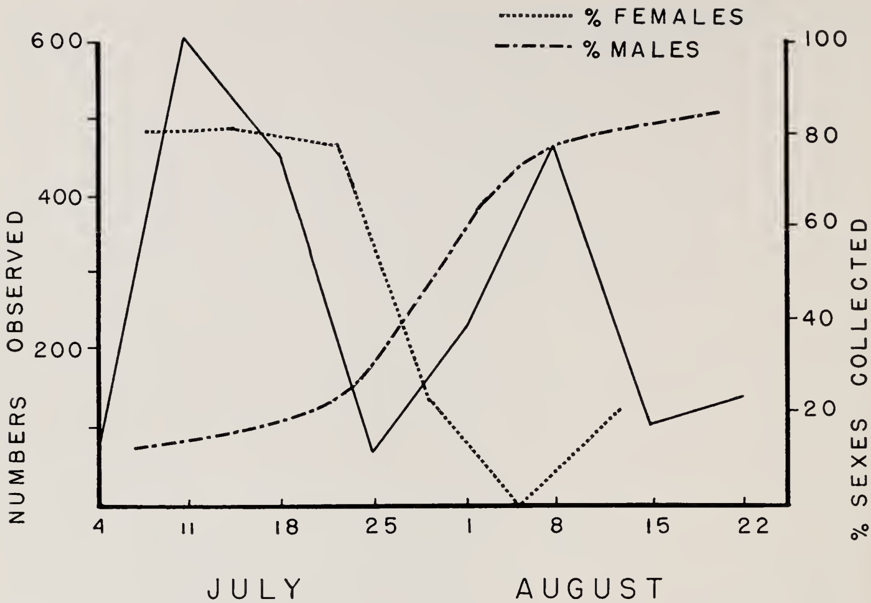

Fig. 1. Numbers of Short-billed Dowitchers (*L. griseus* subspecies) observed at Beach Haven, Ocean County, New Jersey, July–August 1959, and per cent by sexes collected. The per cent female curve is calculated from the data (55 specimens, 1958–62). Instead of being graphed as a mirror image of the female curve, the per cent male curve has been fitted to the data and probably represents the average annual arrival pattern.

from the breeding grounds with the breeding females. The second peak, in late july, consists mainly of adult males, while the young, as noted, do not make an appearance until mid-August.

Because of apparent nonrandom sampling and the lack of collecting throughout the course of a season, sex ratios as well as species ratios computed from specimens in existing collections may fail to indicate differential migration. Furthermore, collections of significant size are often broken down and housed

Table 1
Weights of Fall-taken Adult Dowitchers

Race	Sex	Number	Range and average (in grams)
griseus	♀	30	82.5–153.6 (116.2)
griseus	♂	12	73.0–153.0 (110.5)
hendersoni	♀	3	114.0–121.5 (117.0)
hendersoni	♂	7	75.3–129.0 (99.9)

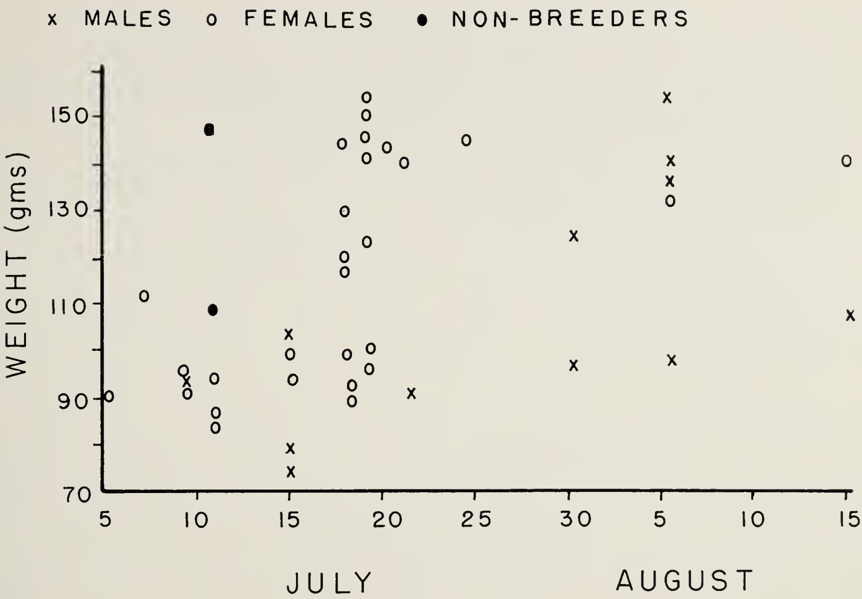

Fig. 2. Weights of fall-taken adult *L. g. griseus* presented by date of collection. The earliest arrivals average about 90 grams. Fat reserves are replenished in 10 days to 2 weeks. Weights prior to departure approximate 145 grams.

in different museums. The researcher without access to all available collections must hope that the specimens available to him are truly representative. Therefore, I mention with some reluctance that a small series in the U.S. National Museum clearly illustrates differential migration. Eight birds taken on Long Island, New York, 14 July 1917, are all females, while nine birds taken by the same collector in Ocean County, New Jersey, on 28 July 1917 are all males.

The weights of migrating dowitchers, as presented in Table 1, are highly variable because of differing amounts of fat. However, when presented by date of collection (Fig. 2), they are more meaningful. The earliest arrivals of both sexes are very light and nearly devoid of subcutaneous fat; they average about 90 grams. Fat is laid on rapidly and maximum weights of 140–150 grams may be attained within 10 days. At this time the birds begin to depart (see Fig. 1). I extracted 49.4 grams of fat from a 139-gram female. This is slightly more than 35 per cent of the net weight, and I suspect that loads of 40 per cent are not uncommon.

DISCUSSION

Migration.—Most shorebirds are thought capable of making extended nonstop flights, and in this regard the dowitchers, as evidenced by their occasional occurrence in Britain (Nisbet, 1961), are no exceptions.

There are several reasons for believing that long nonstop flights are also characteristic of typical migrations, and that *L. g. griseus*, at least, reaches the northeast coast after a direct flight from the breeding grounds. First, as Bent (1927) pointed out, there is obviously no time for leisurely coastal movement if postbreeding birds are to arrive by early July. Second, high counts of dowitchers are apparently far larger in the region from Massachusetts to Virginia than elsewhere along the Atlantic coast, suggesting that the first leg of migration may be terminated in this area. Third, since dowitchers deposit substantial amounts of fat before leaving New Jersey, it is reasonable to suspect that a comparable amount is deposited before starting migration. Following Odum (1958), I have roughly computed that a dowitcher with the not-unreasonable load of 50 grams of metabolizable fat, being utilized at a rate of three times the "existence energy" of approximately 0.04 kcal/g/hr, could remain airborne for about 35 hours. An average speed of 35–40 mph (Cottam et al., 1942) would allow flight ranges of 1,200–1,400 miles. This distance is roughly the airline distance from Labrador to New Jersey.

If the above calculations are approximately valid, a bird leaving Labrador in the early evening would be expected to reach New Jersey with reserves expended in about a day and one-half. Interestingly, unpublished visible migration observations indicate that most dowitchers arrive in New Jersey in the early morning, while observations of birds departing in both spring and fall, are confined to the predusk hours.

Howell's (1932) data indicate that arrival dates in Florida average 10 days to 2 weeks later than in New Jersey, which leads me to suspect that dowitchers fly nonstop from the northeast coast directly to Florida and beyond, as soon as fat reserves are replenished.

The distance from central Manitoba to New Jersey is not much greater than the distance from Labrador to New Jersey. The synchronous arrival of *hendersoni* with *griseus*, and the relative scarcity of dowitchers inland, strongly suggests that many *hendersoni* reach the Atlantic coast after a nonstop flight from the breeding grounds.

Postulated breeding schedule of L. g. griseus.—Practically nothing is known of the breeding biology of any dowitcher, least of all the nominate race. The long-suspected Quebec–Labrador breeding grounds of this form have only recently been confirmed (J. Baird, R. C. Clement, pers. comm.). The demonstration of differential migration of sexes and the available migration data warrant some inferences about aspects of the eastern short-bill's annual cycle.

Spring migration of dowitchers in the northeast is never as pronounced as the fall flight. For example, the highest daily counts in Massachusetts are 400 in spring, 5,000 in fall (Griscom and Snyder, 1955); these writers suggested that the overland flight starts farther down the coast. In New Jersey the peak of the spring flight comes in late May. Thus, breeding females have only about 6 weeks in which to migrate to the breeding grounds and return.

Griseus arrives in Labrador in early June (R. C. Clement, pers. comm.) but may be prevented from establishing territories until ice melts from the inland marshes (J. Baird, in conversation). Birds "dammed up" by the weather may spend a week or so on the St. Lawrence coast (R. C. Clement, pers. comm.).

Some pair formation may be completed before arrival in the nesting areas. Such an adaptation would insure that nesting could be started as soon as the marshes open. Assuming that egg-laying is completed by 15 June, and that the incubation period approximates three weeks (Conover, *in* Bent, 1927), the role of the female can hardly consist of more than laying and occasional sharing of incubation during the first 2 weeks if an additional 10 days will be needed to lay on premigratory fat.

Young probably hatch in early July. Two "barely fledged" young were taken by H. Ouellet and R. McNeil at Boundary Lake, Quebec, on 28 July 1958 (W. Earl Godfrey, pers. comm.). Once flying, the young are on their own, for as I have shown, the males appear along the northeast coast in late July. The young follow about 2 weeks later.

It is probably fair to assume that the regular arrival of birds in early July indicates a synchrony in the start of nesting which, in some seasons at least, is climatically controlled. The breeding grounds of nominate *griseus* are undoubtedly confined to the interior of the Ungava peninsula. If we may treat this vast area as a climatological unit, it may be possible to arrive at some rough estimate of the number of breeding pairs of this race. For all practical purposes, *griseus* is exclusively a coastal migrant in which the breeding females arrive en masse along the northeast coast, primarily from Massachusetts to Virginia, in early July, and remain for about 10 days. A census made from the Del-Mar-Va peninsula northward at this time could probably give such an estimate—were the *griseus* : *hendersoni* ratio known for each census point.

While a number of important papers on the breeding biology of shorebirds have appeared in recent years, most species are still inadequately studied. The lack of definitive data might be circumvented in part, for some species, by a study of their migratory behavior. For example, species which arrive from their northern breeding grounds in early July, such as the Least Sandpiper (*Erolia minutilla*) and Stilt Sandpiper (*Micropalama himantopus*), may exhibit differential migration of sex classes, reflecting a strong division of labor with respect to nesting duties. On the other hand, the main arrival of a species in August probably indicates that both sexes share in rearing the young. Such studies need not be based entirely on collecting. Sexual dimorphism is great enough in some species that many individuals may be sexed by measurements.

Nisbet (1957) has presented evidence that the Ringed Plover (*Charadrius hiaticula*) and Dunlin (*Erolia alpina*), and possibly the Ruff (*Philomachus pugnax*), Eurasian Curlew (*Numenius arquata*), and Green Sandpiper (*Tringa ochropus*), have trimodal peaks in autumn migration. While his suggestion that different breeding populations migrate through England at slightly different times is probably true for some species, it would be instructive to reanalyze these migration peaks in terms of differential migration of the sexes.

SUMMARY

During fall migration along the New Jersey coast, *L. g. griseus* outnumber *L. g. hendersoni* by 8 or 10 to 1. *L. scolopaceus* occurs annually in small numbers after the middle of August.

Most breeding-plumaged adults of these forms may be identified in the field by morphological characters. Furthermore, difference in call note is a valid method of separating *L. scolopaceus* from *L. griseus*, subspecies.

In *L. g. griseus*, and undoubtedly in *L. g. hendersoni*, there are three main peaks in migration; the first, in early July, consists of postbreeding females; the second, in late July or early August, consists mainly of adult males; the third, extending from mid-August to early September, is composed of birds of the year.

L. g. griseus apparently reaches the mid-Atlantic coast after a nonstop flight from the breeding grounds; the same is probably true of *L. g. hendersoni*.

The demonstration of differential migration of sexes allows us to postulate several aspects of the still-unstudied breeding biology of *L. g. griseus*. It appears that females play only a minor role in incubation and probably do not participate in caring for the chicks. Thus, males must assume the bulk of the nesting duties, remaining on the breeding grounds until the young are able to fend for themselves.

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HABITS OF THE CHESTNUT-WINGED CHACHALACA

Alexander F. Skutch

The Chestnut-winged Chachalaca (*Ortalis garrula*) is a slender, long-tailed bird about 22 inches in length. In both sexes, the head and neck are dark gray. The upper parts of the body are grayish brown. The tail is darker brown, broadly tipped, especially on the outer feathers, with buffy gray. The wings, grayish brown when folded, show large areas of deep chestnut when spread in flight. The chest is grayish brown and the more posterior underparts are more buffy. The short, thick bill is pale bluish horn-color, becoming darker basally. Each yellowish brown eye is surrounded by a ring of naked, slate-colored skin. The bare skin of the cheeks and throat is red. The legs and toes are gray.

This representative of the guan family (Cracidae) of tropical America ranges from eastern Nicaragua to Colombia. In Costa Rica it occurs on both coasts and up to an altitude of about 5,000 feet (Carriker, 1910. *Ann. Carnegie Mus.*, 6:384), although I have not myself met it so high. In the Térraba Valley, where the following observations were made, it is common between 2,000 and 3,000 feet above sea level. Here the chachalacas dwell chiefly in older second-growth vegetation, where there are some fairly tall trees, too scattered to form a closed canopy, standing above dense, vine-laden lower growth. I have never seen them within heavy primary forest, and although they sometimes forage in shady pastures and plantations, they rarely venture far from the sheltering thickets.

Throughout the year, these chachalacas live in small flocks, which usually consist of about six to a dozen birds, so scattered that it is difficult to ascertain their exact number. When traveling, they straggle one behind another, much in the manner of toucans, rather than move in compact flocks like parrots. They rarely descend to the ground but spend most of their time in bushes and trees, where they walk with ease and grace along thin limbs. How elegantly slender the long-tailed birds appear as they rest, two or three together, on a high bough, silhouetted against the sky in statuesque immobility! When flying downward, they often set their spread wings, revealing the rich chestnut of the plumes, and glide for considerable distances. On an upward course, they rarely fly far, but ascend by means of short flights from branch to branch.

FOOD

Chestnut-winged Chachalacas subsist largely on leaves and fruits which they gather from trees and shrubs. I have watched them eating the foliage of the tuete (*Vernonia patens*), a tall composite shrub which in the dry season displays broad panicles of white flower heads. At times they swallow whole leaves, but more often they peck away pieces of leaves still attached to the bush. Another species of the Compositae on which they browse is the yellow-flowered shrub, *Oyedaea verbesinoides*. Leaf-eating seems to be rather widespread in the guan family. Once I watched three Crested Guans (*Penelope purpurascens*) spend half an hour stuffing themselves with the tender young foliage of a vine that had climbed over a tall dead tree at the forest's edge.

Of fruits, I have seen the chachalacas eat the hard, green, oily, olivelike drupes of the aceituno (*Simaruba glauca*), and the small black berries of *Hamelia patens*, a red-flowered shrub of the madder family. Formerly they came into our dooryard to feast on fragrant guavas (*Psidium guajava*), eating fruits which still hung in the treetops rather than those on the ground. In the dry season, they share with a great variety of smaller birds the finger-like, green, fruiting spikes of the spindly guarumo trees (*Cecropia* spp.). When pokeweed (*Phytolacca rivinoides*) grows rankly on a recently burned clearing in the forest from which maize has been harvested, the chachalacas descend into the dense low growth to gather the small, juicy, black berries, then fly up into the trees on the edge of the clearing to rest and preen in the sunshine.

In the dry season, the chachalacas descend in straggling flocks in the morning and again in the evening to drink from the nearest river. They walk along the branches which stretch far out over the channel and stand on the boulders that rise above the rushing current. At times they seem to find something to eat on these rocks and in the patches of gravel and sand exposed between them when the water is low, but I have not learned what attracts them in these places. Their thirst quenched, they return to the second-growth thickets where they feel safer. In the wet season, they seem to find enough water without visiting the larger streams.

VOICE

One who attempts to describe the utterances of the Chestnut-winged Chachalaca wishes that at least one of them were as easily paraphrased as the stentorian *cha-cha-lac* of its northern relative, *Ortalis vetula*. But these birds have no comparable note, nor do they engage in bouts of calling in which many individuals over a wide area participate, the vocal outbursts surging back and forth perhaps for miles, in the dramatic fashion of the northern Chachalaca. Hence, the chestnut-winged species bears the name "chachalaca," not in its own right, but on the strength of its close affinity to its more plainly colored congener.

The Chestnut-winged Chachalaca is a noisy bird with a variety of utterances, most of which are difficult to characterize. Frequently it delivers loud, rather high notes which seem like a surprised complaint, disappointing to one who expects to hear a vigorous challenge similar to that of the northern species. Sometimes this chachalaca gives high-pitched, long-drawn squeals that sound like *oooeee.* Or it may repeat a high, soft *white white white white.* A flock of chachalacas resting and preening in the sunshine after their morning meal mingled loud, harsh notes with others that were soft and low, including a sort of purr or rattle such as a domestic hen makes when she settles down to brood her chicks. Heard in the distance, the calls of this chachalaca have sometimes reminded me of the notes of the domesticated Guinea Fowl.

NEST AND EGGS

In the valley of El General, I have seen nests of the Chestnut-winged Chachalaca only from February to May; but its breeding season is probably longer than this, for I have seen half-grown birds at the end of January. The five nests that I have examined were situated in vine-draped bushes and small trees, or else in the midst of a tangle of creepers, in or beside the dense thickets which these birds frequent. In height these nests ranged from 38 inches to eight feet above the ground; three of them were between 4½ and six feet up. The nests were shaped like broad, shallow saucers, from nine to 12 inches in diameter, and were substantially made with a variety of coarse materials. A nest suspended in a tangle of vines was composed chiefly of slender lengths of vine. Another nest was made of coarse sticks, pieces of vine, inflorescences, and, principally, leaves. Many of the leaves had apparently been plucked and placed in the nest while green, and in drying, they had matted compactly together. The largest sticks were 13 inches in length and as thick as a lead pencil.

The lowest nest was composed chiefly of leafy grass stems, which seem to have been gathered while green. The builder had also twisted into her structure the tops of some long, slender grasses that grew beneath it, and these remained alive and green. The most exposed of the nests that I have seen was in a grassy opening amid tall thickets. Here stood a small, dying tree, the lower part of which was draped with a tangle of tall calinguero or molasses grass (*Melinis minutiflora*), which supported the nest 55 inches above the ground. The broad, shallow bowl was composed largely of the thin stems of this grass, compacted into a thick mat. It is evident that the chachalaca builds its nest with whatever suitable material is most easily available, and that it often uses green vegetation.

My earliest date for eggs is 7 February 1956, when I found a set of three that had evidently been newly laid. I have records of three sets of three eggs and of two sets of two eggs, but the smaller sets may have been incomplete, as they were in areas that had been disturbed by agricultural operations, in at least one case while laying was in progress. The eggs are dull white, with a rough shell that is often heavily pitted. The depressions in the surface of the shell vary in size and density even in eggs of the same set; they may be small, deep, and crowded, or larger and more scattered. Large and small pits are mixed together on some eggs, and I have seen sets without pits visible to the naked eye. One egg was sprinkled all over with embossed flecks of pure white, which varied in size from mere dots to flakes five millimeters in diameter and appeared to be composed of nearly pure lime. The second egg of the same set bore scarcely any of these flecks, but it was far more densely pitted than the first egg. Even when devoid of visible pits and flakes, the shells are rougher than those of any other kind of egg that I know. Often the chachalaca's eggs, like those of anis, are heavily stained by the green vegetation on which they rest. The measurements of 10 eggs average 58.2 by 40.3 millimeters. Those showing the four extremes measured 61.9 by 40.5, 59.5 by 42.5, and 55.6 by 38.1 millimeters. The eggs in a set of three found at Eden, Nicaragua, on 27 May were considerably smaller than those from El General, measuring 50.4 by 36.8, 51.5 by 36.6, and 52.0 by 37.7 millimeters (Huber, 1932. *Proc. Acad. Nat. Sci. Phila.*, 84:207).

INCUBATION

On 11 March 1946, we found a nest 5 feet above the ground in a tangle of vines at the edge of a thicket, beside a bushy pasture. The bird who incubated the three eggs was not especially shy and sometimes would permit me to approach within 10 or 12 feet before she slipped from the nest and disappeared into the mass of bushes and creepers behind it. In a blind set in the neighboring pasture, about 30 feet from the nest, I began to watch by moonlight on 21 March. The light of dawn revealed the chachalaca sitting with her tail toward me. When the beams of the rising sun fell on her, she turned to face it. Soon she panted, her red throat distended and conspicuous. She preened. At 7:31 AM she left the nest, and after an absence of an hour and 14 minutes she returned at 8:45, approaching inconspicuously through the dense vegetation behind it, silent and alone. For the remainder of the morning she sat constantly, often panting with her neck stretched up. She was extremely sensitive to heat, and toward noon she continued to pant although she was now in the shade. At 12:30 PM I left the blind.

On the following day, I again entered the blind by moonlight. Around sunrise, a flock of about six chachalacas passed twice through the neighboring trees, calling softly. The bird on the nest seemed indifferent to these intruders, whose presence suggested that pairs of chachalacas do not defend territories: perhaps these birds are polygamous. At 6:59, after the flock had passed, the incubating bird left her eggs for a recess of an hour and two minutes.

At 8:01 she returned as on the preceding morning, silently and alone. After she was well settled on her eggs, I left, to reenter the blind at midday, when it was cloudy and hot. The chachalaca sat steadily until 4:20 PM, and after she left I examined her eggs. Placing them against my ear, I heard active tapping in two of them, peeping in the third; but none of the shells was yet fractured. This time the parent stayed away for one hour and 17 minutes, returning at 5:37, again without an escort. As the sun set, a Chestnut-mandibled Toucan (*Ramphastos swainsoni*) sang in the top of a cecropia tree behind the nest, then chased a chachalaca from the treetop. At 6:00 I left the parent on the nest in the failing light.

I saw nothing to suggest that more than one bird, probably the female, participated in incubation. She took two recesses in the course of the day, one after sunrise and the other in the late afternoon, and the three outings which I timed lasted from 62 to 77 minutes.

On 7 February 1956, I found a nest with three eggs, slightly stained by the leaves on which they rested. The attendant of this nest, which was only 6 feet high, would sit impassive on her eggs while I stood watching her a few yards away. On the afternoon of 28 February, she was still incubating. On the following afternoon, she was absent and only three empty shells remained in the nest. The manner of their fracture left no doubt that they had hatched, after 22 or more days of incubation. In the northern Chachalaca, the incubation period is 22 to 24 days (Kendeigh, 1952. *Ill. Biol. Monographs*, 22:194).

THE YOUNG

At 6:00 AM on 23 March, I resumed my watch at the chachalaca's nest where I had heard the chicks hammering in the eggs on the preceding afternoon. For the next hour and a half, the parent continued to sit quietly, then she became restless, moving around on the nest and repeatedly rising up to look beneath herself. At 7:48 she picked up a piece of empty shell and moved it to the side of the nest. At 8:50 I first glimpsed a downy chick in front of her breast, and I heard soft *peep*'s. At 9:45 two chicks emerged in front of the hen, and ten minutes later I saw three chicks, whose down was already dry and fluffy. Soon the chachalaca turned in the nest to face away from the sun. Now she sat very high, with her wings raised and one of them crossing her rump. She panted in the hot sunshine. When a chick emerged in front of her, she gently billed its head. By 11:00 the chicks were often venturing forth from beneath their mother to move around beside her, panting as she did. She often billed them.

At 11:10 the parent left the nest to eat the berries from some bushes of *Hamelia patens* a few yards away. She plucked both black ripe berries and red unripe ones, sometimes hanging head downward to reach them. The chicks peeped softly while she left them exposed. After an absence of four minutes, she returned to the nest, her bare red throat distended with berries. She moved a red berry forward to the tip of her bill and held it there for several seconds while she mashed it, then took it back into her throat. She did this again and again. Her chicks moved around in front of her and sometimes pecked at the berry in the tip of her bill, but, as far as I could see, they did not eat. Five minutes after her return, the mother seemed to swallow all the berries, emptying her throat. Then she panted.

Presently a chick climbed to a slender dead vine about an inch above the nest's rim and perched there, but it had difficulty in keeping its balance and in less than a minute it returned to the nest. At 12:52 PM the mother again left the nest and ate more berries of *Hamelia* in the same place and manner as before. In five minutes she returned to the nest with her throat swollen with berries and moved one to the tip of her bill. A chick reached up and appeared to take and eat the berry. The mother swallowed the remainder. (These observations were made through eight-power binoculars from the blind 30 feet away.)

At 1:10 the parent left the nest and slowly climbed down through the tangled vegetation to the ground—a mode of departure which I had not previously witnessed. I looked in vain for the chicks to follow her. Ten minutes later, I emerged from the blind to remove a length of vine which had slipped down in front of the nest and obstructed my view of it. As I approached the nest, I found the chachalaca on the ground a few yards beyond it. She walked away slowly, calling softly. Without going near enough to the nest to see whether the chicks were still within it, I quickly returned to the blind and continued to watch. But when nearly an hour had slipped by without another glimpse of a chick, I went up to the nest to investigate. I found two empty shells in it and one on the ground beneath, but the chicks had vanished. Evidently they had left the nest along with their mother when she descended to the ground at 1:10 PM. Since I had not seen them leave, I cannot tell whether they jumped down, or climbed down through the tangled vegetation, or perhaps were carried down clinging to some part of her body. I am certain that she did not carry them down in her bill.

It was exasperating not to have seen the details of the chicks' departure after such long watching. At least I had learned that the chicks left the nest considerably less than 20 hours after their emergence from the egg (the shells had not even been fractured at 4:20 PM on the preceding day), and that their mother led them away over the ground. How the chicks reach the ground is the point that remains to be elucidated. The other parent did not come to assist at this important occasion, a fact which strengthens my conclusion that only one parent had attended the eggs. At a nest of the Marbled Wood-quail

(*Odontophorus gujanensis*), the male came to help lead off the newly hatched chicks, although only the female had incubated (Skutch, 1947. *Condor*, 49: 227–229).

On the evening after the departure of the three chachalaca chicks, I watched to see whether they would return to their nest to be brooded, but neither parent nor chicks came near it. Whether the latter are brooded on the ground, or carried up into a tree or bush for the night, as is said to be true of the northern Chachalaca, I do not know.

After her chicks can move around, the parent rejoins her flock with them. At first she seems to lead them over the ground, although ordinarily chachalacas forage chiefly in bushes and trees. While passing through second-growth woods on 17 April 1948, I found a chachalaca walking over the ground, followed by several young chicks, who vanished before I could see them well. A number of grown chachalacas were among the neighboring trees and bushes.

Long before they are full-grown, the young chachalacas take to the boughs and vines along with their elders. In April of an earlier year, a flock of chachalacas frequented my dooryard to eat guavas. One morning they were accompanied by three young, about the size of a Black-faced Antthrush (*Formicarius analis*). While the adults were in the guava trees, the young birds stayed in the neighboring hedge, where they walked dextrously along slender branches, repeating rapidly a sharp, clear *pip pip pip*. The young are fed by their parents over a considerable interval. On 31 January 1937, I watched a half-grown chachalaca perch close beside an adult in a tuete bush, while the latter plucked pieces of leaf and passed them to the youngster. Later, the half-grown bird foraged for itself.

Of the five chachalacas' nests that I have seen, two produced three chicks each and two were abandoned when the surrounding vegetation was cleared away to plant maize. The fifth nest was invaded by termites, which deposited a good deal of clay on the three eggs. The parent continued to incubate even after her eggs were heavily encrusted with clay, but after a few more days they vanished.

SUMMARY

Chestnut-winged Chachalacas live, in straggling flocks of about six to 12 birds, in the dense second-growth of the humid tropics. They prefer vegetation in which scattered tall trees stand above impenetrable, vine-entangled lower growth. They walk with ease along slender boughs. They fly downward with long glides but they generally ascend by short flights from branch to branch.

Chachalacas forage chiefly above the ground and subsist principally on green leaves, especially those of certain shrubs of the composite family, and a variety of berries and larger fruits. In the dry season, they descend in the morning and evening to drink at the nearest river.

These chachalacas utter a variety of notes that are difficult to paraphrase. They lack a strong, distinctive utterance and a communal vocal performance similar to that of *Ortalis vetula.*

In southern Costa Rica, nests were found from February to May, but the breeding season is evidently longer than this. Nests are situated in vine-draped bushes and small trees or in the midst of a tangle of creepers, at heights ranging (in five cases) from 38 inches to 8 feet. The broad, shallow saucers, from 9 to 12 inches in diameter, are substantially made of a variety of coarse materials, including sticks, pieces of vine, grass, and leaves. The nest often includes green vegetation which stains the eggs.

The set consists of three or, less often, two eggs. The dull white shell is often deeply pitted and sometimes it bears embossed flecks of pure white. Even in the same set, the eggs vary greatly in these features, but all are rougher than most birds' eggs.

Incubation is performed by a single parent, evidently the female, who takes two recesses each day, one in the early morning and the other in the late afternoon. Three absences ranged from 62 to 77 minutes in length. The incubation period is 22 or more days.

A few hours after they hatch, the downy young can perch, at least briefly. A parent with newly hatched chicks filled her throat with berries and, after mashing one in her bill, presented it to them between the tips of her mandibles. Soon after the chicks were dry, the parent led them away over the ground. The manner of their descent escaped me; they were not carried down in the adult's bill. Only one parent was seen to take an interest in the nest.

The parent with chicks rejoins her flock, and at first she may lead her brood over the ground while her companions move through the trees and shrubs above her. Long before they are full-grown, the young also travel through the trees and bushes. They receive at least some of their food from the parent's bill until they are about half-grown.

EL QUIZARRÁ, SAN ISIDRO DEL GENERAL, COSTA RICA, 15 JULY 1962

HABITAT PREFERENCE AND BEHAVIOR OF BREEDING JUNGLE FOWL IN CENTRAL WESTERN THAILAND

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The Red Jungle Fowl (*Gallus gallus*) in some mountain areas of central western Thailand has a population density and behavioral patterns relatively undisturbed by man. During the breeding seasons of 1955 and 1956 I traveled widely in different parts of that country. An intensive ten-day study period was spent during February 1956 in the high bamboo forest area on the eastern slopes of the Tenasserim range. This is an area remote from human population, where fresh-water streams flow from heavy rains in the forest at the crest and transect these eastern slopes to disappear in the eastern low country during the dry season. Here, a bamboo forest area interspersed with patches of small deciduous trees and shrubs was the most favorable breeding habitat for jungle fowl I found in southern and central Thailand. Bamboo growing in scattered but tangled clumps, in a rocky soil which has been repeatedly burned over, seems to offer ideal roosting and nesting cover. And, I believe, an abundant supply of fresh water, with a minimum of human disturbance, is an important factor in sustaining a favorable breeding population.

The few crops examined showed only grains of mountain rice, a plant which grows sparsely in the area during the rainy season. There was no other obvious source of favorable food supply, a factor which needs investigation.

On these dry slopes, close to the banks of streams which the birds visited mornings and late afternoons, territories of the breeding harems showed the greatest density. The area occupied by each crowing cock and his female followers was easily determined by his crowing, which was repeated at frequent intervals from before daylight until dark. Predawn surveys (locating crowing males on the roost) were checked with daylight observations and gave a fairly accurate census of the areas occupied, and also their locations. Two to five females were the usual number found with a dominant male. Unaccompanied males in breeding plumage were found remaining quietly in the concealment of shrub patches on the periphery of harems. These male adults with long sicles (yearling males have the two center tail feathers only slightly longer than the other caudals) would doubtless take over the harem when the dominant male was lost, but were very quiet and secretive during this waiting role. The close supervision of harems by dominant males appeared to induce this secretive behavior of the subdominant male, a role in which they neither crowed nor otherwise revealed themselves (unless flushed) during the days when these observations were being made.

Each dominant male led his little group of hens to the riverlet to drink, usually soon after they left the roost in the morning. They remained at the water supply only a very few minutes, and the male often watched from a perch aboveground while the hens drank. After that, he took one or two gulps of water and hurriedly led the group back into its territory by a different trail. (A yellow-throated marten was collected while following these trails by scent.) During the afternoons when field observations were more easily made, the harems were continuously on the move; and yet, the birds were seldom seen. Frequent crowing of the cock made it possible to chart their travels in their respective territories by observing from a place of concealment. All birds were adept in methods of evading observation and in rapid escape.

In flatlands many miles east of the mountains, where no water appeared to be available, female birds were occasionally seen but their association in breeding harems was not apparent. Here also, small groups of yearling males, commonly three or four in a group, were often seen. These were not afraid of a passing truck, and because of this were often shot. Hens did not accompany these young-male groups, although it may be assumed that in this extensive area of dry and burned-over habitat there are local water holes near which breeding birds might gather. The geographical segregation of young males may be, to a great extent, due to their elimination in a behavioral sense from the crowded and competitive habitat of the breeding harems found in the higher altitude bamboo forests along mountain rivers. The seclusive behavior of subdominant males of breeding age noticed around the periphery of breeding harems indicates that this kind of social structure is one in which the total male population has functional value for successful breeding. New applicants for the role of dominant male, in all its vulnerability, are always present.

In February, new young birds were collected and fresh eggs were found on the forest floor. The breeding season appears to be of sufficient length that a given bird may make several attempts to nest. The presence of scattered eggs suggests a high rate of nest disturbance.

Roosting was in the large clumps of thorny bamboo. Birds belonging to a harem flew to individual perches 15 to 20 feet above the ground and selected a position well out on a bending cane and well screened above and below—a location offering easy exit in case of night prowlers. The birds of a harem were usually scattered in one or more overlapping bamboo clumps 10 to 30 feet apart.

In the few jungle villages I visited, and in outlying temple grounds, inquiry was made about the presence and habits of jungle fowl. The residents of these places keep a few domestic fowl. In one remote village I saw a male bird which appeared to be of wild stock. The bird was thought to have been reared from an egg taken from the wild. Rand and Rabor (1960. Fieldiana: Zool., 35:414–419) report a similar ecological separation of these forms in the Philippines.

Native tribesmen and other hunters in this mountain area report that the entire population of jungle fowl moves into the high rain forest, a distance of 5 to 20 miles, during the rainy season, April to November. A small population of tribsemen hunts throughout the year. The frequent crowing at dawn of dominant breeding males often leads to their destruction by men using decoys and snares. Firearms are scarce, at present, among these people. But the opening of roads to travel by jeeps and trucks is greatly increasing the amount of hunting and disturbance throughout the year. It seems unlikely, due to the rapidly changing frontier in a country which has no precedent for conservation concepts, that such examples of breeding populations can long endure.

SUMMARY

The Tenasserim Mountain range forms an effective barrier against dry season rains from the west in west-central Thailand. However, sufficient precipitation spills over the crest of the range to maintain a kind of summit rain forest and to produce a constant supply of fresh water in small rivers on the eastern slopes. A bamboo forest (possibly subclimax because of fire), which is dense in some places but open in others, covers the hills between the rivers.

In this cover where water is available and dead grasses of the dry season supply a seed crop (mountain rice), the jungle fowl breeding population appears to be at a maximum density. It may be significant that up to the present there have been no roads for American jeeps to bring in hunters with modern firearms. The birds move into the high rain forest during the nonbreeding rainy season. Master cocks with two to five hens hold definite breeding localities (territories) which may be easily located by the predawn crowing. Extra cocks, with no hens, move silently about the periphery of harems. Solitary hens and small groups of immature cocks (yearlings) were found in the dry flat country several miles from the best breeding habitat, where no water appeared to be available. Hunting by native tribesmen was more intense in pursuit of crowing males.

No evidence was found of intermixing between the domestic chickens in villages and the wild jungle fowl. In one village a bird was seen which appeared to have been hatched from an egg of a wild bird.

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GENERAL NOTES

Notes on an epigamic display of the Catbird.—Although a general description of the courtship (heterosexual reproductive communication system leading to consummation sexual act) behavior of the Catbird (*Dumetella carolinensis*) is to be found in Bent (1948. "Life Histories of North American Nuthatches, Wrens, Thrashers and Their Allies," *Smith. Inst. U.S. Natl. Mus., Bull.* 195:1–475) neither detailed observations on specific displays nor their correlation with distinct phases of the breeding cycle seems to be on record. Between 6:00 AM and 6:05 AM on 2 July 1962, on the Charles C. Barlow farm one mile north of Roodhouse, Greene County, Illinois, I observed an epigamic "dance" performed by a male Catbird.

The male had alighted upon a stone bench approximately 3 feet from a lilac (*Syringa*) in which sat a second Catbird, presumably a female. The male assumed a semicrouching posture with the crown and back feathers ruffled, the head bowed—the bill pointing downward—and the tail quarter-fanned and depressed so as to drag on the surface of the bench. In this attitude the bird then began a shuffling "dance," at the same time rocking slightly from side to side. The male moved along a circular path and paused six times to flick his tail upward, thus displaying the chestnut patch on the under tail coverts. The patch could have been observed by the other bird during only three of the flicks.

This part of the display lasted three minutes, during which time the male emitted a faint catlike mewing note. The other bird remained on its perch and appeared to be intently watching the actions of the male.

The male then assumed an erect posture with the tail cocked and the feathers of the thorax seemingly adpressed. Such an attitude recalls the "hostile dancing" posture described by Hailman (1960. *Condor*, 5:464–468) for the Mockingbird (*Mimus polyglottos*). The male hopped in an exaggerated manner around the periphery of the surface of the bench and emitted a louder, more intense mewing note. At this juncture the other bird flew to the surface of the bench and began to hop around the periphery. The male, maintaining the posture described above, chased the other bird over the surface of the bench. The latter then flew to the ground and began to forage. The male also flew to the ground. There he continued to hop in an exaggerated manner for another minute before both birds departed.

At the time that these displays were observed, the above pair of Catbirds was known to have a nest in a nearby mulberry (*Morus*), containing three feathered young with eyes open, just beginning to venture to the edge of the nest. Saunders (*in* Bent, op. cit.) indicates that second or third nests may be built before the young leave the first nest; thus, courtship behavior, as described above, would be expected at this juncture as a prelude to another brood.—Jon C. Barlow, *Department of Mammalogy, American Museum of Natural History, New York 24, New York, 3 December 1962.*

Scissor-tailed Flycatcher in Ohio.—Records of the Scissor-tailed Flycatcher (*Muscivora forficata*) in the eastern United States are not uncommon, but to our knowledge none has been reported from Ohio. On 18 May 1962, Mr. Orval Crates, who lives on a farm 2 miles south of Jenera, Ohio, reported that he had seen a Scissor-tailed Flycatcher that morning and on the preceding day. With my son, Thomas Phillips, I drove to the Crates farm and picked up Mark Crates, son of Orval Crates, and his friend, John Spaeth. We drove a mile south to Hancock County Road 28, turned east for one-half mile, and then north on to Van Buren Township Road 61. Two hundred yards down the road we came upon the bird sitting on the top wire of a fence. We watched it for 15 minutes from a distance of 50 feet. Several times it dropped into the grass and picked up insects. For a few minutes it sat on the topmost branch of a *Crataegus*, then returned to its perch on the wire.

In Northern Ohio in 1962 the first three weeks of May were unseasonably warm. We had severe electrical storms accompanied by violent winds from the southwest. Perhaps this contributed to the appearance of the Scissor-tailed Flycatcher. During the afternoon of 18 May this bird was observed by at least 30 people from Findlay, Arlington, and Jenera, Ohio. By the morning following it had disappeared.—RICHARD S. PHILLIPS, *834 Liberty St., Findlay, Ohio, 5 February 1963.*

Two observations of avian predation.—On 12 January 1963, I observed the display flight of a male Anna's Hummingbird (*Calypte anna*) above a dense growth of *Baccharis* one-half mile east of Berkeley. After the flight the bird perched on a dead branch protruding above one of the bushes and began to preen. At the same time I noticed a Sharp-shinned Hawk (*Accipiter striatus*), judged by its size to be a male, flying rapidly along the *Baccharis* toward the hummingbird. The hawk dashed along about one foot above the ground, apparently using the brush as a screen; when it was approximately opposite the hummingbird, it suddenly swooped up and over the bushes and seized the Anna's. In doing so, the hawk barely checked its flight and continued to a stand of Baytrees (*Umbelluraria californica*), where it disappeared.

On 17 April 1961, I visited the nest of a Great Horned Owl (*Bubo virginianus*) seven miles southeast of Danville, Alameda County, California. Approximately 30 feet from the nest, which held two half-grown young and was located in an oak, I found a pellet containing an entire, undigested tarsometatarsus and foot of a small owl as well as other avian and mammalian remains. Upon comparison at the Museum of Vertebrate Zoology, the foot proved to be that of a Burrowing Owl (*Speotyto cunicularia*).

I have not been able to locate in the literature other reports of avian predation on either the Anna's Hummingbird or the Burrowing Owl. Apparently the only other known capture of a hummingbird by a hawk is one reported by G. H. Lowery, Jr. (1938. *Auk*, 55:280), who found the remains of a Ruby-throated Hummingbird (*Archilochus colubris*) in the stomach of a female Pigeon Hawk (*Falco columbarius*).—HANS J. PEETERS, *Museum of Vertebrate Zoology, Berkeley, California, 1 February 1963.*

Ruff observed in Missouri.—On 28 April 1962, Walter George and I were observing shorebirds at Squaw Creek National Wildlife Refuge, Mound City, Missouri. At 7:00 AM we arrived at the northern part of the refuge where mud flats were most extensive and shorebirds were numerous. While driving on a dike and stopping every few feet for observation, our attention was suddenly focused on an unusual-looking shorebird next to the dike. It was observed with 8 × 40 binoculars at 50 feet for about five minutes before it flew away from the dike to join the multitude of shorebirds on the far-out mud flats. Following both Peterson's and Pough's descriptions as given in their eastern field guides (which we had at the time), the bird was identified as a female Ruff, or Reeve (*Philomachus pugnax*).

This seems to be the first recorded observation of the Ruff in Missouri, as Widmann (1907. "Birds of Missouri," *Trans. Acad. of Sci., St. Louis*, 17:1–296) and Bennitt (1932. "Check-list of the Birds of Missouri," *Univ. of Mo. Studies, Col.*, 7:1–81) fail to mention this species. A review of *The Bluebird*, quarterly publication of The Audubon Society of Missouri, also failed to reveal any records.

That the Ruff has been observed in the Midwest (Ohio, Indiana, Iowa) is mentioned by Hall (1960. "A Gathering of Shore Birds," 242 pp.).

It was most interesting to note that Camp (1962. *Aud. Field Notes*, 16:381–450) collected a male Ruff on 26 April at Winous Point, Ohio, two days prior to our observation.

Since our observation, two Ruffs have been observed during the fall of 1962 at St. Louis, Missouri, by members of the St. Louis Audubon Society.—DAVID A. EASTERLA, *Kansas City Junior College, Kansas City, Kansas, 8 February 1963.*

Three species observed anting on a wet lawn.—On 2 September 1962, I watered my lawn after a prolonged drought. Within about 30 minutes the water attracted 25 Robins (*Turdus migratorius*), three Starlings (*Sturnus vulgaris*), and one Yellow-shafted Flicker (*Colaptes auratus*) to feed, bathe, and in some instances, to ant.

About 10 minutes after arriving, an adult female Robin actively applied ants to the feathers under the wings (apparently the wing-linings as well as the sides of the body), the crissum, and occasionally to the breast and upper tail coverts (near the uropygial gland). The behavior was similar to that described by several authors (see Whitaker, 1957. *Wilson Bull.*, 69:195–262). During the next 45 minutes she applied ants to her plumage no fewer than 25 times. Several times the bird tripped and fell. This may have resulted from a loss of balance caused by the bird's unusual position during anting. No state of "ecstasy," as described by some authors, was apparent. Between periods of anointing itself the bird continued normal Robin-like feeding activities. Several times during, or immediately after anting, I noticed swallowing movements in the bird's throat. After swallowing, the Robin usually resumed anting motions but without an ant in its bill. The behavior was observed at three locations on the lawn.

I collected the Robin (NIUM No. 482) and searched the plumage with an aspirator and 20× hand lens for external parasites. No parasites were located, but a crushed small tan ant (*Lasius neoniger* Emery) was among the breast feathers. This is a rather common lawn ant and many were found over the lawn. Autopsy produced several larger black ants (*Formica fusca* L. complex) from the gizzard. Several members of this collective species were found on the ground and on the branches of a cottonwood (*Populus deltoides*) sapling. At least three ants of this species had been eaten by the Robin. No internal parasites were found in the alimentary tract. The bird had little fat and was in fresh plumage. Some teleoptiles on the head, neck, and sides (under the wings) were in the early stages of development. Perhaps the growth of these feathers irritated the bird and stimulated it to ant. Possibly anointment with crushed ants lessened the irritation. There appears to be an absence of literature in which anting behavior is compared with the stages of molt. None of the other Robins anted nor did they appear influenced by the one bird's behavior.

Just before I collected the Robin, three Starlings, in winter plumage, landed near the watered portion of the lawn. One after the other the birds began active anting. Each bird anointed the underwing area for a brief period and then fed normally.

The flicker anted passively several times during the same period. Intermittent to feeding it flattened its body parallel to the ground, extended its neck, slunk along the ground, and then remained motionless for a few moments. Afterwards it fed and then anted again. The tan lawn ants were most abundant where the flicker performed this activity.

I searched the lawn for ants and found only two species, the same two obtained from the Robin. The tan ants were found in several places but the black ants were found in only two areas. I am grateful to Dr. W. L. Brown, Department of Entomology, Cornell University, for identification of the ants.

In trying to explain the purpose or function of anting, there are two suggestions resulting from my observations that may warrant investigation: (1) Whether or not other anting birds are molting or growing new feathers; and (2) since spraying water attracted birds to feed and bathe, is anting a behavior pattern associated with bathing and dusting. —WILLIAM E. SOUTHERN, *Department of Biological Sciences, Northern Illinois University, DeKalb, Illinois, 18 February 1963.*

The Carolina Parakeet in Michigan.—There has been no prior, even approximately acceptable, record for the occurrence of the Carolina Parakeet (*Conuropsis carolinensis*) in Michigan. The following was written of the St. Joseph River in 1718: "It is the best place that could be found for getting a living and cultivating the soil. There are in this place pheasants, as in France; quails and paroquets" (Monsieur de Sabrevois, 1902. "Memoir on the savages of Canada as far as the Mississippi River, describing their customs and trade." *Wis. Hist. Colls.*, 16:372). Only a small part of the St. Joseph flows through Indiana. At present South Bend, Indiana, there was a short portage to the Kankakee River which flows into the Illinois River. The route was used extensively by the early French missionaries and fur traders. French forts once existed at the mouth of the St. Joseph, at Niles, Michigan, and at present South Bend. P. F. X. de Charlevoix (1923. "Journal of a voyage to North America." Chicago. II:189–190) wrote in 1721 that "parrots" were to be found on the Kankakee in summer, thereby strengthening the probability of their occurrence along the St. Joseph in Michigan.—A. W. SCHORGER, *University of Wisconsin, Madison, Wisconsin, 14 March 1963.*

A note on Snowy Owl food habits.—Snowy Owls (*Nyctea scandiaca*) invaded southern Wisconsin in considerable numbers during the winter of 1960–61. Information on food habits of some of these birds was secured, largely through pellet analyses. Most of the pellets were collected from the winter territories of five owls at Horicon Marsh. As anticipated, their staple diet consisted of meadow voles (*Microtus*) and muskrats (*Ondatra*) (Table 1). These two prey species were especially vulnerable due to the

TABLE 1

SUMMARY OF PREY REMAINS IN SNOWY OWL PELLETS FROM HORICON MARSH, WISCONSIN[1]

Prey species	No. pellets containing prey remains	Percentage of total pellets	Minimum no. of prey individuals represented
Meadow vole (*Microtus*)	27	73	56
Muskrat (*Ondatra*)	11	30	10
Duck	9	24	4
Rat (*Rattus*)	1	3	1
Other birds	1	3	1

[1] Based on 37 pellets picked up from five owl territories during January–March.

scanty snow cover and cold weather. Many muskrats with houses in shallower water were frozen out, and were seen in the Marsh as "runners." Crippled ducks were evidently taken from a waterhole below the federal dike; there were also numerous carcasses of ducks scattered about the Marsh from the previous hunting season.

Other food-habits data were as follows: The stomach of a bird killed on Lake Mendota on 14 February held four red-backed voles (*Clethrionomys*) and one meadow vole. A pellet seen cast by a Snowy Owl at Dushack's Marsh, northeast of Madison, on 28 March, contained three meadow voles. Part of a freshly killed American Coot (*Fulica americana*) was dropped by an owl observed in Madison on 17 April, while two pellets from another Madison Snowy Owl on 21 April contained two rats (*Rattus*) and one meadow vole.—Lloyd B. Keith, *Department of Wildlife Management, University of Wisconsin, Madison, Wisconsin, 15 March 1963.*

An observation of parental behavior of a Rough-winged Swallow.—On 13 June 1959, Vincent Abraitys and I were leaning on the parapet of the highway bridge that spans Lockatong Creek, a small stream that empties into the Delaware River two miles north of the Borough of Stockton in Hunterdon County, New Jersey. Below us a few Rough-winged Swallows (*Stelgidopteryx ruficollis*) were hawking for insects above the water.

A small number of these birds have nested every year beneath the bridge in the open drain pipes that are encased in the bridge abutments. One of these pipes, the end of which extends an inch or so beyond the concrete, is situated about 2½ feet above the water, which there forms a quiet eddy a foot or so deep. Measured from a point directly below the pipe, the nearest shore is 5 feet distant. There a slightly inclined margin of clay separates the streamside vegetation from the water.

As we watched, a swallow entered the pipe and in a moment reappeared and flew off. There then appeared at the opening a young bird which teetered for a moment on the edge and then dropped into the water below, where it lay quietly with outstretched wings. Within seconds, an adult bird, which we assumed was a parent, appeared and hovered for a moment above the fledgling, then dropped lightly upon the fledgling's back and, with rapidly beating wings, propelled the fallen bird across the water toward the shelving bank. The old bird did not relinquish its position nor cease to beat its wings until the fledgling was completely out of the water. It then flew off, and the young bird, using its feet only, edged its way toward the waterside shrubs where it disappeared from our view.

Neither Abraitys nor I have found in the literature at hand any reference to such parental behavior, yet it seems not unreasonable to believe that for species nesting under conditions so precarious, succoring their young in this fashion might well be the rule.—Howard Drinkwater, *Old Road, Whitehouse, N.J., 2 April 1963.*

Solitary Vireo found nesting in south-central Ohio's Hocking County.—Previous to 1961, the Solitary Vireo (*Vireo solitarius*) had been recorded nesting in only three Lake Erie counties of northeastern Ohio (records reported in: 1933. *Wilson Bull.*, 45:189; 1950. Williams. "Birds of Cleveland Region"; published notes of Cleveland Audubon Society). The only recent records are from the Cleveland area.

On 10 June 1961, I heard the song of *V. solitarius* in Old Man's Cave State Park, Hocking Co., Ohio. Later that day a second male was heard in the vicinity of Ash Cave, about a mile's air distance from the first location. On the following morning, in the company of Jeff Kraemer and Jerry Meyer of Cincinnati, Ohio, I set out to investigate the unprecedented June occurrence of this species in Hocking Co. A short time later the male was observed carrying facial tissue to its nearly completed nest in a birch sapling near a park picnic area. Three-quarters of the outer structure was composed of strips of tissue, indicating the proximity of humanity, and the remainder was of bark of native birch.

On 16 June 1962, Jay Sheppard, Richard Watkins, Paul Woodward, Jeff Kraemer, and

I returned to the Old Man's Cave area and found five territorial males. Three males in full song in adjacent territories could be heard from the occupied territory of the nesting male of 1961.

The habitat concerned is mostly of northern type—hemlock, yew, black and yellow birch, and mountain maple (*Tsuga canadensis, Taxus canadensis, Betula lenta* and *lutea*, and *Acer spicatum*)—surrounding the deep, cool ravines which characterize Hocking State Forest, and the hillsides above the rims of these ravines which were planted to pines about 25 years ago.—WORTH S. RANDLE, *1534 Sutton Ave., Cincinnati 30, Ohio, 17 April 1963.*

Tree Swallow nesting in martin colony.—While Purple Martins (*Progne subis*) will often tolerate other birds nesting in adjacent nest boxes, these are usually not closely related species. The House Sparrow (*Passer domesticus*), Starling (*Sturnus vulgaris*), and the Eastern Bluebird (*Sialia sialis*) are mentioned by Bent (1942. *U.S. Natl. Mus. Bull.* 179:503) as common competitors for nesting sites in active martin colonies.

On 22 June 1962, a female Tree Swallow (*Iridoprocne bicolor*) was perched on the lower railing of one of the martin houses at the University of Michigan Biological Station, Cheboygan County, Michigan. Investigation revealed a nest containing four small Tree Swallows in a lower corner box. Two pairs of Purple Martins nesting in the same house were incubating and two other males frequented the same house. The entire colony was composed of 24 birds in three houses along the shore of Douglas Lake. During three afternoons of observation, no interspecific conflicts were noted at this house.

A photograph was made showing that the Tree Swallows occupied the side of the house nearest the trees. None of the martins was seen on this side, but preferred the more open approach afforded elsewhere. I banded the young Tree Swallows on 23 June, and they had fledged by 28 June. The martins had young by this time, which did not fledge until early in July.—JAMES TATE, JR., *University of the Pacific, Stockton, California, 22 February 1963.*

Brown Creeper nesting in West Virginia.—On 18 May 1963, several members of the Brooks Bird Club located a nesting pair of Brown Creepers (*Certhia familiaris*) on the bank of the Shenandoah River in Jefferson County, West Virginia, at an elevation of approximately 300 feet. The location, which is not far from Harper's Ferry, was on a well-wooded river terrace covered with a dense mature stand of mixed mesophytic forest. The immediate area is a picnic grounds for a private club and has been fairly well cleared of underbrush. There are no conifers in the immediate vicinity.

The nest was located about 15 feet from the ground in a snag of a broken silver maple (*Acer saccharinum*) standing almost on the bank of the river. In typical creeper fashion, the nest was built of a few twigs placed under a large slab of bark that was beginning to pull away from what appeared to be an old lightning scar. Some of the nest material was visible from below through the side of the crack and we were able to examine the interior of the nest through this crack. The birds, however, entered from a hole several inches above the nest. At the time of discovery the nest contained six eggs.

Our attention had originally been drawn to the nest by seeing a creeper (thought to be a rather late migrant) carrying food in its bill and remaining on the snag for several minutes. Later, one of the birds was observed to offer food to the second, which was then sitting on the eggs.

This appears to be the second known nesting of the species in the state. The first reported nest was found at an elevation of about 4,100 feet in a virgin spruce forest on

Shaver's Mountain in Randolph County (Handlan, 1949. *The Redstart*, 16:51). The Brown Creeper is a moderately common summer resident in the northern mixed forests and spruce forest at high elevations in West Virginia, but it has not previously been found below about 2,500 feet in the summer. This same situation apparently obtains in the neighboring states of Pennsylvania, Maryland, and Virginia.

While the nesting of this species at this extremely low elevation in more or less atypical habitat is very probably purely fortuitous, it might be well to point out that another possibility does exist. The creeper is a common winter resident in these latitudes and regularly, but uncommonly, a few are reported in the latter part of May and are usually thought to be delayed migrants. However, since Brown Creeper nests are not conspicuous, and since many bird students are totally unfamiliar with the territorial song of the species, it is possible that the species nests under these circumstances more often than is realized.—George A. Hall, *West Virginia University, Morgantown, W.Va.*, and Nevada Laitsch, *M.C. 21, East Liverpool, Ohio, 3 June 1963.*

Western Meadowlark in West Virginia.—On 21 May 1961, while on a field trip of the Brooks Bird Club in Jefferson County, West Virginia, I heard what appeared to be the song of a Western Meadowlark (*Sturnella neglecta*). We quickly located the bird singing from a perch on a short power line. It sang for some time using only the typical *neglecta* song. It was quite evident that the back of this bird was much paler than in the case of the Eastern Meadowlark (*S. magna*), which was also present in this field, but none of the other distinguishing marks could be made out. We studied the bird for about half an hour; five of us were familiar with this species in the West.

Upon being alarmed, the bird left its perch and flew low over the field giving the "chupp" call mentioned by Lanyon (1957. "The Comparative Biology of the Meadowlarks (*Sturnella*) in Wisconsin") as being distinctive of this species. It showed great attachment for the particular section of wire on which it was first discovered and repeatedly returned to it when flushed. When observers approached too closely to it while on the ground, it would fly close to the perching locality, calling frequently, and then hesitate and fly off. It did not closely associate with the two or three individuals of *magna* present.

This observation was made in a small open field not far from Harper's Ferry and only a few hundred yards from the crest of the mountain which forms the Virginia border. Most of this mountainside is covered with dense brush or moderately heavy forest and this small field represents a virtual island of meadowlark habitat.

The bird was seen again in the afternoon, but not thereafter. Mr. Clark Miller of Inwood, West Virginia, informed me that the field was mowed during the next week and that he failed to find the bird there again.

There are no published records for this species in West Virginia, and, as far as I am aware, this is the first fully authenticated sight record for the species in the state. On two earlier occasions observers who were familar with this species believed that they heard the bird in the state but did not follow up their observations. Mrs. Maurice Brooks of Morgantown, West Virginia, reported hearing one in Marshall County some four or five years ago; and Mr. Joseph Grom of Gibsonia, Pennsylvania, reported hearing one in Tucker County in 1960. Mrs. Nevada Laitsch of East Liverpool, Ohio, has written me that on 19 June 1961, on the Guyan River in Lincoln County (220 air miles to the southwest), she heard a Western Meadowlark. This bird was also in a small field which was an ecological island in a densely wooded area.—George A. Hall, *West Virginia University, Morgantown, West Virginia, 3 June 1963.*

Nesting ecology and habits of the Dickcissel on the Arkansas Grand Prairie.—The Dickcissel (*Spiza americana*), a typical prairie bird, is the second most common breeding bird on the Arkansas Grand Prairie. Only the Red-winged Blackbird (*Agelaius phoeniceus*) is more abundant. Observations reported here were made from 1950 to 1955 and during a brief period in May 1962.

Dickcissels are principally summer residents on the Arkansas prairie, although a few birds are found every winter. First spring arrivals usually appear by the second or third week in April. In 1952, first males were recorded on 10 and 11 April; in 1951, on 19 April. By 27 April 1951, many females had arrived. In central Illinois, Gross (1921. *Auk*, 38:11) observed the first males about the last week in April or the first week in May. The females usually arrived about a week later.

The earliest records of nest building on the Arkansas Grand Prairie were on 5 May 1962. By 15 May 1962, at least four nests contained complete clutches of eggs. In central Illinois, Gross (Ibid.:167) found first nests during the last week of May. The latest nesting date at Stuttgart, Arkansas, was 22 July 1952, when a nest was found containing young nearly ready to fledge. Clutch size in 13 nests ranged from 3 to 5 eggs (1 clutch of 3 eggs; 9 of 4; 3 of 5). Nests were from 3 inches to 4 feet from the ground, with an average height of approximately 3 feet for 20 nests. Overmire (1962. *Auk*, 79:115) reported the mean height of 94 Oklahoma nests to be 4 feet. Ten of the Arkansas nests were in briar (*Rubus* sp.), four in haw (*Crataegus* sp.), three in buttonbush (*Cephalanthus occidentalis*), and one each in an undetermined grass (Gramineae), plum (*Prunus* sp.), and dogwood (*Cornus* sp.).

On the basis of nest site preference, the Dickcissel is essentially a bird of the briar patch. An optimum nesting habitat on the Arkansas Grand Prairie consists of briar patches along roadsides bordering maturing oat fields. At the time of Gross's study in Illinois (*Auk*, Ibid.) Dickcissels nested mostly in meadows. Nesting densities in Arkansas were considerably higher along brushy roadside borders than in open fields. This was determined by censusing territorial male Dickcissels in 80 randomly selected plots. There were 40 10-acre field plots and 40 roadside strips, each ½ mile long and 150 yards wide. The average density along brushy roadside borders was approximately one territorial male (or pair) per 7 acres, compared with one male (or pair) per 20 acres out in open fields.

Flocking begins soon after the nesting season, and feeding is concentrated mostly in cultivated rice fields. A flock numbering 30 birds was observed as early as 24 July 1952. The largest flock recorded contained over 500 birds, which were feeding in a rice field on 6 September 1954. Gross (*Auk*, Ibid.:12) observed a roost of at least 485 Dickcissels in Illinois on 10 August 1918.

Virtually all winter records at Stuttgart were of individual birds seen about barnyards, where they were associated with House Sparrows (*Passer domesticus*). Several dates of occurrence were as follows: 29 November 1951, 13 January 1952, 14 February 1952, and 11 March 1952.—Brooke Meanley, *Patuxent Wildlife Research Center, Laurel, Maryland, 18 December 1962.*

Prairie Warbler nests on a 0.6-acre island.—On 12 July 1960, a Prairie Warbler (*Dendroica discolor*) was incubating four eggs on a small island approximately 300 yards from the mainland in Lake Lanier, Georgia. The nest was approximately 3 feet from the ground in a small deciduous tree. Vegetation on the island consisted of a sparse growth of broom-sedge (*Andropogon virginicus*), occasional forbs, and several deciduous trees about 5 feet high. Originally the island was part of a farm which was abandoned when the lake was formed in 1957. The vegetation on the nearest mainland was secondary oak–hickory stands interspersed with pastures.

On 23 July 1960, I made observations at the nest area from 11:35 AM to 1:30 PM (EST). An adult Prairie Warbler fed three fledglings perched in broom-sedge tussocks, which were 20, 50, and 55 feet from the nest. They remained near these positions throughout the observation period. The young birds were silent except when the adult approached with food or foraged nearby. On these occasions a rapid twitter was emitted. The adult was usually observed to forage on the ground from 5 to 30 feet from a perched fledgling. When an insect was captured, the parent usually fed the nearest young bird. Often the parent uttered a single call note as it foraged. During the period of observation, 22 food items were brought to the fledglings. The first received eight items, the second five, and the third nine. Apparently only one parent was involved in the feeding of the young. The adult was never observed to leave the island and probably was able to find a sufficient amount of food without traveling to the mainland. When I revisited the island on 5 August 1960 I found no Prairie Warblers; presumably the brood had been successful and the individuals had dispersed.

Although this island is considerably smaller than the annual average territory size of the Prairie Warbler—3.5 acres (Nolan, pers. comm.)—the brood fledged. These observations suggest that a territory size of 3.5 acres is not necessary for the raising and fledging of a brood. Apparently the food supply on the island was sufficient for the family of warblers. Since the warblers were the only birds nesting on the island, there was probably no competition for insect food with other birds; however, the sparseness of the stand of vegetation as compared with other, local old-field communities would tend to discount any suggested overabundance of food.

This paper was prepared under a contract (At(07-2)-10) between the U.S. Atomic Energy Commission and the University of Georgia.—JAY H. SCHNELL, *Institute of Radiation Ecology, University of Georgia, Athens, 15 August 1962.*

A partial albino Red-winged Blackbird with a deformed bill.—An unusual male Red-winged Blackbird (*Agelaius phoeniceus*) was collected on 24 March 1963, 5 miles east of Fresno, Fresno County, California. The upper mandible had apparently grown sharply decurved to the right of the lower mandible. The lower mandibular tomium was markedly "rolled" inward. The tongue was dried and frayed distally for 4 mm and protruded between the lower mandibular tomium. The bird was little to moderately fat, weighing 59 grams two hours after death. The specimen also showed partial albinism: the outer vane of the middle alular quill and the proximal 1.5 cm of the outer vanes of the last eight primary remiges being white on both wings.

Normal territorial behavior including song and agonistic behavior was observed. The right testis measured 5 × 4 mm; the left testis, 5½ × 4 mm. Unfortunately, the bill abnormality was noticed post-mortem, eliminating the possibility of observing feeding behavior.

A similar bill deformity was reported for the American Bittern (*Botaurus lentiginosus*) by Batts (1954. *Wilson Bull.*, 66:142). The present report is the only record of this type of bill abnormality that I could find in the literature for a passerine species.—EUGENE S. MORTON, *Department of Biological Sciences, University of the Pacific, Stockton, California, 20 May 1963.*

ORNITHOLOGICAL NEWS

All manuscripts submitted for publication in *The Wilson Bulletin* should be sent directly to the new editor, Dr. George A. Hall, Department of Chemistry, West Virginia University, Morgantown, West Virginia. Dr. Hall's first issue of the *Bulletin* will be the March 1964 number.

In *The Wilson Bulletin* for June 1963 (75:221–223), are reviews of the Nuttall Ornithological Club Publications Numbers 3 and 4, "Structural Adaptations of the Head and Neck of the Black Skimmer" and "The Rough-winged Swallow." Bound copies are $3.00 and $4.00, respectively, and should be ordered from the Nuttall Ornithological Club, *care of* the Museum of Comparative Zoology, Harvard University, Cambridge 38, Massachusetts. Checks must *not* be made payable to the Museum of Comparative Zoology but made payable to the Nuttall Ornithological Club.

J. Dorst (Paris), E. Eisenmann (New York), F. Salomonsen (Copenhagen), Chairman C. Vaurie (New York), and K. H. Voous (Amsterdam) have been appointed to the Standing Committee for Ornithological Nomenclature of the International Ornithological Congress.

This Committee is advisory only. Ornithologists may, if they wish, submit their proposals for action by the International Commission for Zoological Nomenclature to this Standing Committee for its consideration. This Committee may, at its discretion, present its opinions to the International Commission. The Standing Committee endorses the principle of the Preamble of the Code of Zoological Nomenclature that well-established names should be preserved. Proposals for this Committee should be sent directly to the chairman in quintuplicate.

FROM THE AOU

At its annual meeting in Miami, Florida, on 12 August 1963, the AOU elected the following officers:

Austin L. Rand, President	Lawrence H. Walkinshaw, Secretary
Robert W. Storer, First Vice-President	Robert J. Newman, Treasurer
Oliver L. Austin, Jr., Second Vice-President	Robert M. Mengel, Editor

and elected members of the Council: John P. Emlen, Jr., Joseph J. Hickey, and Pierce Brodkorb.

Dr. S. Dillon Ripley has been appointed Secretary of the Smithsonian Institution, effective upon the retirement of Dr. Leonard C. Carmicheal, who now holds that position.

Dr. Richard L. Zusi has been appointed Associate Curator in the Division of Birds of the Smithsonian Institution.

JOSSELYN VAN TYNE MEMORIAL LIBRARY

The following gifts have been recently received. From:

W. H. Burt—10 reprints
Donald S. Burton—1 journal
George A. Clark, Jr.—9 reprints
Charles T. Collins—1 reprint
L. R. Dice—3 reprints
Robert W. Dickerman—13 reprints
Keith L. Dixon—7 reprints
Mrs. C. W. Edwards—1 book
Jack P. Hailman—1 reprint
Karl W. Haller—33 books
F. Haverschmidt—2 reprints
Donald S. Heintzelman—1 reprint
Mrs. Reuben L. Kahn—61 journals
M. Philip Kahl, Jr.—1 reprint
Leon Kelso—6 translations, 1 reprint
S. Charles Kendeigh—6 reprints
Peter H. Klopfer—3 reprints
J. Koskimies—1 reprint
Robert Lasiewski—2 reprints
Amelia R. Laskey—1 reprint
Daniel McKinley—2 pamphlets, 1 journal, 13 reprints
Margaret M. Nice—1 book, 1 journal, 35 reprints
G. Niethammer—1 reprint
R. A. Paynter, Jr.—1 reprint
Allan R. Phillips—1 journal, 6 reprints
S. Dillon Ripley—2 reprints
Walter E. Scott—14 journals, 2 reprints
J. M. Sheppard—1 manuscript
Doris Huestis Speirs—1 book
Paul A. Stewart—1 reprint
Robert W. Storer—1 book
Forest V. Strnad—1 journal
L. H. Walkinshaw—30 journals, 18 reprints
A. C. Wilson—1 reprint

NEW LIFE MEMBER

Harvey I. Fisher, of Carbondale, Illinois, an active member of the WOS since 1949, is a new Life Member. Dr. Fisher received his B.S. degree from Kansas State University and his Ph.D. from the University of California at Berkeley; he currently is Professor of Zoology and Chairman of the Zoology Department at Southern Illinois University. His ornithological interests include functional anatomy and natural history.

Dr. Fisher has published six books and numerous scientific papers. At present he is a member of the AOU, Cooper Ornithological Society, American Association for the Advancement of Science, and the Society for the Study of Evolution. In addition, he has been assistant editor of *The Condor* and editor of *The Auk*, *Illinois Biological Monographs*, and *Transactions of Illinois Academy of Science*.

ORNITHOLOGICAL LITERATURE

The Life of Birds. By Joel Carl Welty. W. B. Saunders Company, Philadelphia and London, 1962: $6\frac{1}{2} \times 9\frac{3}{4}$ in., xiii + 546 pp., numerous figures. $9.00.

This book has two stated aims—to present simply the basic facts of bird biology, and to make the reader enthusiastic about birds. The author has done a thorough job of presenting the facts; so much so, in fact, that he may cause bewilderment rather than enthusiasm in some of the students for whom the book was written. The majority, however, will probably find this an unusually interesting text. There is no question of the author's enthusiasm for the subject and there is no trace of pedantry in his style. Although the author assumes little or no biological training in his readers, he develops each of the topics covered at some length, and mastery of the book should constitute adequate preparation for advanced courses in ornithology.

About one-quarter of the book covers the anatomy and physiology of birds, taken up by organ systems, and including such topics as molt, surface-volume relationships, feeding adaptations, and photoperiodism. Almost one-third of the book covers aspects of the breeding cycle: vocalizations, territory, courtship, nests, eggs, incubation, and care and development of young. The remainder is concerned with the kinds of birds, flight, behavior, ecology, zoogeography, migration, and evolution.

To judge from the selected list of about 800 references (out of some 8,000 consulted) at the end of the book, the literature is well covered up to 1960, with the addition of a few more recent titles. Other more recent information on breeding cycles in the tropics, immunological importance of the bursa of Fabricius, hummingbird metabolism, and many other topics is thus the responsibility of the lecturer.

The author has taken much information from Stresemann's "Aves" volume and has obviously supplemented this with an extensive sampling of the literature. Suggested readings at the ends of chapters are mostly general works such as other textbooks and broad surveys, rather than original articles. The list of 800 references, arranged alphabetically by author, might better have been divided into separate lists after each chapter to give the student easy access to the literature of a particular topic. Text citations are sometimes omitted where they would have been useful. For example, we are left with no citation for such statements as ". . . the gamecock's eyes, which have no fovea, revealed a minimum visual angle of 4.07 minutes."

A problem which must be faced by the author of an ornithology text for beginners is to present the remarkable diversity of birds in a way which will not completely overwhelm the student and at the same time present the principles to make the facts meaningful. Welty has chosen to divide his book into a series of subject-matter segments within each of which he presents certain generalizations or principles followed by miscellaneous examples selected from birds of the world. Although this may be the best way to present an enormous number of facts, the method suffers from lack of continuity for any one species, and it invites generalizations which may conflict. "Nesting sites can reveal taxonomic differences" (p. 14) and ". . . patterns of nest building have relatively little taxonomic or evolutionary significance" (p. 254); also, ". . . much of their behavior is, by mammalian standards, fragmentary, stereotyped, at times amazingly stupid" (p. 159), and "While it is probably true that typically a bird's action is largely stereotyped and instinctive, it does not follow that it is non-adaptive or stupid" (p. 168). Such statements, while not entirely contradictory, may confuse and discourage innocent students.

There are, inevitably, other errors or inconsistencies in the text which will probably be corrected in a future edition and which are not important liabilities to the total work.

The caption of Figure 8.13 definitely and erroneously implies that the spangled plumage of the Common Starling becomes glossy black through endocrine action; on page 155 it is implied that isolated pairs of gulls are incapable of breeding; the "hatching muscle" (which is *M. complexus*) does not disappear shortly after hatching, as stated on page 316; the Ivory-billed Woodpecker is not extinct, as stated on page 346. In the chapter on Migration and Orientation there are sections headed "Visual Orientation," "Astronomic Navigation," "Orientation by Special Senses," and "Sense of Direction." The "sense of direction" is described as a more formidable idea than kinesthetic memory or sensitivity to the earth's magnetism and to Coriolis force, but the evidence presented for it is equally unacceptable. Another unconvincing discussion at the end of the book centers around the production of "freaks" such as the Dodo. It is claimed that small, isolated populations may evolve extreme and bizarre characters such as flightlessness because "mutation frequency and isolation are stronger than selection pressure." This is an unnecessary appeal to genetic drift and orthogenesis to explain the evolution of specialized forms.

An unfortunate feature is a full-page family tree of birds which shows some striking differences from Wetmore's list of orders and families with which it is included. The tree closely allies loons and grebes, includes the button-quail and bustards with the galliforms, separates pigeons and doves, separates skimmers from gulls and terns, allies the blackbirds and ploceids with swallows, larks, and thrushes, has two widely separated branches, one for turacos and one for plantain eaters (!), etc.—all with no word of explanation. In the list that follows, Ichthyornithiformes are still placed in the Odontognathae.

There is no mention of the terminology of molts and plumages proposed by Humphrey and Parkes, although this terminology will be encountered by students in the "Handbook of North American Birds" and in the current literature.

Drawings, diagrams, charts, and graphs are uniformly clear and attractive. There is no doubt that the illustrative material is unusually good. The numerous photographs, mostly by Eric Hosking but also by Ronald Austing and others, are excellent and well reproduced. For the most part they have been carefully chosen, but two photographs on pages 180 and 347 show gannet colonies and have similar captions. "The Life of Birds" differs from other elementary texts in that its examples and illustrations are not chosen primarily from North American birds, but are worldwide with an emphasis on European birds, perhaps derivable from the heavy reliance on Stresemann and Hosking.

The book is well bound and printed. There are very few typographical errors and relatively few misspelled scientific names. In the extensive index appear such items as "Aeschylus, death of," "arteriosclerosis," 22 subjects dealing with "eye," "grit, as a limiting factor," "Kurische Nehrung," 67 subjects dealing with "migration," and "Svardson's principle." Diverse subjects of this kind are not merely mentioned in the text but are generally well explained.

If a review is to be useful it must also be constructively critical. Unfortunately, criticisms take considerable space and the reviewer may find that he cannot enlarge on the many admirable aspects of a book after covering its few weak points. Such is the case here. The book is attractive, readable, interesting, enthusiastic, well organized, and remarkably complete. It represents an unusually successful attempt to meet the needs of the student and teacher of introductory ornithology.—Richard L. Zusi.

Preliminary Field Guide to the Birds of the Indian Ocean: For Use during the International Indian Ocean Expedition. By George E. Watson, Richard L. Zusi, and Robert E. (*sic*) Storer. United States National Museum, Smithsonian Institution, Washington, D.C., 1963: 7⅞ × 10¼ in., x + 214 pp., 25 black-and-white plates, 18 maps. No price given.

Both the pelagic and insular birds of the Indian Ocean are poorly known. An unusual opportunity to at least partially remedy this will be available during the International Indian Ocean Expedition 1963–64, when scores of scientists will converge on the area for a unique, large-scale, oceanographic study. The majority of the investigators will be biological and physical oceanographers. However, given a modicum of information about what is known of the avifauna of the region and what needs to be learned, and also means for identifying the birds, the oceanographers may collect information of importance to ornithology. In a commendable effort to provide the needed background and to encourage ornithological research, the United States National Museum has issued this useful guide, which is being distributed to all vessels participating in the expedition and to many of the scientific personnel.

The area covered by the guide extends from Lat. 20° N to Lat. 40° S. Within this region there are about 17 islands or archipelagoes, and approximately 300 species of marine and terrestrial birds. The composition of the avifauna of some islands, such as Réunion and the Seychelles, is fairly well documented, while that of others, such as Tromelin and Rodriguez, is unknown or poorly known. There have been only the most cursory studies of the distribution of the pelagic species, and knowledge of the general biology of nearly all 300 species, even of the endemic terrestrial forms, is negligible.

After a brief introductory account of the status of knowledge of Indian Ocean birds and a discussion of the potential contributions of the I.I.O.E., there is a section describing methods of preserving specimens and recording observations. This is followed by a synoptic list of species ("Synoptic Species List"), in which is given the scientific and vernacular names of each form, a concise description of its range, reference to identification plates in the volume, notes on morphological features not apparent in the plates, and, usually, comments on food and breeding habits. Indices to the scientific and vernacular names employed in the list conclude the section.

Field identification is treated next in a series of 18 black-and-white plates, drawn by Zusi. The plates are arranged systematically and illustrate all the birds of the area. Opposite each plate there is a list of the species shown and brief notes on general and specific characters by which the taxa may be differentiated. The illustrations are sketches, rather crudely executed, but adequate for field identification. Unfortunately, the species are not drawn to scale and there is no indication of size, either on the plates or in the descriptive material on the facing pages. In fact, notations on size have been neglected throughout the work. This would be of little hindrance to the experienced ornithologist, but the novice, for whom the guide has been written, will surely be confused. To be certain I am not being unduly critical, I showed various plates in the guide to a student, familiar with North American birds but with no acquaintance with foreign species, and asked him to estimate the size of various forms. The marine birds offered few problems, but the terrestrial birds were frequently misjudged. For example, *Bebrornis* and *Nesillas* were thought to be the size of the American Robin, and *Coracina* and "*Coquus*" were estimated to approximate the dimensions of *Vireo olivaceous!*

The final portion of the guide is devoted to the island groups. There is a map of every island or archipelago, descriptions of topography, vegetation, and climate, and a short history of human occupancy. What is known of the ornithology of each island is summarized, particularly important problems needing investigation are noted, and, finally, there is an annotated list of the recorded species.

Like most field guides it has no bibliography. This is unfortunate because the publication was conceived as a research tool rather than as a guide to the enjoyment of the birds of the Indian Ocean. The potential investigator wishing to do some homework before his visit to the area, the individual who may want to compare his observations with those of earlier workers, and the ornithologist looking for a handy bibliography will find the absence of references disappointing. Also peculiarly lacking is any mention of identification guides, such as Alexander's "Birds of the Ocean" or Roberts' "The Birds of South Africa," which would be useful supplements to the present publication.—Raymond A. Paynter, Jr.

Faunal Relationships of Birds in the Iliamna Lake Area, Alaska. By Francis S. L. Williamson and Leonard J. Peyton. Biological Papers of the University of Alaska, No. 5, 1962: 6 × 9 in., iv + 73 pp., 16 figs., 10 tables. $1.00.

Not since W. H. Osgood's "A Biological Reconnaissance of the Base of the Alaska Peninsula," published in 1904 and based on a quick passage through the country in the summer and fall of 1902, has there been any comprehensive study of the avifauna in the Iliamna Lake region. The area is ecologically interesting because elements of the tundra, taiga, and coastal coniferous-forest biotas meet and interdigitate there in a complex manner. Williamson and Peyton spent a total of 86 man-days in the field during 23 May to 13 June 1958, and 2 to 25 June 1959, mostly in a 50-square-mile area around the village of Iliamna, where birds were studied incidentally to investigations of animal-borne diseases for the Arctic Health Research Center. This coverage brought the authors in contact with most of the avian habitats of the region, except those in alpine country, which they did not visit. Their report is based on collected specimens and observations, a review of previous literature, as well as on a good deal of information reported by other biologists and local residents.

The title is somewhat misleading, since faunistics as such is discussed only initially and briefly on two pages under the heading, "General Ecological Considerations," and again terminally on four pages under the heading, "Faunal Affinities of Iliamna Birds." The authors conclude that "The Iliamna avifauna is comprised of Sitkan (5 species), Hudsonian (38 species), and Eskimoan (20 species) avifaunal elements associated with the Moist Coniferous Forest, Coniferous Forest, and Tundra Biomes respectively."

The rest of the report is taken up with a consideration of habitat utilization by the birds of the area (12 pages), an annotated list of species (36 pages), and a discussion of the racial relationships of six species, the populations of which in the Iliamna area manifest intergrading characteristics between inland and coastal subspecies (seven pages). The section on ecologic formations consists of a concise description of 12 habitats, well supported by photographs and a summarizing table (pp. 19–21) showing primary, secondary, and tertiary preferences of the birds for these formations. There are occasional inconsistencies between the scoring of a particular species in this table and information contained in the annotations, but for the most part the table represents a clear and convenient summary of the ecological distribution of the birds in the locally available habitats around Iliamna.

The meat of the report is contained in an annotated account of 103 species which are known or reputed to occur in the Iliamna area. The authors consider all of the 81 species observed by them to have been breeding during the time of their study and that the additional 22 species listed as occurring in the area are probably also breeding birds. The annotated accounts provide important information on local occurrence, relative abundance, habits, breeding, and data on the collected specimens.—Tom J. Cade.

Bird Watching, Housing and Feeding. By Walter E. Schutz. The Bruce Publishing Company, Milwaukee, 1963: 6¼ × 9¼ in., 168 pp., many illus. incl. photos. $3.75.

This attractively illustrated little book contains a number of suggestions and ideas which are not to be found in other sources, and therefore it is a fine addition to a library of references on bird watching and attracting birds. I disagree with some of the theories, conclusions, and suggestions, but am willing to admit that there is more than one acceptable point of view. Certainly open to argument are such statements as: "Generally bird banders set up a very fine black nylon net about 10 ft. high and 40 ft. wide. This is placed in a known flyway. . . ." Many banders do not use nets; many nets are set elsewhere than in "known flyways"—unless flyway is being used in an extremely broad sense. And it may be true that "Of the three essentials for attracting birds, food, water and shelter, food is the most important," but most people with feeding stations have learned that food alone will not attract birds unless there is shelter close by. To express other, minor points of disagreement, I feel that seeds should not be added to suet mixtures, that water is more important in winter than the author indicates, and that suet poured in coconut shells can present hazards.

The greatest value of the book lies in the detailed instructions and diagrams for feeders and houses. Few books or pamphlets on the subject offer so much help, not only in regard to types of houses and feeders, but in descriptions of methods and materials, for building and mounting them, and for constructing squirrel and cat guards. True, the directions call for considerable knowledge and talent in the use of tools and for more tools than the average person possesses. Most of the houses are more elaborate than necessary for the birds' requirements, but detailed directions are nevertheless there to be followed or modified to suit one's own ideas.

It is unfortunate that so little emphasis is placed on the fact that the houses shown are adaptable for other species than those listed. This fact is buried in the text, and the casual reader, leafing through to find a plan for a bird house, is confronted, for example, with a six-sided house labeled for a Red-headed or Hairy Woodpecker, a little triangular one for a nuthatch, and two houses looking very similar except for roof design, one for a chickadee, the other for a Downy Woodpecker. The complete novice could well be misled.

The sections on winter care of birds and bird houses, care of sick birds, and some of the natural enemies of wild birds are fine additions, though the author missed the chance to put in a favorable word for hawks and owls. All in all the good features outweigh any points open to questions. The book will be helpful to everyone in one respect or another. —Sally F. Hoyt.

COLORED PLATES IN *THE WILSON BULLETIN* THROUGH 1962

Kenneth C. Parkes

Few features of an ornithological journal are as universally popular as are colored plates of birds, especially when these have been accurately reproduced from the work of a skilled painter. Color reproduction is, of course, an expensive undertaking, and the time has long since arrived for editors of journals with limited budgets to be highly selective in choosing paintings or photographs to be printed in color. The plate should not be published merely as an attractive picture, but should make some point; it should illustrate something that *needs* illustration, whether it be a species of bird as such, a plumage stage, or a behavioral posture. It seems to me that there is now very little justification for publication in ornithological journals of additional color plates of well-known plumage stages of familiar North American and European birds. As long ago as 1947, I was able to list 29 different colored illustrations of the Bobwhite (*Colinus virginianus*), exclusive of photographs, in books and journals then available in the Cornell University Library (Parkes, 1947: 63–64), and this figure may well have doubled by 1963.

This is not to say that such well-known species should be taboo as subjects for color plates in our ornithological journals. Of many common birds there are plumage stages which may never have been satisfactorily illustrated, and of which a good colored figure would be most useful. An outstanding example is the plate by Shortt illustrating his note on the juvenal plumages of the two North American species of pipit (Shortt, 1951). The continuing need for such illustrations is shown by the fact that of the 29 color plates of the Bobwhite mentioned above, two portrayed color variants, two the normal downy young, and only one (Audubon!) the juvenal plumage. All of the rest included only the adult male and/or female.

The members of the Wilson Ornithological Society can be proud of the bird portrait gallery represented in the pages of a set of *The Wilson Bulletin.* As we celebrate the 75th anniversary of our journal, it might be of interest to have available a list of the colored plates published thus far. The body of this paper, then, is a checklist of the species of birds figured in color in *The Wilson Bulletin.*

It was not until 1926 that the first colored illustration appeared in Volume 38 of the *Bulletin.* No illustrations of any type are to be found in the first six volumes. In Volume 7, No. 2 (1900), page 73, appeared the first illustration, a full-page cut showing variation in the pattern of upper tail coverts of the Yellow-shafted Flicker (*Colaptes auratus*), accompanying a monograph on that species by Frank L. Burns. We then skip to the leading article in Volume 9 (1902), with which we find a full-page halftone reproduction of a wash drawing by "W.K.S." of the nest site of the Rock Nuthatch (*Sitta neumayer*), as well as similar drawings of the nests of the European and Red-breasted Nuthatches (*S. europaea* and *S. canadensis*). There is also a line cut of the heads of the three species of *Sitta.* These illustrations accompany a paper by H. C. Tracy on the nest of the Rock Nuthatch.

The first map in *The Wilson Bulletin* appeared in the following issue, Volume 9, No. 2 (1902). It is a two-page map of Lorain County, Ohio, to accompany a paper on the birds of that county, by Lynds Jones.

In the fourth issue of the same volume appeared the first illustration of a whole bird—in fact, a pair. It is a full-page reproduction of a spirited but rather crude drawing of the Cuban Tody (*Todus multicolor*) by Alice Noble, accompanying an article on this species by John W. Daniel, Jr.

The first photographs to be published in *The Wilson Bulletin* appeared as a frontispiece to Volume 10 (1903). They were taken by the Reverend W. F. Henninger and show two nests of Bewick's Wren (*Thryomanes bewickii*). These photographs were apparently published for their own intrinsic interest, as no text of any sort accompanied them. The next photograph, in the following issue, illustrates a paper by R. W. Shufeldt on the nest of the Orchard Oriole (*Icterus spurius*). In the next issue (Volume 10, No. 3) appeared the first scenic photograph and the first photographs of living birds. These accompany a paper by Edward R. Warren on a nesting of the Great Horned Owl (*Bubo virginianus*) in Delta County, Colorado, and illustrate the nest site and the young birds.

The first drawing by a recognized bird artist appeared in Volume 10, No. 4 (1903). It was a full-page sketch of a huddled covey of Bobwhites by Robert J. Sim, who illustrated a number of U.S. government publications on birds in later years. The following year, in Volume 11, No. 3, the two full pages of halftone reproductions of sketches by Sim, drawn from a living Red-necked Grebe (*Podiceps grisegena*), really inaugurated the career of *The Wilson Bulletin* as a repository of good bird art.

The first colored plate in *The Wilson Bulletin*, as mentioned above, appeared in 1926, as the frontispiece to No. 2 of Volume 38. Taken from a watercolor by George Miksch Sutton, it portrays the American Avocet (*Recurvirostra americana*) on its breeding grounds. There is a large standing bird in the foreground and three flying birds, preparing to land, in the background. The plate illustrates an article by Walter W. Bennett entitled "White Pelicans and other birds of Chase Lake, North Dakota." In the same issue is an editorial, thanking the artist and the engraver for their generosity in presenting this plate to the Wilson Ornithological Club (as it was then called), and an article, written at the request of the editor, on the method of color engraving used, prepared by the engraver, Harry G. Lotz. It was highly appropriate that the first colored plate in *The Wilson Bulletin* should have been taken from a painting by George Miksch Sutton, as Dr. Sutton has contributed just over half of the paintings reproduced in the *Bulletin* to date.

Although the editorial accompanying the first colored plate solicited opinions from Club members (and, by implication, contributions toward costs) with regard to publication of more color, the next such plate did not appear until almost three years later, as the frontispiece of Volume 41 (1929). It is a rather poorly reproduced "Impression of Wood Ibises at 'Gator Lake," again by Dr. Sutton. The editor explained that the journal's regular publication budget could not afford such reproductions, but he had found the Sutton painting so irresistible that he had obtained a portion of the publication costs by correspondence and solicited further contributions from readers.

One more colored plate was published in 1929, and two in 1930. Then came the longest colorless period in the *Bulletin*'s history after the first plate appeared. In No. 4 of Volume 52 (1940), in the second year of the editorship of Josselyn Van Tyne, appeared a colored plate of the head of an Emerald Toucanet (*Aulacorhynchus prasinus*), the first of what was to be a series of Dr. Sutton's famous Mexican watercolor field sketches in *The Wilson Bulletin*. This plate accompanied a paper by Dr. Sutton and Thomas D. Burleigh on the birds of Tamazunchale, San Luis Potosí, and was donated by the late John B. Semple, sponsor of this and many other Sutton expeditions. From then on, only Volumes 53 (1941) and 61 (1949) have lacked colored plates, and some volumes have had as many as four.

In all, 41 colored plates have appeared in *The Wilson Bulletin* through 1962. Of these, five were reproductions of photographs, the rest of paintings. A total of 48 avian species has been figured, in addition to two plates of hybrids (*Piranga*, *Vermivora*). The artists represented, in alphabetical order, are as follows (with number of plates published):

Breckenridge, Walter J.	1	Peterson, Roger T.	1
Clem, Robert V.	1	Sandford, Lloyd	1
Dilger, William C.	3	Shortt, Terence M.	3
Eckelberry, Don R.	3	Sutton, George M.	19
Grossenheider, Richard P.	1	Swenk, Iva B.	1
Mengel, Robert M.	1	Weller, Milton W.	1

Two colored photographs each have been contributed by Hal Harrison and Olin Sewall Pettingill, Jr., and one by Bernard Baker.

The following checklist of species figured in color in *The Wilson Bulletin* is arranged taxonomically rather than chronologically. Subspecific names are used only if these are indicated in the caption of the plate. No page references are given, as all plates were published as frontispieces for their respective issues. The stated month of issue has been constant: March (No. 1), June (No. 2), September (No. 3), and December (No. 4). Unless the word "photo" appears, the plate was reproduced from a painting.

FAMILY SPHENISCIDAE

Rockhopper Penguin (*Eudyptes crestatus*): adults and 24-day chicks.
Vol. 72, No. 3, 1960. Photo, Pettingill.

Little Penguin (*Eudyptula minor*): adult and downy young.
Vol. 64, No. 2, 1952. Grossenheider.

FAMILY TINAMIDAE

Rufescent Tinamou (*Crypturellus cinnamomeus mexicanus*): adult female (head).
Vol. 63, No. 2, 1951. Sutton.

FAMILY PHALACROCORACIDAE

Olivaceous Cormorant (*Phalacrocorax olivaceus mexicanus*): immature (head).
Vol. 64, No. 4, 1952. Sutton.

FAMILY ARDEIDAE

Pinnated Bittern (*Botaurus pinnatus caribaeus*): adult.
Vol. 73, No. 4, 1961 (with description of subspecies). Breckenridge.

FAMILY CICONIIDAE

Wood Ibis (*Mycteria americana*): adults.
Vol. 41, No. 1, 1929. Sutton.

FAMILY ANATIDAE

Black Duck (*Anas rubripes*): bills and feet of 11 age/sex classes.
Vol. 55, No. 1, 1943. Shortt.

Baikal Teal (*Anas formosa*): adult male.
Vol. 57, No. 1, 1945. Shortt.

Redhead (*Aythya americana*): male at 4 mo; male at 10 weeks; adult female, spring aspect; adult male, winter–spring aspect; adult female, summer aspect; day-old chicks; "eclipse" of year-old male (2nd basic plumage).
Vol. 69, No. 1, 1957. Weller.

Common Eider (*Somateria mollissima*): adult female (mated with male King Eider).
Vol. 71, No. 3, 1959. Photo, Pettingill.

King Eider (*Somateria spectabilis*): adult male (mated with female Common Eider).
Vol. 71, No. 3, 1959. Photo, Pettingill.

FAMILY ACCIPITRIDAE

Plumbeous Kite (*Ictinea plumbea*): adult female.
Vol. 56, No. 1, 1944. Sutton.
Gray Hawk (*Buteo nitidus*): adult, anterior half.
Vol. 65, No. 1, 1953. Sutton.
Blackish Crane-hawk (*Geranospiza nigra*): adult female (head).
Vol. 66, No. 4, 1954. Sutton.

FAMILY FALCONIDAE

Bat Falcon (*Falco albigularis*): adult male.
Vol. 54, No. 1, 1942. Sutton.

FAMILY CRACIDAE

Great Curassow (*Crax rubra*): adult male (head).
Vol. 67, No. 2, 1955. Sutton.

FAMILY PHASIANIDAE

Singing Quail (*Dactylortyx thoracicus pettingilli*): adult male and female, newly hatched chicks.
Vol. 69, No. 2, 1957 (with description of subspecies). Sutton.

FAMILY RALLIDAE

Brown-banded Rail (*Rallus mirificus*): adult female.
Vol. 71, No. 4, 1959 (with description of species). Sandford.
Spotted Rail (*Pardirallus maculatus*): adult.
Vol. 74, No. 4, 1962. Clem.

FAMILY SCOLOPACIDAE

Wandering Tattler (*Heteroscelus incanum*): downy young females.
Vol. 59, No. 1, 1947. Shortt.

FAMILY RECURVIROSTRIDAE

American Avocet (*Recurvirostra americana*): adult, summer aspect.
Vol. 38, No. 2, 1926. Sutton.

FAMILY TROCHILIDAE

Violet-headed Hummingbird (*Klais guimeti*): adult male and female.
Vol. 70, No. 1, 1958. Eckelberry.
White-crested Coquette (*Paphosia adorabilis*): adult males and female.
Vol. 73, No. 1, 1961. Eckelberry.

FAMILY TROGONIDAE

Black-throated Trogon (*Trogon rufus*): adult male and female.
Vol. 71, No. 1, 1959. Eckelberry.

FAMILY ALCEDINIDAE

Green Kingfisher (*Chloroceryle americana*): adult male.
Vol. 64, No. 3, 1952. Sutton.

FAMILY MOMOTIDAE

Blue-crowned Motmot (*Momotus momota coeruliceps*): adult.
Vol. 58, No. 1, 1946. Sutton.

FAMILY RAMPHASTIDAE

Emerald Toucanet (*Aulacorhynchus prasinus prasinus*): adult male (head).
Vol. 52, No. 4, 1940. Sutton.

FAMILY PICIDAE

Bronzed Woodpecker (*Piculus aeruginosus*): adult male (head).
Vol. 65, No. 2, 1953. Sutton.
Lineated Woodpecker (*Dryocopus lineatus*): adult female (head).
Vol. 66, No. 1, 1954. Sutton.
Flint-billed Woodpecker (*Phloeoceastes guatemalensis regius*): adult male (head).
Vol. 64, No. 1, 1952. Sutton.

FAMILY TURDIDAE

Wood Thrush (*Hylocichla mustelina*): adult male.
Vol. 68, No. 3, 1956. Dilger.
Hermit Thrush (*Catharus guttatus faxoni*): adult male.
Vol. 68, No. 3, 1956. Dilger.
Swainson's Thrush (*Catharus ustulatus swainsoni*): adult male.
Vol. 68, No. 3, 1956. Dilger.
Gray-cheeked Thrush (*Catharus minimus bicknelli*): adult male.
Vol. 68, No. 3, 1956. Dilger.
Veery (*Catharus fuscescens fuscescens*): adult male.
Vol. 68, No. 3, 1956. Dilger.

FAMILY PARULIDAE

Golden-winged Warbler (*Vermivora chrysoptera*) × Blue-winged Warbler (*V. pinus*): adult males of 6 genotypes.
Vol. 63, No. 1, 1951. Dilger.
Prairie Warbler (*Dendroica discolor*): adult male at nest with young.
Vol. 57, No. 3, 1945. Photo, Baker.
Louisiana Waterthrush (*Seiurus motacilla*): juvenile.
Vol. 70, No. 3, 1958. Dilger.
Mourning Warbler (*Oporornis philadelphia*): adult male and nestlings.
Vol. 72, No. 1, 1960. Photo, Harrison.
Altamira Yellowthroat (*Geothlypis flavovelata*): adult male.
Vol. 73, No. 4, 1961. Breckenridge.
Wilson's Warbler (*Wilsonia pusilla pusilla*): adult male at nest.
Vol. 63, No. 3, 1951. Photo, Harrison.

FAMILY THRAUPIDAE

Blue-hooded Euphonia (*Tanagra elegantissima*): adult male and female.
Vol. 63, No. 4, 1951. Sutton.
Scarlet Tanager (*Piranga olivacea*) × Western Tanager (*P. ludoviciana*): adult male.
Vol. 62, No. 1, 1950. Mengel.

FAMILY FRINGILLIDAE

Crimson-collared Grosbeak (*Rhodothraupis celaeno*): adult male.
Vol. 62, No. 4, 1950. Sutton.
Arizona Junco (*Junco phaeonotus palliatus*): adult male.
Vol. 60, No. 1, 1948. Peterson.
Harris' Sparrow (*Zonotrichia querula*): 1st winter, 2nd fall, 2nd winter, and definitive spring aspects.
Vol. 41, No. 3, 1929. Sutton.
White-crowned Sparrow (*Zonotrichia leucophrys gambelii*): "adult" and "immature."
Vol. 42, No. 2, 1930. Swenk.

White-throated Sparrow (*Zonotrichia albicollis*): "adult" and "immature" (but see Lowther, 1961).
Vol. 42, No. 2, 1930. Swenk.

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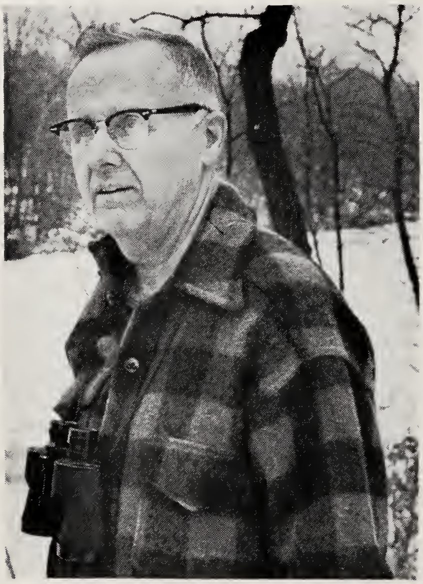
CARNEGIE MUSEUM, PITTSBURGH 13, PENNSYLVANIA, 18 MARCH 1963

NEW LIFE MEMBER



Walter J. Breckenridge, of Minneapolis, Minnesota, an active member since 1929 and a past president of the WOS, is a new Life Member. Dr. Breckenridge received his B.A. degree from the University of Iowa, and his M.A. and Ph.D. degrees from the University of Minnesota. In 1926 he began preparation work at the Minnesota Museum of Natural History and is now Director of that museum.

Dr. Breckenridge's papers have appeared in the *American Journal of Mammalogy*, *Copeia*, *Journal of Wildlife Management*, and *The Wilson Bulletin*, and he authored the book "Reptiles and Amphibians of Minnesota." He is a member of the AOU (elected Fellow and past member of the Council), American Society of Mammalogists, Minnesota Academy of Science (past president), and Minnesota Ornithologists Union (past president).

At present Dr. Breckenridge is conducting research on the ecological relations of three species of toads in northwestern Minnesota and the life history of the Manitoba toad. His hobbies include wildlife photography and bird artwork, and one of his paintings, of a Pinnated Bittern and an Altamira Yellowthroat, was published in *The Wilson Bulletin*.

ANNUAL REPORT OF THE CONSERVATION COMMITTEE

Concern for major conservation issues can be traced to an early date in the Wilson Ornithological Society. In 1898, President R. M. Strong stated, "I wish to encourage to the fullest extent the active cooperation of the members in the various movements toward the protection of birds . . ." (Strong, 1898). An editorial in 1910 emphasized the importance of habitat to birds and that ecological bird studies had been too generally neglected. This was probably among the first efforts to stress the relationship and importance of suitable habitat for birdlife.

The Society took definite action to encourage maintenance of wildlife habitat at its fourth annual meeting (Wilson Ornithological Club, 1917), when it voted to urge the County Commissioners to establish Bird and Wildlife Havens in the prospective Outer Park Forest belt of Cook County, Illinois.

Conservation issues continued to face the Society periodically and, in 1925, the editor suggested opening a new section on conservation in *The Wilson Bulletin* (Wilson Ornithological Soc., 1925). To be included were items of immediate concern to people interested in birds, as well as topics involving the perpetuation of birdlife for the future. The birth of the Conservation Committee within the Wilson Ornithological Society dates from that year. Subsequently, major conservation issues were brought to the Society through editorial statements and committee reports.

Of the historical reports, two seem worthy of special attention. The 1939 statement spelled out responsibilities of the Conservation Committee (Pirnie, 1939). Almost 20 years later, T. G. Scott emphasized the responsibilities of ornithologists to the future (Scott, 1958). The common theme in these two reports is that members of the Society, within each of their localities as well as in the entire range of birds, consider expending some well-directed energy in taking action for the welfare of birds. Of course, such actions could take a variety of forms.

The objectives of this 1963 report are twofold: (1) to provide background information on recent conservation accomplishments relating to birdlife and (2) to call attention to current items on which Society members could add some energetic effort. As the human population increases, the use of our renewable natural resources becomes a more and more urgent problem.

We suggest that in this 75th anniversary year of the Wilson Ornithological Society, members rededicate themselves to keeping abreast of the numerous proposals and changes taking place during this whirlwind period of development and adjustment of conservation programs. Help is needed in advancing sound programs to preserve and utilize birds.

Similar to the procedure used in the last few reports of this Committee, the subject matter of this report is organized into six major categories: Conservation Education, Land Use Problems, Habitat Pollution, Migratory Bird Hunting Seasons, Control of Bird Populations, and Endangered Species and Subspecies.

CONSERVATION EDUCATION

Conservation Education Perspective.—Whenever man, in his maze of social interactions, comes to an impasse in which the thinking or action of an individual or group is thwarted by custom, habit, or tradition, the common cry is for "more education." The need with or without an impasse is undeniable. There is likely to be more conflict between philosophy and action on one hand, and custom, tradition, and rule of thumb on the other in the field of conservation than in any other endeavor.

Conservation is a broad blanket, but even in the academic area it is pulled thin and taut by all who would be covered. Conservation education, therefore, cannot be adequately defined or described in all its ramifications by a brief, concise statement. Much of the confusion as to the direction and role of conservation education stems from the fact that any two interested groups may be talking at cross purposes because each is concerned only with part of this increasingly complex field. The need for clarification, however, has resulted in numerous governmental committees and quasi-official conservation–education organizations cropping up among interested groups. The primary purpose of these committees and organizations is to orient the diverse interests to a common goal. The results to date have not been inspiring.

The outline presented below is offered to illustrate the broad scope and multilevel approach needed in conservation education. There may be other and better ways to outline this field. No pride of originality is claimed. The objective of the outline is to engender awareness that intellectual flexibility and attitude adjustment will be required if all phases of conservation education are to be dealt with effectively. Conservation education must be adjusted to a broad spectrum of interest.

I. Technical education is required for all professional conservationists.
   a. Undergraduate training should be oriented to courses in basic science.
   b. Graduate training at the master's and doctor's degree level should be research oriented.

II. Cultural training in conservation is necessary for:
   a. Teachers who will teach the sociological and biological interrelationships of man, plants, animals, and the land.
   b. Nontechnically trained extension workers who deal with the public.
   c. Persons whose fields overlap or impinge on natural resources and conservation.

III. Semitechnical or popularized scientific information on conservation fulfills a major role in conservation education for:
   a. Adults making up the bulk of the general public. Based on type of interest, there are two major groups of these people.
      1. Those with interests requiring a minimum of exploitation, as camper, hiker, canoeist, birdwatcher, landowner, and garden club member.
      2. Those with active interests, as fisherman, hunter, resort owner, and outdoor commercializer.
   b. Administrators, journalists, and writers.

IV. Subadult training in simplified basic concepts serves as the foundation for advanced programs in conservation education.
   a. Grade school children can be reached via lectures, demonstrations, books, movies, TV films, radio programs, field trips, and outdoor projects. Natural curiosity of children for living things around them, favors actual participation through the last two approaches.
   b. High school pupils can be reached via the above-named avenues, as well as through work programs in the field, summer conservation camps, 4-H clubs, Future Farmers of America groups, and scouting programs.

This outline could be expanded or rearranged but, however changed, its salient point of broad scope will remain. Conservation education usually brings to mind Point IV, subadult education. The rapidly expanding programs in the remaining areas necessitate a readjustment in our thinking. Today we must define what aspect of conservation education we are talking about before presenting a case for any particular interest. Conservation education, like agriculture, requires one to be explicit as to the phase of the general field about which he is speaking.

If this brief appraisal serves no other end than to caution against ambiguous use of the term conservation education, its purpose will have been accomplished.

Whether conservation is taught by an educator with limited training in conservation or a conservationist with limited training in education, it must be taught as a science.

For conservation to become an effective force in our society, the natural and physical sciences which form the bulwark of conservation must integrate compatibly with the fields of social science. For conservation education to be adequately acquired, the complexity of conservation must be reduced to its component parts and the relationship of each part to the whole concept be made clear. While there is need for more education for more people, there is even greater need for more understanding of the principles on which conservation is based.

Youth Conservation Camps.—In an effort to advance conservation education, to accomplish conservation and forestry work, and to improve recreation facilities on public lands, two state youth conservation camps were established in Wisconsin in 1962. These camps, located in Bayfield and Vilas counties, gave 400 older high school boys six weeks of outdoor work and instruction. Each boy was paid $18.00 per week, in addition to receiving board and lodging. Success of this initial effort was so good that the Wisconsin legislature was asked to authorize a third camp. These youth camps, financed by a one-cent tax on cigarettes, seem to be a worthy procedure to develop the physical and mental resources of boys and accomplish conservation development and maintenance projects simultaneously. These are not correction camps for the delinquent or corps for the needy. Hopefully, the boys improved their attitudes toward natural resources.

On a national level, bills (S. 1 and H.R. 5131) have been introduced to establish a Youth Conservation Corps (Natl. Wildl. Fed., 1963*a*). If approved, the program would establish a corps of young men between 16 and 22 years of age to work in forests, parks, and wildlife refuges.

Outdoor Nature Centers.—The National Audubon Society's program of educational Nature Centers continues to grow (Buchheister, 1963). Objective of the centers is to extend proven methods of teaching and learning in the out-of-doors. There are now more than 100 community projects located in 29 states. One project is located in Canada. Eleven of the nature centers provide full-year instruction by one or more teacher–naturalists. Sixteen others provide part-time instruction. The centers themselves have resulted in the preservation of more than 40,000 acres of natural habitat.

LAND USE PROBLEMS

Wetland Acquisition.—During the 75 years of the Wilson Society's existence, the National Wildlife Refuge System was initiated and has grown tremendously. By Executive Order of Theodore Roosevelt, Pelican Island in Florida was established as the first refuge in 1903. This act gave national recognition to the need for conserving our wildlife resources. The system now contains more than 270 refuges. Most of the great waterfowl refuges were acquired and developed since 1935. More acquisition is needed to block out existing refuges, to complete the pattern of refuges within the entire range of these birds, and to help preserve the breeding and wintering habitat.

In a 1962 speech on the wetlands acquisition program of the Federal Government, Assistant Secretary of the Interior Frank P. Briggs sketched an acquisition goal of 2,970,000 acres by 1970. The schedule of acquisition for both waterfowl refuges and potholes or small marshes in the prairie breeding grounds is outlined below.

Fiscal Year	Acres	Estimated Cost
1962	39,626	$ 5,000,000
1963	257,374	12,000,000
1964	589,000	25,000,000
1965	589,000	25,000,000
1966	589,000	25,000,000
1967	525,000	25,000,000
1968	361,000	23,000,000
1969	10,000	1,250,000
1970	10,000	1,250,000

From the year 1971 to 2007, Briggs said that the Bureau of Sport Fisheries and Wildlife contemplates the purchase of an additional 750,000 acres. That apparently would conclude planned purchases by the Bureau for wildlife purposes.

Land acquisition continues at varying rates to meet these goals. The Migratory Bird Conservation Commission recently approved the establishment of six new national wildlife refuges and the enlargement of existing units. The new refuges and their approved acreages are: Alamosa, Colorado (9,429 acres); Davis Island, Mississippi (25,941 acres); Eastern Neck, Maryland (2,247 acres); Toppenish, Washington (12,378 acres); Lake Nettie, North Dakota (2,890 acres); and Primehook, Delaware (11,233 acres). Additions were also made to a number of existing refuges.

A new refuge was included in the Omnibus Rivers and Harbors Act of 1962. The 87th Congress authorized the acquisition of 2,311 acres of land for the Eufala National Wildlife Refuge in conjunction with the U.S. Corps of Engineers' Walter F. George Lock and Dam Project in Alabama. The Administration has approved the Corps' request for $500,000 to buy the land in the next fiscal year.

Under the authorized advanced loan of $105 million (P.L. 87-383), funds must be appropriated annually. To date, the amount of appropriations have been less than anticipated. In the 1962–63 fiscal year, Congress made the first money, $7 million, available for the accelerated wetlands purchase program. The 1964 budget request calls for an increase to $12 million, which with an anticipated $4 million from Duck Stamp receipts will channel about $16 million into the wetlands acquisition program.

To handle the increased land negotiations, the 87th Congress amended the Migratory Bird Conservation Act to enlarge the yearly expense allowance for the Migratory Bird Conservation Commission from $5,000 to $7,500. This increase was justified on the basis of accelerated wetlands activity and the need to defray expenses of state officials who sit with the Commission to consider land acquisition affecting their particular states.

Through the first two years and seven months of the small wetlands program, started in July 1961, 44,250 acres were purchased and 165 tracts totaling 11,000 wetland acres were taken under easement. This is fairly good progress for a new program.

Opposition of county and state governments to the federal government purchasing lands for wildlife continues to threaten the expanded acquisition program. Approval from the Governor must be obtained before purchase can be made in each of the three prairie pothole states. Minnesota has largely agreed to the program. Resistance is being encountered in South Dakota and North Dakota. The basis for this resistance is the alledged loss of income by county governments when land is removed from the tax rolls.

To reduce the local opposition to the accelerated federal wetlands acquisition program, revision of the federal law governing the distribution of funds from the sale of refuge products is being proposed. At present, counties can receive 25 per cent of the net receipts from refuges within their boundaries. Senators Quentin Burdick (North Dakota), Milton R. Young (North Dakota), and George S. McGovern (South Dakota) introduced a bill (S. 179) in the 88th Congress which would increase the participation by counties in revenues from the National Wildlife Refuges. This proposal was referred to the Senate Committee on Commerce. Representatives Hjalmar C. Nygaard (North Dakota) and Don L. Short (North Dakota) introduced identical bills (H.R. 1004 and H.R. 1127), which were referred to the House Committee on Merchant Marine and Fisheries.

These bills provide that revenue collected by the Department of the Interior from refuges which have been acquired in fee title be held in a separate fund. Then, one per cent of the adjusted cost of the land would be paid annually to the counties in which the refuges are located. In the 87th Congress a payment of three-fourths of one per cent of the adjusted cost was considered. Under this measure for fiscal 1962, 148 counties would have received more than they presently receive (41 counties get nothing now), 9 counties would have received approximately the same amount of money, and about 20 counties would have received fewer funds, but only two or three appreciably less (Natl. Wildl. Fed., 1963*b*). One parish in Louisiana, which gets a large sum from oil lease revenues, would have "lost" a substantial amount of money.

Adequate tax legislation is a must if the stated goals of the accelerated wetlands acquisition program are to be achieved. Proposals to change the sharing of revenues from refuges will perhaps receive further consideration by the 88th Congress. Such legislation would facilitate Governor and County Commissioner approval.

Congress will also consider the Tule Lake, Lower Klamath, and Upper Klamath National Wildlife Refuges. Senator Thomas H. Kuchel (California) reintroduced a bill (S. 793) to give congressional protection to these vital areas. Congressman Harold T. Johnson (California) introduced an identical bill (H.R. 3817) in the House of Representatives.

Superimposed years ago by Executive Orders on earlier reclamation withdrawals, the three Oregon and California refuges are an important link for migratory waterfowl on the Pacific Flyway. More than 80 per cent of the ducks in the flyway pass through the refuges during spring and fall migrations. Many waterfowl as well as other species of marsh birds nest at the refuges, and good production of the scarce Redhead and Ruddy Duck is obtained. Local irrigation and reclamation interests are making a serious effort to homestead the Tule Lake Refuge, to reduce greatly the water sumps, and to place them under cultivation. Reclamationists have made serious inroads in the Tule Lake Refuge over the years and further diversion of lands would drastically reduce the refuge's value for waterfowl and other birds. Congressional dedication of the refuges to wildlife protection is essential and is being sought by conservationists. They want to remove the threat that some future administrator may decide to seek to have the Executive Orders rescinded, or that further reclamation inroads will be encouraged. A congressional directive would prevent such a catastrophe from happening.

In Canada, the National Wildlife Federation is continuing to classify the vital waterfowl production habitat in the prairie provinces. Here is where an estimated 50–75 per cent of our ducks and coots are raised in years of adequate water. This habitat classification project was initiated in April 1961. The objective is to delineate zones of breeding habitat of differing quality on the basis of characteristics of soil and climate. Ultimately, a system of priorities for acquisition and preservation of breeding habitat is to be developed.

Drainage.—Linked closely with the Bureau of Sport Fisheries and Wildlife's efforts to acquire wetlands for migratory waterfowl and other wildlife are the Department of Agriculture's financial and technical assistance programs for wetland drainage. The 87th Congress took two actions that helped curtail the subsidized drainage which has been instrumental in destroying one-third of the small water areas in the nation's most productive waterfowl nesting region, the prairie pothole area of the Dakotas, Minnesota, and eastern Montana.

The first action consisted of an amendment to the 1963 Agriculture Appropriations Act which prohibited offering financial or technical assistance in all 50 states for drainage of Type 3, 4, and 5 wetlands (important waterfowl areas) during the 1962–63 fiscal year. Representative Henry Reuss (Wis.) recently indicated that reports of the Fish and Wildlife Service clearly showed the effectiveness of this restriction (*Milwaukee Journal*, 15 February 1963). In a preceding 30-month period the Service could merely recommend that drainage be denied and county Agricultural Stabilization and Conservation Committees could ignore the recommendations and grant funds for drainage. In that period, 3,384 applications for drainage involved wetlands that the Service found valuable for wildlife. Of these, 2,112 were drained and only 37 per cent were saved. Under the new law the Service opposed 247 applications and all of the wetlands involved were saved. We understand Congressman Reuss will try to amend the 1964 Agriculture Appropriations Act to continue the curtailment of subsidized drainage of valuable wildlife lands. At a time when the Department of Agriculture recommends converting 50 million acres of good soils, presently being cropped, to other uses, including recreation, this very definitely seems to be an action in the best public interest.

The second action of the 87th Congress prohibited the Department of Agriculture from providing assistance for drainage of designated wetlands in Minnesota, North Dakota, and South Dakota when the Department of the Interior says the practice is harmful to wildlife (P.L. 87-732). Under this new law, the Bureau of Sport Fisheries and Wildlife has 90 days in which to inspect wetlands for which drainage applications have been received by the Department of Agriculture and to report if important wildlife habitat is involved. Failure to report in time would terminate the prohibition, as would a decision by the Bureau or the affected state wildlife agency not to make an offer to purchase or lease the wetland within one year. The ban on assistance for drainage is also lifted if an offer to lease or buy is not consummated within 5 years.

Conservationists have sought some reasonable check on federal drainage assistance programs for a long time. Although the two new provisions of law, reported above, have helped to slow the rate of drainage, they are negative in character. For that reason, conservationists are seeking a positive means of encouraging landowners to retain wetland habitat in its natural condition.

Nothing in the federal law prevents a landowner from draining wetlands at his own expense. But Congress has made it quite evident that public funds cannot continue to be used to stimulate drainage of private lands without consideration being given to the effects of drainage on wildlife, a valuable public resource.

Recreation.—Major accomplishments of the 87th Congress include the establishment of three national seashores. The Cape Cod National Seashore was established (P.L. 87-126) in Massachusetts and funds were granted to initiate land acquisition. Point Reyes National Seashore was created in California (P.L. 87-657) and the Padre Island National Seashore in Texas (P.L. 87-712). The Congressional Act establishing Padre Island was ratified by the Texas legislature in April 1963. Sizable blocks of natural habitat will be preserved in these seashore areas, some of which will benefit birds, especially shorebirds and waterfowl.

Recent bills introduced in the 88th Congress to add new units to the National Park System include the following (Natl. Aud. Soc., 1963*a*):

Prairie National Park, introduced by Senators James B. Pearson and Frank Carlson (S. 986) and Congressman William H. Avery (H.R. 4424) for a 60,000-acre area in Pottawatomie County, Kansas.

Sleeping Bear Dunes National Lakeshore, advanced by Senators Philip A. Hart and Pat McNamara (S. 792) and Representative Neil Staebler (H.R. 4201), involves a 77,000-acre area on Lake Michigan near Traverse City, Michigan.

Indiana Dunes National Lakeshore was offered by Senator Paul Douglas and 18 co-sponsors (S. 650), Representative John P. Saylor (H.R. 3344) and others.

Chesapeake and Ohio Canal National Historical Park introduced by Representative Charles McC. Mathias, Jr., to encompass the present C. and O. Canal National Monument along the Potomac River in Maryland and enlarge it by buying and leasing adjacent lands up to a maximum of 15,000 acres.

Ice Age National Scientific Reserve introduced in identical bills by Lester Johnson (H.R. 1096) and Henry Reuss (H.R. 1115).

Other proposals for National Parks were scheduled for hearings in April or May 1963 and included the Ozark National Rivers area in southern Missouri, Canyonlands National Park in Utah, Valle Grande National Park in New Mexico, Oregon Dunes National Seashore, and Fire Island National Seashore in New York.

In 1962, the 87th Congress enacted a law (P.L. 87-714) that gives the Secretary of the Interior needed authority to control and regulate recreational use on the national wildlife refuges, game ranges, and similar units. It clearly specifies that recreation is intended to be an incidental or secondary use of refuges, permissible only in such places and at such times that it will not jeopardize the primary purposes for which refuges are established.

The Secretary now can permit development of picnic sites, sanitary services, boat ramps, nature centers, and other facilities to accommodate refuge recreational use. He also can issue and enforce regulations so that such use is consistent with the overall purpose of each refuge. Permitting limited and specified use of national wildlife refuges and other similar units is a noteworthy advance to help people enjoy the numerous outstanding recreational opportunities at these areas. However, there is a need to watch development under the new authority to make sure recreational planners do not maximize recreation on wildlife refuges. That course, if pursued, would be contrary to the expressed interest of Congress. Persons interested in the national wildlife refuge program should follow carefully future developments under this new authority.

Congressman John Dingell reintroduced a bill (H.R. 2578) to require a $2.00 annual stamp to be purchased by persons 16 years of age or older who use national wildlife refuges. A person shall possess a valid federal migratory bird hunting stamp or a new $2.00 wildlife refuge stamp in order to enjoy the recreational opportunities of refuges.

On 31 January 1962, the Outdoor Recreation Resources Review Commission submitted its report "Outdoor Recreation for America" (available from the Superintendent of Documents, Washington 25, D.C.). The report was the result of three years of extensive research and contains a searching analysis of the recreation needs of the Nation together with recommendations for attempting to meet these demands.

Following one of the recommendations of the report, Secretary of the Interior Udall, in 1962, established the Bureau of Outdoor Recreation by departmental order. This Bureau has six main functions (U.S. Dept. Interior, 1962:40): (1) coordinate related federal programs, (2) stimulate and provide assistance in state planning, (3) administer grants-in-aid, (4) sponsor and conduct research, (5) encourage interstate and regional cooperation, and (6) formulate a nationwide recreation plan on the basis of state, regional, and federal plans.

An organic act bill (S. 20) to give the new Interior Bureau authority to carry out its main functions is now being considered by the 88th Congress. This act would be the first step in placing the new Bureau in complete operation.

A second and related proposal is the Land Water Conservation Fund bill (S. 859). This legislation is an outgrowth of recommendations by the Outdoor Recreation Resources Review Commission and is supported by President Kennedy. A ten-year program is planned, financed largely on a pay-as-you-go basis. Major sources of funds include (1) entrance fees and other recreation-user charges at federal areas, (2) receipts from the sale of surplus federal lands, and (3) rededication of the existing four-cents-a-gallon tax on pleasure boat fuel. The income would be used to provide (1) grants on a matching basis to help states plan for, acquire, and develop recreation areas, including wildlife areas, and (2) aid for the federal government to acquire inholdings in national forests and parks, to develop recreation facilities at federal impoundments, and to establish sanctuaries for preserving threatened species of wildlife.

Two bills (S. 7 and S. 9) have been introduced by Senator Harrison A. Williams, Jr., to modify the open space aspects of the 1961 Housing Act (P.L. 87-70). One proposal (S. 7) would expand and enlarge the earlier legislation, making additional federal grants available to match funds spent by local communities for open space land. The National Audubon Society will recommend that "outdoor education" be added to the authorized purposes for which such areas may be acquired (Natl. Aud. Soc., 1963*b*). The other measure (S. 9) would permit the federal government to assume the full cost of land purchased for park, playground, or recreation use in urban renewal areas. These bills are awaiting action by the Senate Committee on Banking and Currency. This proposed legislation could be of considerable significance to birdlife and conservation education efforts. When suitable outdoor education areas are located within reasonable distances of schools and residences, children and adults can readily make use of them.

Wilderness.—Conservationists were greatly disappointed by the failure of the 87th Congress to approve the Wilderness Bill which sought to give wilderness designation and protection to areas in the national forests, parks, and wildlife refuges. As reported by the Society's Conservation Committee last year, the Wilderness Bill was approved by a 78 to 8 Senate vote and was sent to the House, where it was referred to the House Interior and Insular Affairs Committee. That group held a series of three field meetings in the west in the fall of 1961 and public hearings in Washington in 1962.

It soon became apparent, however, that key members of the Committee were opposed to the Senate bill, and a drastically amended version finally was reported by the Committee to the House. The committee chairman, Congressman Wayne N. Aspinall (Colorado) willingly accepted a committee instruction to seek to put the bill to a House vote under a procedure that would have prevented its full debate and correction. Aspinall was unable to get clearance from the leadership to take the bill to the floor under such an arrangement. Faced with the prospect of having the bill corrected substantially on the House floor, he left Washington fully three weeks before adjournment. His decision killed all chance of consideration of the Wilderness Bill in the 87th Congress. It also blocked committee action on other important conservation measures, such as the Tule Lake Wildlife Refuge bill and Administration bills pertaining to the newly created Bureau of Outdoor Recreation and the proposed Land Conservation Fund. A number of those bills already had passed the Senate, and there is no doubt that the House would have approved most of them had the work of the committee not been interrupted.

Considerable misunderstanding appears to have developed concerning the specific language of the proposed wilderness legislation. To help refine your own thinking, we recommend reading "The Facts About The Wilderness Bill," an informational statement issued by the National Audubon Society.

The Wilderness Bill was reintroduced in the House by Congressman John P. Saylor (H.R. 930) on the opening day of the 88th Congress and in the Senate by Senator Clinton P. Anderson (S. 4) and a group of cosponsors. Bill S. 4 advanced 27 March when the Senate Committee on Interior and Insular Affairs voted 11 to 5 to send the measure to the floor with a favorable report. Minor amendments were added by the Committee, the most serious being one that would prohibit the exercise of eminent domain by the federal government should it undertake in the future to acquire small private holdings, such as inactive, patented mining claims that exist within some wilderness areas. On 8 April 1963, the Senate passed the bill by a majority vote of 73 to 12. The Wilderness Bill faces an uncertain future in the House.

Two executive actions which assure the preservation of large areas of undisturbed mountain habitat involve the Anaconda–Pintlar and the Selway–Bitterroot Wilderness Areas. The first, near Butte, Montana, embraces 159,000 acres. The second, astride the Idaho–Montana high divide country west of Hamilton, is the nation's largest dedicated wilderness area with more than 1.2 million acres. These former national forest Primitive Areas were reclassified as wilderness under decisions of Secretary of Agriculture Orville L. Freeman in December 1962 and January 1963. Although pleased that the Secretary of Agriculture promoted the Selway–Bitterroot to full wilderness status, conservationists are concerned that the new area comprises only 77 per cent of the former primitive area. The Selway–Bitterroot Primitive Area was withdrawn from all forms of commercial use in the 1930's and was to be preserved for its wilderness value. Some conservationists are wondering why the technical area of wild land was reduced by nearly 23 per cent in the new designation.

Habitat Development.—Activities of man continue to modify the environment, sometimes benefiting birdlife and many times affecting the fauna adversely. Some major developments are summarized here.

The 25th anniversary of the Federal Aid in Wildlife Restoration Act was celebrated in August 1962. Before Congress passed the Act in 1937, wildlife research in state game departments was largely unknown, game management was mostly by trial and error, and land acquisition for wildlife by states was negligible. As of 30 June 1961, 2,294,069 acres had been acquired in fee title under the P-R program (1938–61) by 47 states (U.S. Bureau of Sport Fisheries and Wildl., 1962:2). Thousands of additional acres have been leased for public use. Nongame birds as well as game birds respond to management of the areas. Many of these lands are used by people for purposes other than hunting. Nonhunters should be thankful that the people paying the tax on arms and ammunition have helped provide them with a place to enjoy the out-of-doors.

With more development, many of the state wildlife areas acquired under the Federal Aid in Wildlife Restoration Act could be improved. A bill (H.R. 4705) now pending in Congress would assist states with the needed development work (Natl. Wildl. Fed., 1963*c*). The Secretary of the Interior could request that surplus federal property be held from disposal. Available property could then be assigned for a variety of uses, including fish and wildlife conservation use by the states and their political subdivisions. This proposal would implement one of the recommendations of the Outdoor Recreation Resources Review Commission.

In a new policy statement approved by President Kennedy in the summer of 1962, recreation, wildlife, and fish were placed on the same level with flood control, navigation, and other project purposes usually associated with federally constructed reservoirs. It replaces the former policy directive that was restrictive in the sense that fish, wildlife, and recreation were excluded as integral parts of reservoir project planning.

The document informs the Interior, Agriculture, Army, and Health, Education and Welfare departments that "planning for the use and development of water and related land resources shall be on a fully comprehensive basis so as to consider . . . outdoor recreation, as well as sport and commercial fish and wildlife protection and enhancement; preservation of unique areas of natural beauty, historical and scientific interests. . . ."

It also recognizes that the physical development of a river may not always be in the best interest of a river or of the people who recreate there and enjoy its natural values. The document informs the federal planners that the "well-being of all the people shall be the overriding determinate in considering the best use of water and related land resources." It instructs that preservation also shall be an objective in river planning, and that "proper stewardship in the long-term interest of the nation's natural bounty requires in particular that: there be protection and rehabilitation of resources to assure availability of their best use when needed; open-space, green-space, and wild areas of rivers, lakes, beaches, mountains, and related land areas be maintained and used for recreational purposes; and areas of unique natural beauty, historical and scientific interest be preserved and managed primarily for the inspiration, enjoyment, and education of the people."

This policy statement means, that for the first time, planners of federal river developments can figure in needed lands for recreation, fish, and wildlife as an initial project item, not as separate items as required previously. It also makes clear that the recreational, fish, wildlife, scenic, and natural use of a river for nondevelopment purposes can be provided for. The practical application of the policy has been clouded, however, by recent objection by the Bureau of the Budget to the purchase of lands for wildlife at some new reservoir projects. The Bureau, which is the fiscal wing of the White House, apparently believes that the Bureau of Sport Fisheries and Wildlife should pay for the lands from Duck Stamp receipts. This matter now is a subject of Budget Bureau–Interior Department debate. Secretary of the Interior Udall contends that the Budget Bureau is not correct.

Under the terms of the Accelerated Public Works Act of 1962, a total of $6 million was apportioned for wildlife and fish restoration projects in the United States, Guam, Puerto Rico, and the Virgin Islands (Wildl. Mgmt. Inst., 1963*a*). As approved, this Act authorized the appropriation of $900 million for projects to provide employment in economically distressed areas. Funds are made available to state and territorial fish and game departments for use on projects otherwise qualified under the successful Federal Aid in Wildlife and Fish Restoration Acts. Money is provided for approved projects on a 50–50 matching basis with nonfederal funds. Potentially, birdlife could receive many benefits from the habitat-development phases of this Act.

The agreement signed 28 March 1963 by the Departments of Defense and Agriculture should benefit wildlife. These departments agree to work together for the conservation of forests, soils, and waters on lands administered by the military agencies (Wildl. Mgmt. Inst., 1963*b*). Officials in charge of military installations, reservoir projects, and other Department of Defense facilities can obtain from the Department of Agriculture technical assistance, advice, and special research services. Defense will reciprocate by assisting in forest fire work and in supplying mapping services. Lands will be used to insure a continuing supply of resources on them.

In another cooperative agreement, the Army Corps of Engineers and the Bureau of Sport Fisheries and Wildlife agreed to provide firm protection for wildlife values on 159,000 acres along the Upper Mississippi River (*Milwaukee Journal*, 30 March 1963). In 1962, the Upper Mississippi River attracted 6,000,000 visitors interested in boating, water skiing, swimming, camping, fishing, hunting, and sight-seeing. The primary purpose of the new agreement is to minimize the impact of these recreational activities on valuable wildlife resources. Seasonal populations of waterfowl could benefit substantially from this pact.

In a courageous move early in 1963, Secretary of the Interior Udall increased private grazing fees on 180 million acres of land administered by the U.S. Bureau of Land Management in the western states. Restoration of the overgrazed rangelands should be enhanced by this historic action. Birdlife will benefit from the anticipated improvement in vegetation which should eventually result.

Highway construction continues to be viewed in widely differing ways. The Federal Aid Highway Act of 1962 provides, among other things, for development of roads and trails in forests and on other public lands. Bills (S. 1147 and H.R. 1900) are now pending in the 88th Congress to enable the Secretary of Agriculture to construct and maintain an adequate system of roads and trails for the national forests to enhance timber management and recreation (Natl. Wildl. Fed., 1963*d*). Generally, both the 1962 enactment and the 1963 proposals seem to be potentially beneficial for birdlife. Openings attractive to birds and accessible to people would be created in many timbered areas.

Also pending in Congress are bills (S. 468 and H.R. 2996) to secure protection for streams and natural resources in highway construction. Approval of the Secretary of the Interior would be required for surveys, plans, specifications, and estimates for projects involving federal-aid highways. The Secretary, through consultation with appropriate state agencies, would prevent or minimize damage to fish, wildlife, and recreation resources.

Ornithologists should be aware of possibilities to create small ponds and impoundments in conjunction with major soil-moving operations associated with highway construction. Such water areas, as now found along parts of the Indiana and Ohio toll roads, are rather heavily used by ducks during migration, and probably by other forms of wildlife.

In 1962, the Department of Agriculture launched a program to reduce surplus commodities by encouraging the conversion of an estimated 50 million acres of cropland to other uses. The 1962 Food and Agriculture Act offers opportunities to landowners and state agencies to develop recreation facilities and fish and wildlife habitat on private lands. Many incentives, in terms of low-interest long-term loans, cost-sharing, and practice adjustment payments, are offered to facilitate the conversion program. For the first time, recreation of many types is being viewed as a justified expenditure of public funds in agricultural programs. Also available, is federal cost-sharing for wildlife practices under the Agriculture Conservation Program authorized by Congress in 1961 (P.L. 87-112). Further opportunities to benefit birdlife are available under the small watershed, rural renewal, and area redevelopment programs.

People should study these programs carefully and consult with groups in agriculture to see if they can help increase public understanding of the available financial and technical assistance (Gabrielson, 1963). Potentially, the new agriculture program can help bring urban residents closer to the problems of soil and water management and the problems faced by the land operator. This is good. An improved understanding by more people of the proper use of our renewable natural resources is needed nationally.

Two new and ambitious wildlife projects are proposed for eastern Montana. The first of these involves the Fort Peck Game Range, an area of about 400,000 acres around the periphery of the Fort Peck Reservoir on the Missouri River. The area has been under the joint jurisdiction of the Bureau of Sport Fisheries and Wildlife and the Bureau of Land Management, both in the Department of the Interior. The Secretary of the Interior, late in 1962, directed that sole jurisdiction be vested in the wildlife agency and that an order be drafted to accomplish the decision. A conflict developed within the department over the continued use of the area for grazing. Reports indicate that the situation will be resolved largely in favor of the wildlife agency.

The Bureau of Sport Fisheries and Wildlife has prepared an imaginative plan to increase vastly the value of the area as habitat for mammals and wildlife of all kinds. Grazing definitely would be limited and every opportunity would be taken to enable the range to recover from serious overuse by livestock. The Bureau has proposed to name the area the Charles M. Russell National Wildlife Range in honor of the famed western artist.

The second project, receiving serious study, involves pumping water from the Fort Peck Reservoir and flooding three shallow basins of the prehistoric bed of the Musselshell River which lie north of the reservoir toward the small town of Malta. Wildlife biologists believe that this restoration project would make one of the best waterfowl nesting and resting areas in the United States. The project, which would involve approximately 40,000 acres of land, is tentatively identified by the name of Fort Hawley, after a nearby pony express crossing on the Missouri River.

In contrast to the beneficial aspects of these Montana projects, is the tremendous threat to fish and wildlife by the proposed Rampart Dam on the Yukon River in central Alaska. This new proposal dwarfs all previous similar projects in the unprecedented magnitude of fish and wildlife resources and habitat that would be destroyed (Gabrielson, 1963).

A 500-foot dam would create an impoundment covering *10,000 square miles* of the Yukon Flats that now produce an average of 1½ million ducks and geese yearly. More ducks are produced there than are bagged in most flyways. These waterfowl represent millions of man-days of recreation potential in the states, since Yukon Flats waterfowl are bagged from the Pacific to the Atlantic. The proposed dam would alter the annual water cycle that makes the Yukon area an important waterfowl breeding and concentration ground. Construction of the Rampart Dam and subsequent flooding would be a serious blow to the waterfowl population of North America. Look into this proposed project and learn about the facts involved.

HABITAT POLLUTION

The growing importance of habitat pollution was emphasized by President Kennedy in his health message directed to Congress on 7 February 1963. He emphasized the "threats to the physical well-being of our families from the contamination of food, air, and water." Most living creatures are affected, one way or another, by the contaminants. Pollution of environments continues to threaten the status of any bird with a limited range or a specialized migration pattern which concentrates it and exposes it to contamination. Such species could be reduced seriously in numbers before people are aware of it. Greater attention must be directed toward correcting and preventing pollution of the environment we share with other living creatures.

Pesticides.—The use of pesticides continues to hold congressional attention. The storm aroused by Rachel Carson's book, "Silent Spring," has had a profound impact on government. The President's Science Advisory Committee, in cooperation with the Federal Council for Science and Technology, has undertaken a major review of the Government's activities with respect to the use of chemicals in the environment (Natl. Wildl. Fed., 1963*e*). Represented on the committee are all federal departments concerned in one way or another with insecticides, herbicides, fungicides, and other chemicals used to control insect and pest plants and in the production and preservation of food. The committee's report and recommendations are ready for White House study now.

Specific legislation has been introduced in the 88th Congress dealing with the general pesticide problem. Congressman John D. Dingell (Michigan) has introduced two bills (Natl. Aud. Soc., 1963*c*). He reintroduced his Chemical Pesticides Coordination Act (H.R. 2857) to require advance consultation with federal and state wildlife officials before any federal agency can start a spraying program designed for mass biological controls. Subsequently, the second bill (H.R. 4487) was offered. It would (1) strengthen the research authority of the Department of the Interior in pesticide--wildlife relationships, (2) remove the present $2,565,000 limitation on funds that can be appropriated annually to the Fish and Wildlife Service for such research, (3) direct the Secretary of the Interior to make the findings of such research known to the Secretary of Agriculture, and (4) require that information necessary to prevent needless damage to wildlife resources be printed on the labels of package pesticides. Both bills have been referred to the House Committee on Merchant Marine and Fisheries.

At a panel discussion on 2 October 1962 at the Smithsonian Institution, Carl W. Buchheister, president of the National Audubon Society, offered a five-point action program to help meet the pesticides problem at state and national levels (Natl. Aud. Soc., 1962). His proposals included:

1. Shift the emphasis in the U.S. Department of Agriculture from the present general reliance on toxic chemicals to research in biological and cultural controls and to a balanced program that would minimize, but not necessarily eliminate, the use of chemicals.
2. Greatly increase funds for Fish and Wildlife Service research on the effects of pesticides.
3. Pass a law giving the Federal Pest Control Review Board genuine authority to review, modify, or veto pest-control programs proposed by federal agencies. The existing board, created by administrative action, has only advisory functions.
4. Amend the federal laws relating to the registration and labeling of pesticides to require that labels carry a specific warning—so worded as to be understandable to the consumer—when any pesticide is potentially dangerous to fish and wildlife or as a water pollutant.
5. By legislative act, create in each state a "Board of Pesticides Control" so composed as to fairly represent the different aspects of public interest, including health, agriculture, fish, wildlife, and water pollution. Such state boards should be given the following powers or duties:
    a. To regulate the packaging, labeling, advertising, and selling of pesticides within a state.
    b. To license persons engaged in commercial or contract spraying.
    c. To regulate pesticide programs engaged in by public agencies.

d. To require permits for the application of pesticides on private lands, if necessary, to prevent water pollution or to avert the dangerous accumulation of toxic residues on foodstuffs or in the soil.

e. To carry on a program of public information about safe pest-control methods.

Some states have acted along the recommended lines. In 1962, the Massachusetts legislature established a Pesticides Board. Legislatures in Maine, Connecticut, Ohio, and New Hampshire are considering bills to regulate chemical pesticides (Natl. Aud. Soc., 1963*d*). Action is anticipated in Illinois, and possibly other states. Such proposals should be watched closely to insure that sound, mature judgment is used to develop proper wording in the bills. Cooperative action between the numerous interests associated with pesticides is definitely necessary to provide workable regulations.

Detergents.—Amendments to the Federal Water Pollution Control Act are being proposed to require standards of decomposability for synthetic detergents. Congressman Henry Reuss (Wisconsin) suggested an amendment to protect navigable waters of the United States from further pollution by requiring that synthetic-based detergents manufactured in the United States or imported into the United States comply with certain standards of decomposability (Natl. Wildl. Fed., 1963*f*). An identical bill (S. 1118) has been offered by Senator Lee Metcalf of Montana (Natl. Wildl. Fed., 1963*d*).

Water Pollution.—Bills have been offered in the 88th Congress to strengthen the nation's water pollution control program. Senators Edmund S. Muskie (Maine) and Hubert H. Humphrey (Minnesota) introduced a bill (S. 649) at the same time that Representatives John A. Blatnik (Minnesota) and John D. Dingell (Michigan) offered H.R. 3166 and H.R. 3167, respectively. Features of these proposals include (Wildl. Mgmt. Inst., 1963*c*):

1. Establishing a firm statement of policy to keep waters as clean as possible, rather than continuing the present negative policy of attempting to permit pollution of waters up to the ability of the waters to assimilate wastes through natural processes.
2. Establishing a Federal Water Pollution Control Administration to be headed by a Commissioner of Water Pollution Control.
3. Authorizing yearly $100 million for assistance to cities to help separate combined sanitary and storm sewers. Combined sewer systems are a major cause of water pollution. Huge quantities of municipal wastes are released into rivers when treatment plants are by-passed during times of heavy rain and water runoff.
4. Establishing water quality criteria for interstate or navigable waters to protect public water supplies, fish, aquatic life, wildlife, and recreational, agricultural, industrial, and other legitimate uses.

Features of these proposals could help restore water areas which have become practically unusable or hazardous as a result of excessive pollution. Wildlife, as well as people, could benefit substantially.

Legislation (S. 736) has also been sponsored by a number of senators to aid industry in improving pollution control (Natl. Wildl. Fed., 1963*g*). The Internal Revenue Code of 1954 would be amended to encourage the construction of treatment works to control water and air pollution by permitting the deduction of such expenditures. A second bill (S. 737) would make inexpensive credit available to small firms for the purchase of pollution control facilities.

Oil.—An International Conference on Prevention of Oil Pollution of the Sea was held in London in March 1962 (Buchheister, 1962*a*). Purpose of the meeting was to see how the convention treaty, subscribed to by 17 nations, could be strengthened. The United States became a member of the International Convention in 1961 (P.L. 87-167).

At the conference, attended by 56 nations, agreement was reached on the following items

1. To extend the zones where no discharge of waste oil is permitted to include all of the North Sea and the Baltic Sea, and an area of the northeast Atlantic extending 1,600 miles west of Britain.
2. To extend from 50 miles to 100 miles the prohibited zones along the coasts of countries surrounding the Mediterranean, Adriatic, Black Sea, Red Sea, and the Persian Gulf.
3. To bring new classes of ships within the convention and include all tankers down to small ones of 150 tons gross. Merchant marine (dry cargo), as well as tankers would be covered by the regulations. These proposed amendments were submitted to the United States Senate on 25 March 1963. A two-thirds vote is needed to enact the proposals.

Although no deadline was established for prohibiting all discharges of oil or oily wastes at sea, it was reemphasized at the London meeting that this must be the ultimate goal of the international effort.

Carl Buchheister states, "I came away from the conference with a firm conviction that faster progress will be made in cleaning up oil pollution of the seas and coastal waters only as conservation organizations become actively interested in the problem." Here is a real challenge for Wilson Society members.

Major oil pollution problems continue to develop periodically at inland areas and affect the welfare of wildlife. In January 1963, two industrial accidents occurred in Minnesota, resulting in wide dispersal of a reported 2.5 million gallons of oil. A soybean storage tank at Mankato, Minnesota and a crude oil pipe at Savage, Minnesota burst during the subzero weather. With the spring thaw, the oil spread down the Minnesota and Mississippi rivers as migrating birds were moving northward to their breeding grounds.

Minnesota Governor Karl Rolvaag ordered the National Guard to rescue affected ducks. The State Executive Council allocated the last $14,000 in a calamity fund to help finance the rescue operation. An early estimate showed that 10,000 wild ducks, largely scaup, had died from the effects of the oil (*Milwaukee Journal*, 7 April 1963). Songbirds, gulls, beaver, mink, and deer were also found covered with oil. Guardsmen established barriers across the main sloughs and backwaters of the Mississippi River to prevent the 100-mile long oil slick from entering the resting and feeding places of wildfowl. Efforts were directed to confine the oil to the main channel of the river and the waterfowl to the clean backwater areas. Governor Rolvaag and Governor Reynolds of Wisconsin have requested the federal Public Health Service to work on the problem.

MIGRATORY BIRD HUNTING SEASONS

Wide variations between the population status of different migratory birds have recently resulted in major changes in hunting regulations. We believe the cases cited here serve to illustrate how modern wildlife research and management, since their origin in the 1930's, have progressed in developing knowledge and action programs to meet certain present-day bird population problems. We hope the facts presented here will help improve understanding of the issues and objectives involved.

Mourning Dove.—A bill was introduced in the 87th Congress that sought to amend the Migratory Bird Treaty Act to prohibit the hunting of Mourning Doves. Widespread objection was registered by many state fish and game departments and governors to the measure offered by Congressman Karth (Minnesota). The California legislature resoluted in opposition to the bill. Objectors contended that biological information showed that shooting is not a threat to dove populations. A total closed season is definitely not required for the Mourning Dove at this time.

Lesser Sandhill Crane.—The population status, management problems, and results of recent hunting seasons were presented at the annual convention of the National Audubon Society (Boeker, 1962). Summary statements from that report are offered here.

During the winter of 1961–62 nearly 200,000 Lesser Sandhill Cranes were on the major wintering areas in southwestern United States and interior Mexico. A peak of 240,000 cranes has been recorded along the Platte River in Nebraska during spring migration. Real and alleged crop depredations have been reported in Canada and the Central Flyway states. The amount of crop damage caused by cranes in a given year is largely dependent upon weather conditions which govern the timing and extent of crop harvest. Severe damage may be sustained in wet years when the harvest is delayed. In dry years much of the harvest is completed before the cranes arrive, and little or no crop damage occurs. Threat of damage is greatest where the cranes concentrate in large flocks during migration and on the wintering ground.

Requests for a crane hunting season were first registered with the Bureau of Sport Fisheries and Wildlife by Texas and New Mexico in 1953. The request was based largely on the premise that large concentrations of cranes in western Texas and eastern New Mexico caused extensive crop damage which was an economic burden on farmers in the areas. By 1959 crop depredations were also severe in Saskatchewan. Canadian authorities recommended a hunting season on the wintering grounds.

After intensive investigations, to insure protection for the Greater Sandhill Crane and the rare Whooping Crane, the first hunting season on Lesser Sandhill Cranes was granted by the Secretary of the Interior for parts of western Texas and eastern New Mexico for 1–30 January 1961. State law permitted a daily bag and possession limit of two birds in a six-county area of New Mexico only. An estimated 542 Lesser Sandhill Cranes were bagged.

In 1961, a crane season was held in Alaska (1–30 September) and in parts of Texas and New Mexico (4 November–3 December). Daily bag and possession limits were two birds. The total harvest in the latter two southern states was estimated at 2,914 birds. No figures are available to us on the harvest in Alaska.

In 1962, a crane season was again held in Alaska (1–30 September) and in parts of Texas and New Mexico (3 November–2 December). No estimate of the harvest is available at this time.

Three points seem clear from the limited hunting seasons:

1. The annual harvest of Lesser Sandhill Cranes has been small, seemingly well within the capability of the population to rebuild its numbers through yearly reproductive gains.
2. No Greater Sandhill Cranes or Whooping Cranes are known to have been killed as a result of the crane seasons.
3. In Texas and New Mexico the season has been well received by both farmers and sportsmen. Many farmers expressed the opinion that legal hunting is an acceptable method of alleviating the crop depredations problem. Hunters disperse local crane populations.

While the crop depredations problem on major wintering areas seems to be resolved by limited hunting, the threat of depredations remains in Saskatchewan. Magnitude of crop losses in a given year will continue to be influenced by the interrelationship of time of crop harvest and weather conditions near major crane concentration areas. Farmers could help discourage depredations by scaring the birds off unharvested crop fields. Establishment of refuge areas has been recommended for cranes to reduce the possibility of crop depredations (Buchheister, 1962*b*). Another approach would be to make an effective crop insurance program available to farmers within the daily feeding radius of major crane concentration areas.

Whistling Swan.—In 1962, the Department of the Interior provided a limited open season in Utah only for taking Whistling Swans under special permit from 13 October through 26 December. Special regulations included (1) issuing no more than 1,000 special permits, and (2) restricting each permittee to only one Whistling Swan during the open season. Robert I. Smith (personal communication, 4 April 1963) reported that an estimated 350 swans were bagged. A full evaluation of the season is being conducted.

Canada Goose.—Special hunting regulations continue to be established for individual manageable flocks of Canada Geese. This management approach includes limiting the annual harvest by time, locality, and, in some cases, in the Midwest, by a quota. A formula for curtailing the harvest of Canada Geese in Missouri continues to be used. Conservation Departments in Illinois and Wisconsin, in cooperation with the Bureau of Sport Fisheries and Wildlife and the Mississippi Flyway Council, continue to establish an annual harvest quota for the Canada Geese of the Mississippi Valley, especially those that winter primarily in southern Illinois and adjacent areas. The objective is to hold the yearly harvest less than the annual reproductive gains and thereby encourage the flock to increase until a wintering population of 300,000 birds is achieved. With a larger population, an improved distribution of geese may be accomplished, especially in states south of Illinois. At the same time the goose populations are being managed intensively, hunting regulations are being modified constantly to improve the quality of hunting around the major goose concentration sites. The development and application of an interstate goose-kill quota system is recognized as one of the important recent developments in the history of waterfowl regulations. This action recognizes that the size of a flyway or species population represents the sum of birds in each manageable unit or flock.

The season was closed on Canada Geese in Arkansas and most of Louisiana in 1962, and will probably remain closed for a period of three to five years. The objective is to protect existing natural and transplanted small flocks of geese using these states and thereby encourage their enlargement. Whether or not areas north of these states will have to cooperate by protecting the birds to permit the objective to be reached, remains to be determined. Nevertheless, regulations aimed at maintaining or increasing separate flocks are definitely a forward step toward improving the management of goose populations.

Ducks and Coots.—Drought in the vital prairie breeding grounds continues to curtail reproduction of some ducks and the coot, and to make variations in hunting regulations mandatory. In 1962, there were closed seasons on some species of waterfowl, reduced bag limits on others, and larger bag limits on still others. Regulations permitting a daily bag of one Mallard or Black Duck in the Mississippi Flyway were the most restrictive provided for these birds in many decades. Fortunately, hunters' abilities to identify these species are generally good. At the same time these very restrictive regulations were imposed, a bonus of two scaup was permitted in the Atlantic, Central, and Mississippi flyways, in addition to the bag limit on other species.

This type of species management, through variation in size of bag limits, features identification of ducks by hunters. Evidence indicates that some hunters have difficulty in identifying certain ducks in the hand, say nothing of those in flight. To minimize the chances of hunters taking other species, especially Ring-necked Ducks, Florida permitted the scaup bonus only in designated areas where the waterfowl population was predominately scaup (O. E. Frye, Jr., personal communication, 4 April 1963). Fortunately, in Florida, scaup concentrations are in shallow, brackish, or salt water areas which are inhabited rarely by ring-necks. Certainly this designation of regulations for specific localities and species is another major advancement in managing waterfowl more intensively.

As a result of the recent restrictive hunting seasons, some private duck clubs in the Mississippi Flyway have threatened to permit their waterfowl lands to be converted to other uses. Since private clubs control about 75 per cent of the more important waterfowl lands in the flyway, their decisions could potentially affect a sizable acreage of good habitat. However, their threats do not justify establishment of unsound liberal seasons.

In sharp contrast to these threats, was the action of County Soil and Water Conservation District Supervisors in Arkansas (Wildl. Mgmt. Inst., 1963*d*). A newspaper appeal was made to farmers in the winter of 1962–63 to flood harvested soybean and rice fields and to maintain levees to provide ducks with ample, choice feeding sites on this important duck wintering ground. Many farmers were reported to have contributed to the effort in spite of the reduced bag limit. Their objective was to send the ducks, primarily Mallards, back to the northern breeding grounds in good condition.

With the populations of many species of ducks at low levels, efforts have been intensified to reduce the illegal harvest. A proposal introduced in the 87th Congress sought to amend the Migratory Bird Treaty Act to provide for posting and closing baited areas. Offered too late for consideration in 1962, the proposal probably will be reintroduced in the 88th Congress. The measure would permit the Bureau of Sport Fisheries and Wildlife to post and close baited areas for an entire shooting season. Such a regulation, if enacted, could serve the dual purpose of protecting individuals who may not know that feed was spread deliberately to attract birds, and of providing enforcement agents with a realistic weapon to use against chronic violators.

CONTROL OF BIRD POPULATIONS

At certain times and places the populations of some birds enlarge to the point that they conflict with man's use of the land or his activities. The Starling is now a species of this type. Many times its ranks are swelled by grackles, cowbirds, Red-winged Blackbirds, and other members of the blackbird family. Frequently, these species compound real or potential damage problems. The problems resulting from these birds, particularly the Starling, are of growing concern to many people.

Since the Starling was introduced in New York's Central Park in 1870, it has spread to the Pacific Coast and southern Canada. Only small flocks were observed on the West Coast during the late 1940's. By 1962, the western wintering population numbered in the millions.

The first public concern over Starlings was expressed in urban areas, notably in Vancouver, Portland, and Seattle. About 1957, holly growers in the Williamette Valley of Oregon reported that Starling droppings were fouling their holly greens and making them unmarketable as Christmas decorations. At approximately the same time, damage to cherries, apples, and other soft fruits occurred in a number of western states. Subsequently, farmers and ranchers complained of Starling damage in their livestock feedlots. Recently, grapes, olives, and other crops grown in the Southwest have been damaged.

Starlings, in roosts containing tens of thousands of birds, occur in a variety of places and can or do cause damage. One roost is in a Pennsylvania pine forest adjacent to a municipal water reservoir. Another is located on a southern military airbase a few hundred feet from runways used by bombers of the Strategic Air Command. Others occur in many towns and cities where the birds spend the night on building ledges and in trees along busy streets or in parks. People dislike the associated unclean conditions.

Even small numbers of Starlings may, on rare occasions, cause damage. A small flock of less than a hundred crossed the runway of a New England airbase late one afternoon and were ingested into the engines of a million-dollar jet fighter aircraft, which lost power and crashed.

Starlings also may be involved in transmitting diseases. In 1962, public health investigators reported several cases of a human respiratory ailment, called histoplasmosis, in eastern United States. This disease is caused by a fungus and is known to flourish in Starling droppings. Another mysterious ailment, transmissible gastroenteritis, killed upwards of a 100,000 young pigs in the Midwest during the winter of 1961–62. The pattern of spread of this disease was associated with the presence of Starlings at feedlots. The possible role of Starlings and other birds in spreading diseases to livestock, poultry, and people is virtually unknown and needs study.

All of the incidents cited above indicate increasing competition between birds and varied interests of man. Pressure is mounting from industry, agriculture, and governmental agencies for development of ways and means to prevent or reduce damage under a wide variety of situations. There have been substantial increases in federal appropriations for the study of nuisance bird problems. However, there is no assurance that the present research effort of approximately $500,000 annually will provide early and acceptable bird management techniques. Unlike more sedentary animals, that at times may be objectionable and become regarded as pests, many birds are migratory and seasonally disburse widely. When scattered, birds are generally recognized as being beneficial. Only a few of their kind are regarded as undesirable, and these usually only in certain localities for relatively short periods of time. With the diversity of values associated with birds, discovery and development of satisfactory methods for preventing damage is no easy task.

The research program of the Bureau of Sport Fisheries and Wildlife includes conducting extensive banding operations to learn more about seasonal movements of blackbirds and Starlings. Over 25,000 were banded during 1961 in the eastern states and cooperative banding of approximately 30,000 birds is well under way in California. Recent band recoveries reveal that large numbers of Starlings wintering along the Pacific Coast spend the summer months on breeding grounds of the northern United States and southern Canada. If breeding populations increase in these areas, larger concentrations of winter migrants can be expected to appear in the Southwest. Summer residents also are being found in the Central Valley of California.

Biologists are attempting to locate winter concentrations of Starlings and blackbirds of several species. Two hundred fifty-two major blackbird and Starling roost sites, containing approximately 214 million birds, have been located throughout various parts of the United States, particularly in the lower Mississippi Valley. Included in this total were approximately 77 million redwings, 59 million grackles, 40 million Starlings, and a scattering of other birds. The per cent of the continental population represented in these roosts is unknown. Studies are continuing to locate additional major winter-concentration sites.

Other investigational phases on possible bird control procedures involve (1) evaluating visual and sonic scaring devices, (2) modifying cultural practices, such as developing and using bird resistant varieties of corn, and (3) continuing to search for chemical repellents, selective lethal agents, stupefying drugs, and chemosterilants. Work is also continuing on population dynamics and the physiology of bird behavior, including their sensory perception. As new developments occur in other fields of science, their possible application to bird problems is considered. For example, the use of the laser phenomenon (light amplification by stimulated radiation) is being explored to determine its potential utility as a bird deterrent.

Findings from 1962 studies suggest that recorded distress cries of immature Yellow-headed Blackbirds are superior to those of other species for preventing crop damage by blackbirds. Tape recordings of their cries broadcasted over cornfields produced favorable responses. Likewise, broadcasting the cries from aircraft appears encouraging for driving flocks of depredating birds from fields. Another device, known as a simulated landmine, produces sound volumes for repellent effects several times greater than carbide exploders.

Despite the recognized desirability for preventing damage without killing birds, there are times and places when birds must be removed. Therefore, it is necessary to carry out investigations to discover and develop lethal materials and devices. This work includes a search for anesthetic agents that may be incorporated in bait material to produce sleep within three or four minutes. Compounds that affect muscular coordination and cause temporary immobility are being investigated to evaluate their utility as antiflying materials. Chemosterilants appear to offer one of the best means for limiting population levels of objectionable species. However, a great deal of basic research must be carried out before the use of any of these materials can be recommended for problem situations.

Regardless of one's views concerning the importance or need for control, it is apparent that greater effort must be devoted to finding ways and means of alleviating an increasing array of nuisance bird problems. Aside from those involving the introduced species (pigeons, sparrows, and Starlings), it is also recognized that better methods must be found to manage flocks of native forms, such as blackbirds and Herring Gulls. The growing use of jet aircraft makes it necessary to learn more about the habits and seasonal movements of all major problem species, particularly members of the gull family. Deep probing is needed to discover critical relationships between seasonal populations of birds and their environment, especially specific habitat requirements and behavioral responses. There is a continuing need and opportunity for both amateur and professional ornithologists to assist in the acquisition of this knowledge.

ENDANGERED SPECIES AND SUBSPECIES

In recent years, this section of the Committee's report has listed species in the endangered category with a minimum of discussion of the exact status of each species or without comments on major management efforts. This year we have attempted to give brief histories on some species to demonstrate how certain endangered birds are being or can be helped. Other threatened American species are merely listed.

When reading these case histories, please remember that the status of individual species can, in many instances, serve as an index to man's relation to his fellow creatures. Since the formation of the Wilson Ornithological Society in 1888, the Passenger Pigeon (1914), Carolina Parakeet (1915), and Heath Hen (1932) have passed from the face of the earth. These events are evidence of man not understanding his relationship to his environment or to his fellow living beings.

A great need still exists for developing our knowledge of habitat requirements and population characteristics of a number of species. Research is urgently needed on many threatened species to establish the population status more adequately, to determine the factors limiting populations, and to develop sound management procedures aimed at insuring the perpetuation of each species.

In many cases, drastic steps will be required to save essential habitat that is decreasing rapidly and to apply known sound management practices to designated population units. With proper knowledge, land managers of all kinds would be enabled to make those seemingly small modifications of program that result in important habitat changes. Somehow, we must move to retain or restore that diversity of landscape that alone can insure that all other forms of life will find niches allotted them by evolution's new agent, man. Fortunately, state fish and game departments, some land-use branches of the federal government, and private groups and individuals are moving in these directions in scattered localities. With the majority of birds living on nongovernment lands, habitat management efforts by private people are of vital concern. Economics and the will of people probably will largely determine how widespread the efforts become.

Trumpeter Swan.—The history of the Trumpeter Swan is a perfect example of what modern wildlife research and management can accomplish when given adequate opportunities, resources, and funds. Estimates indicate that the continental population may have been as low as 100 in 1916 and perhaps as high as 1,500 in 1961 (Munro, 1962). This population increase is largely the result of providing protection from shooting and maintaining suitable habitat in national wildlife refuges. The Red Rock Lakes Refuge was established in Montana in 1935. From a total of 26 swans in 1932, this refuge population reached 380 in 1954 (Banko, 1960:146). Increases have also been recorded in Canadian nesting areas, and in recent years isolated pairs have been recorded in new locations (Munro, 1962). Breeding trumpeters dislike overcrowding. Some lakes used in Alberta are well over 1,000 acres in extent, but are large enough for only one swan family.

As the breeding populations enlarged, it became obvious that man must lend a helping hand, if the trumpeter was to be reestablished as a breeding bird in more locations in western Canada and the United States. The U.S. Fish and Wildlife Service has taken stock from the overcrowded Red Rock Lakes flock and attempted establishment of colonies at Ruby Lake Refuge (Nevada), National Elk Refuge (Wyoming), Malheur Refuge (Oregon), and La Creek Refuge (South Dakota). Nesting has occurred at all sites except the La Creek Refuge, where a transplant of cygnets was made in 1960.

In Canada, H. Albert Hochbaum of the Delta Waterfowl Research Station has developed the art of breeding trumpeters in captivity. Twelve cygnets were raised in the last three years. Birds from the Delta flock may eventually be used to attempt establishment of breeding groups at suitable locations in western Canada. The experiences in Canada and the United States all aid in developing an efficient transplantation program.

In 1959, the U.S. Bureau of Sport Fisheries and Wildlife initiated a cooperative program with public zoos permitting the conditional loan and display of the rare Trumpeter Swan. At least 18 public zoos, having an estimated total attendance of over 15 million people annually, now display 36 Trumpeter Swans under this educational program. An incomplete list of cities having swans include San Diego, Miami, Springfield (Illinois), New Orleans, Detroit, St. Paul (Minnesota), Kansas City (Missouri), New York, Toledo, Portland (Oregon), Philadelphia, Pittsburgh, San Antonio, Salt Lake City, Seattle, and Washington, D.C. A maximum of 10 pairs of swans was to be taken from the wild in 1962 for loan to additional qualified public zoos and institutions.

Management efforts in the past half century have helped assure the survival of the Trumpeter Swan. D. A. Munro (1962) concluded that "If numbers are to be maintained or increased through transplantation, we will have to keep a careful eye on swan habitat."

Filling, ditching, and draining of the swan's breeding grounds will continue to threaten this magnificent bird. Habitat preservation, transplantation, and continuing protection are essential features of the evolving management program.

Hawaiian Goose.—Historically, there may have been as many as 25,000 Nene in the world, all in Hawaii. An all-time population low was reached in 1950, when 17 birds were left in captivity and only 17 were known in the wild (Elder and Woodside, 1958). In 1949, the Board of Agriculture and Forestry of the Territory of Hawaii initiated propagation experiments with one pair of Nene obtained from Herbert Shipman, a rancher (Buchheister, 1962). An ecological investigation of wild Nene was conducted in 1957 (Elder and Woodside, 1958). As a result of this study, suitable habitat and other areas capable of restoration were identified and two sanctuaries were established under cooperative agreements with private ranch owners to give the birds needed protection. In 1958, Congress passed the Nene Goose Act, authorizing the U.S. Fish and Wildlife Service to spend $15,000 per year for five years to conduct research and to develop restoration methods.

Reports indicate that between 50 and 75 Nene now exist in the wild in Hawaii, in addition to some 200 birds in captivity there and at the Severn Wildfowl Trust in England (Cottam, 1962*b*). Captive birds are being released in habitat that seems very favorable. This is a good case demonstrating that with adequate knowledge, determined people with imagination and adequate financing can save a rare species from extinction. Continued efforts are needed to insure a proper sustained management program.

The 5-year research and restoration project of the U.S. Fish and Wildlife Service is due to terminate in 1963. Buchheister (1962*a*) reported that some members of Congress have been blocking extension of the project on the grounds that since Hawaii has adopted the Nene as its official state bird, the United States as a whole should no longer feel any concern about it. As one of the world's rarest and most endangered species, its fate definitely seems a matter of national interest, as well as state responsibility. Encouragingly, Senator Daniel K. Inouye (Hawaii) has introduced a bill (S. 266) to secure funds for the conservation and restoration of the Nene. This proposal has been referred to the Senate Committee on Commerce (Natl. Wildl. Fed., 1963*h*).

Ross' Goose.—At one point in history, this small white goose was very rare. Most experts estimated that only 3,000 Ross' Geese existed in the not too distant past. It has been protected since 1931. Not until 1940 was the breeding ground discovered by Angus Gavin on the Perry River north of the Arctic Circle. In fall migration the Ross' Geese pass southeast to the region of Great Slave Lake and Lake Athabaska, then south along the eastern face of the Rocky Mountains to central Montana. From here they cross the Rockies, pass through southeast Oregon, Tule Lake, California, and finally enter their wintering grounds in the great central valleys of California's Sacramento and San Joaquin rivers (Morse, 1963).

Although protected, Ross' Geese are subject to some shooting throughout their entire migration. A few are bagged by Eskimos and Indians in the Far North and hunters in the United States accidentally shoot them for Snow Geese. A certain amount of mistaken identification by hunters seems inevitable; both species of white geese pass through the same general area and flocks often mingle.

In 1955, the Fish and Wildlife Service started a special mid-February census of the Ross' Goose on its restricted wintering grounds in California. From a total of 6,000 in 1955, the population has increased steadily to almost 28,000 in 1962 (Morse, 1963). While the Ross' Goose is in no immediate danger of extinction, additional knowledge of its distribution during nesting and migration is needed before more intensive management can be planned. Banding projects being conducted by the California Department of Fish and Game, the Canadian Wildlife Service, and the Fish and Wildlife Service will probably supply some of the essential information. Enforcement of regulations protecting the Ross' Goose will continue to be a difficult job. In addition, intensive educational efforts will be required to encourage hunters to learn species in flight. Whether or not populations of this species can enlarge sufficiently to again permit a hunting season of any type remains to be seen.

Aleutian Canada Goose.—This rare bird nests on the Aleutian Islands, including Buldir Island of the Aleutian Islands National Wildlife Refuge. It probably winters with other races of Canada geese in the interior valleys of California and possibly in other western areas. The goose populations declined drastically after blue foxes were introduced to the Aleutian Islands to increase the natives' fur catch. Foxes preyed on goose eggs and young and probably on nesting geese (Cottam, 1962*b*). Foxes were not released on Buldir Island, where 300 of these geese were observed in 1962. The Fish and Wildlife Service captured seven goslings to start a captive flock for restocking. Elimination of the introduced fox on the best known goose nesting islands is also being attempted. Restocking can follow removal of the fox. Additional research is vital to learn where the birds winter. After better information on the distribution and status of this goose is available, management efforts can improve.

Giant Canada Goose.—Until 1962, this magnificent bird appeared to be extinct. Rediscovery of a wintering flock of 6,000 Giant Canada Geese at Rochester, Minnesota by Harold C. Hanson of the Illinois Natural History Survey alerted conservationists. Subsequently, Dr. Hanson has established the existence of at least an additional few thousand of these birds in the Midwest. Certainly these findings should stimulate both amateur and professional conservationists to examine even some of our commonest birds very carefully. Discoveries can be most significant. Knowledge of the status, distribution, and habits of subpopulations of Canada geese is needed to mold effective management programs for individual populations. Development of management programs covering the entire range of individual populations of geese is a stimulating challenge facing wildlife agencies in Canada and the United States, as well as all other interested people.

Tule White-fronted Goose.—This bird is seriously endangered (Cottam, 1962*b*). Little is known of its nesting and wintering grounds. Because this race frequents some of the same geographic areas as do other races of this species that are hunted, some are probably shot. Research is urgently needed to assemble facts and more adequately determine the status of this goose.

Laysan Duck.—This nonmigratory and essentially terrestrial duck now occurs only on the 709-acre Laysan Island, Hawaii (Warner, 1963). Prior to disturbance the population was approximately 600 in 1893. In the next 20 years hunting and destruction of important vegetative cover by introduced rabbits reduced the duck population to approximately seven individuals in 1912. In 1909, the Hawaiian Islands Refuge was established, which included Laysan Island. After rabbits were eliminated from the island by about 1924, vegetation became reestablished. With more suitable habitat and protection, the duck population steadily increased. A census in 1961 yielded 688 ducks, or approximately one bird per vegetated acre of island (Warner, 1963). A population of about 600 ducks is apparently what the island can support in its present condition. The species is now entirely terrestrial during spring and summer, largely nocturnal, insectivorous, and has adapted to a habitat devoid of standing fresh water (Warner, 1963). In addition to the wild populations, captive breeding populations are being maintained at nine locations in America and England. Response of this rare species to protection, the island's recovered flora, and captivity is heartening. However, continued efforts by conservationists are needed to maintain this duck's healthy status.

Mexican Duck.—Recent evidence helped confirm the view that the New Mexican Duck is synonymous with the Mexican Duck (Johnsgaard, 1961:37). The adult Mexican Duck population in Mexico is probably less than 20,000 birds (Johnsgaard, 1961:5). In New Mexico, the wild population of this duck is estimated at 150 during peak periods (Huey, 1963). Formerly it was found commonly on sloughs and bosques between Albuquerque and the Texas boundary. Extensive drainage along the Rio Grande has all but destroyed the vital nesting habitat. In 1958, a project was initiated to preserve and restore the subspecies in New Mexico by establishing a captive flock, the progeny of which would be released into rehabilitated or developed habitat (Huey, 1963). Five ducklings were trapped in 1959 to form the nucleus for the captive flock. Subsequently a few more birds were added. In 1961, 25 of 32 ducklings hatched in captivity were raised to maturity. Pairs of these young ducks were distributed to aviculturists who agreed to assist in the propagation effort. In 1962, 16 pairs of Mexican Ducks were provided the U.S. Bureau of Sport Fisheries and Wildlife for a captive flock at the Bosque del Apache National Wildlife Refuge. The first releases of ducklings into suitable wild habitat are planned on a limited basis for 1963. These initial efforts of personnel of the New Mexico Department of Game and Fish constitute a valuable timely contribution toward the welfare of this subspecies within their state.

Hawaiian Duck.—The exact status of this bird is uncertain, although it is known to be in a precarious state (Cottam, 1962*b*). This small Mallard-like duck is gravely endangered by destruction of its essential habitat. More information on the abundance of this duck is required. Officers of the World Wildlife Fund have appropriated money to start in Hawaii a propagation program similar to the one that has helped so greatly to improve the status of the Nene.

Other Hawaiian birds.—The Hawaiian Gallinule and, to a lesser extent, the coot and stilt are seriously endangered by loss of essential habitat. On the islands a total of 11 endemic species is now considered endangered (Cottam et al., 1962). How many of these threatened species will be added to the list of 14 species already believed to be extinct (Peterson, 1961:331), will be determined by time and the efforts of conservationists.

Bald Eagle.—Since Congress selected the "American Eagle" as our national bird in 1782, efforts have been directed toward considering the bird's welfare. The Bald Eagle Act of 1940 gave protection to the bird. Subsequent concern over the status of the Bald Eagle led to the establishment of the cooperative Continental Bald Eagle Project under the auspices of the National Audubon Society. Under this project, the first continental winter inventory of Bald Eagles was completed in January 1961, with a total of 3,642 birds being reported in the United States, exclusive of Alaska. On a subsequent census in January 1962, a total of 3,807 birds was counted (Sprunt and Cunningham, 1962). Improvement in coverage on the census probably resulted in more birds being seen in 1962. Four major winter-concentration areas have been established: Middle West, 57 per cent; Florida, 14 per cent; Pacific Northwest, 10 per cent; and Middle Atlantic, 6 per cent. The Chesapeake Bay region is an important wintering area in the east. Over a third of the reported U.S. eagle population occurred in the Mississippi Valley between southern Minnesota and Arkansas.

Of major concern is the wide range in reproductive success in Bald Eagles. Nesting success in 1962 in the East Coast (Virginia to Maine) population was only about 10 per cent; in the Middle West (Wisconsin–Michigan–Ohio), 40.5 per cent; and in southern Florida, 57 per cent. Available evidence suggests that pesticides may be involved in curtailing reproduction (Dewitt and Buckley, 1962). Of 27 dead Bald Eagles shipped to the Patuxent Wildlife Research Laboratory for analysis, all but one (from Alaska) had measurable amounts of DDT or its metabolites in their tissues. Studies on captive eagles in Alaska by the U.S. Fish and Wildlife Service showed that all eagles fed 160 ppm or more of DDT developed severe tremors and died. Effect of exposure to DDT on spermatogenesis is being investigated. Three Bald Eagle eggs collected from unsuccessful nests in New Jersey contained DDT.

Despite federal protection since 1941, the gun remains an important cause of death of eagles. The National Audubon Society tabulated the cause of death of 118 eagles and found that 77 per cent were shot (Sprunt and Cunningham, 1962). This loss, attributable to irresponsible shooting, was not determined by a scientifically satisfactory procedure. However, it is a good clue indicating the magnitude of the education and enforcement job that remains to be done.

An important step in intensifying protection for the Bald Eagle was achieved in 1962. The first cooperative Bald Eagle Sanctuary was established in Florida under the direction of the Florida Audubon Society. A total of 59 ranchers in the Kissimmee River Valley agreed to the cooperative plan and brought 659,000 acres into the protected area. Sixty-five active eagle nests were located on these lands. Each rancher has agreed to (1) protect the eagles from disturbance, (2) protect the nests, (3) refrain from removing any nest trees until at least one breeding season has passed without eagles being present, (4) allow Audubon personnel to post the land and inspect the nests, and (5) notify the Florida Audubon Society in the event his land is sold. This approach of maintaining suitable habitat for the Bald Eagle on private lands through a cooperative arrangement deserves special attention. It may have application in other locations and for other species of wildlife. The National Audubon Society is presently drafting recommendations designed to protect eagle nesting habitat.

The New Jersey Audubon Society is also promoting habitat management for the Bald Eagle. They suggested that the U.S. Fish and Wildlife Service plant pitch pines in suitable locations on National Wildlife Refuges for future eagle nesting sites. This is being undertaken.

The National Audubon Society is continuing its important two-phase Continental Bald Eagle Project. Phase I deals with population status and distribution, while Phase II is concerned with detailed studies of eagle biology.

Golden Eagle.—On 24 October 1962, Congress amended the Bald Eagle Act of 1940 to extend statutory protection from shooting to the Golden Eagle. Support was generated when individual members of Congress learned that approval of the law also could indirectly benefit immature Bald Eagles, which, in the field, can be easily mistaken for Golden Eagles. Senate sponsors were forced to accept an amendment authorizing the shooting of Golden Eagles on petition of a Governor and a finding of the Secretary of the Interior that livestock, agriculture, or other interests are being damaged. The Interior Department subsequently proposed regulations to implement the Act. On objections from several members of Congress and from conservationists, the provision that would have allowed the emergency taking of Golden Eagles from airplanes was eliminated. The law now requires the Secretary of the Interior, when requested by the Governor of any state, to authorize the taking of Golden Eagles for the seasonal protection of livestock for such time and in such areas as the Secretary considers necessary. Secretary Udall has received a request from the Governor of Texas and has authorized the killing of Golden Eagles—except by poison and from airplanes—by livestock operators and their agents in 28 Texas counties (Natl. Aud. Soc., 1963*e*). Both the Fish and Wildlife Service and the

National Audubon Society had qualified personnel in Texas to conduct a field study of Golden Eagle depredations in the designated area during the period covered by the special permit, which ended 30 April 1963. It is indeed encouraging to note that an objective evaluation of the anticipated depredations was carried out.

Kites.—All species of kites are in short supply and decreasing (Cottam, 1962*b*). The Florida Everglade Kite population probably now consists of four males and two females. These birds are restricted to a narrow belt on the shore of Lake Okeechobee in southern Florida.

Other raptors.—The National Audubon Society recently completed a survey of state laws providing protection to hawks and owls (Natl. Aud. Soc., 1963*f*). Nineteen states now protect all raptors, 26 others protect some, and in four states (Arkansas, Montana, Nevada, and New Mexico) none are protected. Specific information is lacking for Hawaii. However, our newest state probably does not have a law to protect the Hawaiian Hawk and two species of owls. A copy of the complete summary can be secured from R. C. Clement of the National Audubon Society.

Besides protection from shooting, many raptors are threatened with possible inhibition of reproduction from chemical compounds applied as pesticides and potentially concentrated in organisms serving as food. Expanding on remarks made at the 1962 Audubon Convention in Texas, R. T. Peterson (personal communication) stated that he felt the decline of Ospreys on the Connecticut coast and the virtual disappearance of the Peregrine Falcon as nesting birds in the New York City region, including the Palisades of the Hudson Valley, may be due to chemical poisoning. Unpublished studies of Ospreys in Connecticut by Peter Ames show accumulations of DDE in eggs which failed to hatch. Laboratory studies are needed to establish the relationship between reproductive capacities of raptors and reported or continuous exposure to sublethal quantities of pesticides.

California Condor.—America's largest vulture has maintained a population of approximately 60 birds for more than a dozen years in the mountains in California (Cottam, 1962*b*). The condor's future is questionable. Man is extending roads into the mountain retreat of this shy bird. Wildland meeting the habitat requirements of this species is being converted to other human uses. The National Audubon Society is now reassessing the condor's population and chances for continued survival.

Attwater Prairie Chicken.—Before the turn of the century this bird was abundant in the grassy prairies along almost the entire Gulf Coast of Texas and halfway across Louisiana. Conversion of the wild prairie to cropland, heavy grazing, clean farming, and relentless slaughter reduced the original population of possibly a million birds in Texas to about 8,700 in 1937, and now probably to a few hundred (Cottam, 1962*a*). In 1960, the remaining birds were scattered over 11 counties in small disjunct populations. These small remnants are well protected. However, there is an urgent need for state, federal, and private interests to develop a sound habitat management program to meet the restrictive habitat requirements of this species.

Greater Prairie Chicken.—This grouse declined rapidly as its former prairie habitat was converted to cropland (Hamerstrom, F. and F., 1960). While fairly continuous populations, varying from low to medium density, still inhabit parts of North Dakota, South Dakota, and Nebraska, only comparatively small and isolated populations survive in Wisconsin, Michigan, Minnesota, Illinois, Missouri, and Indiana. Although prairie chickens have been numerous enough in the Dakotas and Nebraska to permit some hunting during recent years, small populations in other states have been protected from shooting. Closed seasons have not brought the Prairie Chicken back to former abundance. Lands entered under the Soil Bank Program have helped its survival in some localities.

Provision of undisturbed nesting cover has aided the birds in Missouri and Wisconsin. A private foundation in Wisconsin has contributed over $100,000 for the habitat management program. Lands obtained with the private funds are turned over to the Wisconsin Conservation Department for development and maintenance. In many states the habitat situation is much more critical. The chief problems have been the lack of sufficient public interest and funds to support management measures required to insure survival of the scattered remnant populations. These same conditions prevail for the Lesser Prairie Chicken.

Whooping Crane.—This bird suffered a setback in 1962. No young were produced and six adult or subadult birds were lost, dropping the total population to 32 wild birds. Apparently production was hampered by late ice conditions on the Canadian breeding grounds. This decline in numbers of cranes is neither unprecedented nor irreversible, and should not be the basis of alarmists calling for the wild flock to be placed in captivity.

In addition to the wild whoopers, seven are in captivity, of which six are in the Audubon Park Zoo in New Orleans and one cripple in the zoo at San Antonio, Texas (Cottam, 1962*b*).

The U.S. Bureau of Sport Fisheries and Wildlife is continuing its periodic crane censuses and public educational efforts to protect the birds. The National Audubon Society is helping provide added protection on the Texas coast wintering grounds. People in Canada contributed importantly in 1961–62 by diverting the location of a proposed railroad construction project which threatened to disrupt the crane breeding grounds in Wood Buffalo Park located in the District of MacKenzie and Alberta. The small total numbers, low rate of reproduction, and restricted winter range continue to make the status of whoopers serious. Flyway education and protection efforts deserve increased emphasis for the wild cranes. Better techniques are needed to handle captive birds.

Eskimo Curlew.—During the existence of the Wilson Ornithological Society (1888–1963), this bird has gone from a period of abundance, to almost extinction, to rediscovery. In 1887, E. W. Nelson found it the most abundant curlew at Kotzebue Sound, Alaska (Emanuel, 1962). By 1900, its numbers were so reduced that Joseph Grinnell could not find a single Eskimo Curlew at the same location. For 14 years prior to 1959 there were no published sight records of this formerly abundant shorebird (Emanuel, 1962). On 22 March 1959, a strange curlew was observed on Galveston Island, Texas. It was tentatively identified as an Eskimo Curlew. A single bird was observed at Galveston Island in spring in 1960 and 1961. In 1962, two birds were observed simultaneously (Emanuel, 1962). The true identity of these birds remains to be confirmed. However, these sight records suggest that the Eskimo Curlew still exists in at least very meager numbers. Both amateur and professional ornithologists should examine shorebirds in the field with increased care. They may be rewarded with a new sight record of the Eskimo Curlew and add to the knowledge of the distribution of this rare species.

Wading and other water birds.—Status and challenging management possibilities for many of these birds were recently reported (Cottam, 1962*b*; Cottam et al., 1962). Highlights of these statements are summarized here. The Roseate Spoonbill, Wood Ibis, Reddish Egret, and Hudsonian Godwit are still uncommon and need effective protection, as do all waders. The Hawaiian Gallinule is found on three islands of Hawaii and is endangered because of drainage and destruction of habitat. Likewise, the Hawaiian Stilt is endangered by loss of habitat.

Vigorous protection of nesting islands is needed for many of the colonial nesting water birds, including terns, skimmers, herons, ibises, and egrets. Accretion islands afford some of the best nesting sites along the Gulf Coast, particularly in Texas. The Fish and Wildlife Service and state game departments can contribute by encouraging dredging companies and operators to construct suitable islands and locate them in the most desirable places. The Fish and Wildlife Service, because of its close cooperation with the U.S. Corps of Engineers and Bureau of Reclamation, has already furnished much help along this line. W.O.S. members, state and local bird and nature clubs, and civic organizations can render great service by getting title to many of these areas turned over to organizations that recognize their value and who will provide the necessary management. National conservation organizations, such as the National Audubon Society and the Nature Conservancy, at times can and do help in obtaining titles and in making arrangements for protection and management.

Kirtland's Warbler.—This rare wood warbler now probably numbers about 1,000 (Mayfield, 1963). It inhabits a narrow and transitory habitat for nesting in Michigan and winters only in the Bahama Islands. The ecology of the wintering grounds is unknown. Attempts to establish special management areas for breeders were started in 1955. In 1957, the Michigan Conservation Commission formally established three warbler management areas totaling 7,680 acres (Radke and Byelich, 1963). In 1962, the Forest Service established an additional 4,010-acre warbler management area on the Lower Michigan National Forest. Both agencies are to be commended highly for designating these sites and for adjusting forest management practices to maintain suitable nesting habitat for this rare songbird. Recent reports in *The Wilson Bulletin* on intensive breeding habitat management for the Kirtland's Warbler are highly recommended for reading. A remaining pressing need is to learn the problems this bird faces on its wintering grounds.

Ivory-billed Woodpecker.—Reports within the past two years indicate the possibility of one bird being in South Carolina and up to five in east Texas (Cottam et al., 1962). In view of the extremely precarious status of this large woodpecker, more intensive efforts to protect the few survivors seem appropriate in the localities frequented by the birds.

Puerto Rican Parrot.—Restricted forest habitat and predation by rats endanger this bird (Cottam, 1962*b*). A population of some 200 remains. Although the nature of efforts is unknown to us at this time, we understand that attempts are being made to help this species.

Other American birds.—Other species endangered or having seriously reduced populations include the following:

Bachman's Warbler
Harlequin Quail
Puerto Rican Whip-poor-will
Cape Sable Seaside Sparrow
Dusky Seaside Sparrow
Ipswich Sparrow
Song Sparrow (three races in the San Francisco Bay area).

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WOS CONSERVATION COMMITTEE
LAURENCE R. JAHN, CHAIRMAN
ROLAND C. CLEMENT
WALTER W. DYKSTRA
ROBERT A. McCABE
DANIEL A. POOLE
ROBERT L. RUDD

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Lynds Jones, 1902–08
F. L. Burns, 1909–11
W. E. Saunders, 1912–13
T. C. Stephens, 1914–16
W. F. Henninger, 1917
Myron H. Swenk, 1918–19
R. M. Strong, 1920–21
Thos. L. Hankinson, 1922–23
Albert F. Ganier, 1924–26
Lynds Jones, 1927–29
J. W. Stack, 1930–31
J. M. Shaver, 1932–34
Josselyn Van Tyne, 1935–37
Mrs. Margaret Morse Nice, 1938–39
Lawrence E. Hicks, 1940–41
George Miksch Sutton, 1942–43
S. Charles Kendeigh, 1943–45
George Miksch Sutton, 1946–47
Olin Sewall Pettingill, Jr., 1948–50
Maurice Brooks, 1950–52
W. J. Breckenridge, 1952–54
Burt L. Monroe, 1954–56
John T. Emlen, Jr., 1956–58
Lawrence H. Walkinshaw, 1958–60
Harold F. Mayfield, 1960–62
Phillips B. Street, 1962–

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W. E. Saunders, 1909–11
B. H. Swales, 1912–13
Geo. L. Fordyce, 1914–19
H. C. Oberholser, 1920–21
Dayton Stoner, 1922–23
Wm. I. Lyon, 1924
Thos. H. Whitney, 1925–28
George Miksch Sutton, 1929–31
Edwin L. Moseley, 1932
Josselyn Van Tyne, 1933–34
Alfred M. Bailey, 1935–36
Mrs. Margaret Morse Nice, 1937
Lawrence E. Hicks, 1938–39
George Miksch Sutton, 1940–41
S. Charles Kendeigh, 1942–43
Olin Sewall Pettingill, Jr., 1944–47
Maurice Brooks, 1948–49
W. J. Breckenridge, 1950–51
Burt L. Monroe, 1952–53
Harold F. Mayfield, 1954
John T. Emlen, Jr., 1955
Lawrence H. Walkinshaw, 1956–57
Harold F. Mayfield, 1958–59
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Alfred M. Bailey, 1932–34
Mrs. Margaret M. Nice, 1935–36
Lawrence E. Hicks, 1937
George Miksch Sutton, 1938–39
S. Charles Kendeigh, 1940–41
Olin Sewall Pettingill, Jr., 1942–43
Harrison F. Lewis, 1944–46
Maurice Brooks, 1947
W. J. Breckenridge, 1948–49
Burt L. Monroe, 1950–51
Harold F. Mayfield, 1952–53
Lawrence H. Walkinshaw, 1954–55
Phillips B. Street, 1956–59
Roger Tory Peterson, 1960–61
Aaron M. Bagg, 1962–

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Lynds Jones, 1888–89
J. Warren Jacobs, 1890–91
Albert F. Ganier, 1918–22
Gordon Wilson, 1923–25

Willard N. Clute, 1892
J. Warren Jacobs, 1893
Wm. B. Caulk, 1894
J. E. Dickinson, 1895–97
W. L. Dawson, 1898–1901
John W. Daniel, Jr., 1902–05
Frank L. Burns, 1906
Benj. T. Gault, 1907–11
C. W. G. Eifrig, 1912–13
Orpheus M. Schantz, 1914
Thos. L. Hankinson, 1915–16
G. A. Abbott, 1917
Howard K. Gloyd, 1926–28
Jesse M. Shaver, 1929–31
Lawrence E. Hicks, 1932–36
Olin Sewall Pettingill, Jr., 1937–41
Maurice Brooks, 1942–46
James B. Young, 1947–48
Harold F. Mayfield, 1948–51
Phillips B. Street, 1952–55
Fred T. Hall, 1956–57
Aaron M. Bagg, 1958–61
Pershing B. Hofslund, 1962–

Treasurer

R. M. Strong, 1892–93
Lynds Jones, 1894–1901
F. L. Burns, 1902–05
B. H. Swales, 1906–08
W. F. Henninger, 1909–13
P. B. Coffin, 1914–16
Frank M. Phelps, 1917–19
George L. Fordyce, 1920–22
Wm. I. Lyon, 1923
Ben. J. Blincoe, 1924–26
J. W. Stack, 1927–29
W. M. Rosene, 1930–35
S. E. Perkins, III, 1936–38
Gustav Swanson, 1939–42
Milton B. Trautman. 1943–45
Burt L. Monroe, 1946–49
James H. Olsen, 1950
Leonard C. Brecher, 1951–54
Ralph M. Edeburn, 1955–58
Merrill Wood, 1959–63
C. Chandler Ross, 1963–

Editor

Lynds Jones, 1892–1900
Frank L. Burns, 1901
Lynds Jones, 1902–24
T. C. Stephens, 1925–38
Josselyn Van Tyne, 1939–48
David E. Davis, 1949
George Miksch Sutton, 1950–51
Harrison B. Tordoff, 1952–54
Keith L. Dixon, 1955–58
H. Lewis Batts, Jr., 1959–63
George A. Hall, 1964–

Elected Council Members

Albert F. Ganier, 1935–38
Lynds Jones, 1935–36
Myron H. Swenk, 1935
W. M. Rosene, 1936
Alfred M. Bailey, 1937
S. Charles Kendeigh, 1937–39
Miles D. Pirnie, 1938–41
Maurice Brooks, 1939–41
Lawrence H. Walkinshaw, 1940–45
Burt L. Monroe, 1942–45
Eugene P. Odum, 1942–45
Rudolf Bennitt, 1946–47
George H. Lowery, Jr., 1946–48
Milton B. Trautman, 1946–48
Richard H. Pough, 1948–50
John T. Emlen, Jr., 1949
William C. Vaughn, 1949–51
Fred T. Hall, 1950–52
Wm. W. H. Gunn, 1951–53
Joseph C. Howell, 1952–54
A. W. Schorger, 1953–55
Harvey I. Fisher, 1954–56, 1960–
Leonard C. Brecher, 1955–57
Andrew J. Berger, 1956–58
Pershing B. Hofslund, 1957–59
Ernest P. Edwards, 1958–60
Ralph M. Edeburn, 1959–61
J. Bruce Falls, 1962–
Kenneth C. Parkes, 1962–
H. Lewis Batts, Jr., 1963–

PROCEEDINGS OF THE FORTY-FOURTH ANNUAL MEETING

Pershing B. Hofslund, Secretary

The Forty-fourth Annual Meeting of the Wilson Ornithological Society was held in the Seventy-fifth Anniversary Year of the Society's founding, Thursday, 2 May, to Sunday, 5 May 1963 in Charleston, South Carolina. The meeting was sponsored by the Charleston Museum, The Charleston Natural History Society, and the Carolina Bird Club. The local committee was under the gracious and efficient direction of E. Milby Burton, Director of the Charleston Museum. This excellent meeting was greatly enjoyed by the 254 registered members and guests who attended.

Four papers sessions and two business meetings were held in the Charleston Museum. The meeting opened with a showing of the film "Coastal Carolina" by Alexander Sprunt in the Baruch Auditorium of the Medical College, followed by the dedication of the Bird Hall and an informal reception in the Charleston Museum; the Executive Council met in the Fort Sumter Hotel. The papers sessions on Friday were inaugurated with a welcome given by the Honorable J. Palmer Gaillard, Mayor of Charleston, and a response on behalf of the Society by President Phillips B. Street. Following the afternoon session, the Society was entertained royally at a supper given at the clubhouse of the South Carolina Electric and Gas Company on Sullivan's Island. The annual dinner was held Saturday night at the Fort Sumter Hotel. Delightfully MC'd by Ernest A. Cutts from the local committee, the banquet was highlighted by the President's address and an illustrated lecture, "A Summer on Victoria Island," by Dr. George M. Sutton. The tables were attractively decorated by the local committee and were featured by a copy of "The History of Fort Sumter" and Ashby Cooper's "Dictionary of Charlestonese." A special privilege at this 75th anniversary meeting and the banquet was the presence of Dr. Reuben M. Strong, one of the founders of the Wilson Society.

There were early morning field trips on Friday and Saturday. The trips to Magnolia Gardens, Francis Marion National Forest, and Bee's Ferry Road produced 176 species. Unfortunately, the Bachman's Warbler was not listed, but Mississippi and Swallow-tailed kites, a Fulvous Tree-duck, all the herons on the South Carolina bird list, and the many other birds seen, amply satisfied the participants.

The members who were able to participate in the Sunday excursions were afforded a rare treat. The morning boat trip around the heronries of Drum Island, the jetties, and Fort Sumter was followed by an afternoon at the John Henry Dick plantation "Dixie." After an ample opportunity to bird, visit the varied collection of waterfowl, and enjoy the magnificence of the surroundings, the Society members were guests of John Henry Dick at a luncheon.

The 75th anniversary meeting of the Wilson Ornithological Society must be listed as an outstanding success.

First Business Session

President Street called the meeting to order at 9:30 AM, Friday, 3 May. J. Palmer Gaillard, Mayor of Charleston, welcomed the Wilson Ornithological Society's members and guests. President Street responded on behalf of the Society.

The Proceedings of the Forty-third Annual Meeting were approved as published in *The Wilson Bulletin* for September 1962.

Secretary's Report

The Secretary, Pershing B. Hofslund, summarized the principal actions taken at the Thursday evening meeting of the Executive Council as follows:

1. The Council reaffirmed the invitation from Western Michigan University to hold the 45th Annual Meeting of the Wilson Ornithological Society at Kalamazoo, Michigan, on 30 April–3 May 1964.
2. The Council voted to accept the invitation of the South Dakota Ornithologists' Union to hold the 1965 meeting at Sylvan Lake in the Black Hills region of South Dakota. Tentative dates have been set at 17–20 June.
3. The Council accepted the report of the Louis Agassiz Fuertes Research Committee and awarded $100 to Nicholaas Verbeek for his research problem on the breeding biology of the Water Pipit.
4. The Council accepted with regret the resignations of Merrill Wood, Treasurer, and H. Lewis Batts, Jr., Editor.
5. The Council elected George A. Hall of West Virginia University as the new editor, Dr. Hall's term to start with the March issue, Volume 76 (1964), of the *Bulletin.*

Treasurer's Report

In the absence of the Treasurer, Merrill Wood, the Secretary summarized the following report on the finances of the Society:

Report of the Treasurer for 1962

General Fund

Balance as shown by last report dated 31 December 1961			$ 4,402.92
RECEIPTS			
Dues:			
Active Memberships	$5,234.00		
Sustaining Memberships	828.00	$6,062.00	
Subscriptions to *The Wilson Bulletin*		1,241.25	
Sale of back issues of *The Wilson Bulletin*		149.05	
Interest and dividends on savings and investments		1,096.82	
Annual Meeting (banquet excluded)		568.27	
Miscellaneous		77.40	$ 9,194.79
Total Receipts			$13,597.71
DISBURSEMENTS			
The Wilson Bulletin (printing and engraving)		$7,120.39	
The Wilson Bulletin (mailing and maintenance of mailing)		769.83	
Editor's expense		102.25	
Secretary's expense		25.35	
Treasurer's expense (printing, postage, safe deposit box)		315.35	
Canadian discount on checks and money		11.49	
Back issue expense (postage)		15.00	
International Council for Bird Preservation (1962 dues)		25.00	
Membership Committee expense		59.22	
Annual Meeting expense		790.78	
Transfer to Fuertes' Research Fund		74.00	
Miscellaneous		23.29	
Total Disbursements			$ 9,331.95
Balance on hand in First National Bank, State College, Pennsylvania, 31 December 1962			$ 4,265.76

Josselyn Van Tyne Memorial Library Book Fund

Balance as shown by last report dated 31 December 1961		$602.09
RECEIPTS		
Sale of duplicates and gifts		$304.59
Total Receipts		$906.68
DISBURSEMENTS		
Purchase of books		$141.15
Balance on hand in First National Bank, State College, Pennsylvania, 31 December 1962		$765.53

Louis Agassiz Fuertes Research Fund

Balance as shown by last report dated 31 December 1961		$100.00
RECEIPTS		
Contributions	$26.00	
Transfer from General Fund (Council action)	74.00	
Total Receipts		$200.00
DISBURSEMENTS		
Award to Mr. Donald S. Heintzelman		$100.00
Balance on hand in First National Bank, State College, Pennsylvania, 31 December 1962		$100.00

Endowment Fund

Balance in Savings Account as shown by last report dated 31 December 1961	$ 940.66
RECEIPTS	
Life Membership payments	$ 1,225.00
Stock dividends received (included below)	
15 shares of Massachusetts Investors Trust	
Securities exchanged	
$5,000 U.S. Treas. 4% Notes due 15 May 1963 for	
$5,000 U.S. Treas. 4% Bonds due 15 August 1972	
Total Receipts	$ 2,165.66
DISBURSEMENTS	
None	
Balance in Savings Account, First National Bank, State College, Pennsylvania, 31 December 1962	$ 2,165.66
Total	2,165.66
SECURITIES OWNED	
$5,000 U.S. Treas. 4% Bonds due 1 October 1969 at 101¾	5,087.50
$5,000 U.S. Treas. 4% Bonds due 15 August 1972 at 101	5,050.00
$3,000 Phillips Petroleum 4½% Bonds due 15 February 1987 at 114⅝	3,438.75
70 shares M. A. Hanna Co. at 26¼	1,837.50
15 shares Kaiser Aluminum & Chemical Co. 4¾% cum. cvt. pfd. (1957 series) at 105	1,575.00
416 shares Massachusetts Investors Trust at 13.59	5,653.44
100 shares Fireman's Fund Insurance at 68	6,800.00
25 shares Owens-Illinois Glass Co. 4% cum. pfd. at 100	2,500.00

(Securities listed at closing prices 31 December 1962)

Total Securities Owned $31,942.19

Total in Endowment Fund, 31 December 1962 .... $34,107.85

Respectfully submitted,
MERRILL WOOD
Treasurer

The Society voted to accept the Treasurer's report.

Research Grant Committee

Dr. Harvey I. Fisher, Chairman of the Louis Agassiz Fuertes Research Grant Committee, presented the following report:

There were 12 inquiries this year and 8 completed applications. The applications came from the following states: Arizona, California, Florida, Kansas, Montana, Michigan, and Washington. This indicates the widespread publicity given this grant and also the widespread interest.

The committee recommends that Mr. Nicholaas Verbeek receive the $100 award. Mr. Verbeek is presently in the Department of Zoology, Montana State University, Missoula, Montana. He is from Holland, but he received his Master of Science degree from the University of British Columbia. He is presently studying the breeding biology of the Water Pipit.

The Society voted to accept the Research Grant Committee's report.

Conservation Committee Report

In the absence of Lawrence Jahn, Chairman, Roland Clement summarized the Conservation Committee's report. The report appears elsewhere in this issue of the *Bulletin.*

Membership Committee Report

In the absence of the committee Chairwoman, Hazel Bradley Lory, the Secretary read the Membership Committee report.

The treasurer's records show a total of 105 new members for this year, 30 more than a year ago. Our committee has sponsored 32 of these, one more than a year ago. Other members of our Society have sponsored many members, and 30 or more have joined without sponsorship.

The Membership Committee consisted of 19 members this year; one from Canada and the rest well distributed over the states.

Looking forward, we still have a backlog of 200 prospects that we have not used, and, as in past years, I have asked that I be supplied with the registration list from the 1963 annual meeting. Membership rolls from other organizations can also be used.

Library Committee Report

Dr. Harrison Tordoff presented the Library Committee Report in the absence of Chairman William A. Lunk.

The storage of back issues of *The Wilson Bulletin* has continued to be a matter of considerable concern, and with each passing year the problem of excess stocks has become more acute. Recently steps have been authorized to dispose of some of the most conspicuous overages. It is hoped that after the present meeting we will be allowed to take yet more drastic action.

The New Book Fund continues to show a sizable balance, as a result of our sales of duplicates and of the fine generosity of the membership. A number of books have been purchased during the past year—notably a group of works dealing with cage birds—that have helped to fill prominent gaps in the library coverage. Money from the fund is also being used to pay for binding that is badly needed, this being considered essential to the maintenance of our holdings in usable condition. For the present standing of the fund, we must refer to the treasurer's report.

We are continuing, in a small way, last year's plan of exhibiting recently acquired books at the annual meeting.

Another increment of the library of the late Josselyn Van Tyne was formally accepted from Mrs. Van Tyne: these comprised 105 books of the general ornithological section.

Total acquisitions for the year, from 52 gifts by 44 donors, were: 146 books, 332 reprints, 112 journals, 4 pamphlets, and 14 translations. These figures represent a moderate decline. The number of journals regularly received has increased to about 110, 84 of which are by exchange.

Fifty-three out-of-town loans were made, consisting of 132 items sent to 42 individuals. More use of the library facilities by the membership at large is encouraged. We are grateful for the continued support.

Endowment Committee

Dr. Stephen W. Eaton, Chairman, reported that we now have 199 Life Members, including 13 additions this year. The 200th life membership was enrolled later during the meeting.

Temporary Committees

President Street appointed the following temporary committees:

Auditing Committee
- David E. Davis, Chairman
- Dorothy L. Bordner
- James Landing

Nominating Committee
- Burt L. Monroe, Sr., Chairman
- O. S. Pettingill, Jr.
- George M. Sutton

Resolutions Committee
- Maurice G. Brooks, Chairman
- Andrew J. Berger
- Mrs. Robert V. D. Booth

Second Business Session

The final business session was called to order at 3:15 PM, Saturday, 4 May.

On motion duly made and seconded, the report of the Membership Committee was accepted, and the candidates (as posted) were elected to membership.

Report of the Auditing Committee

The Auditing Committee examined the books of the Wilson Ornithological Society at State College, Pennsylvania, on 11 April 1963, and found them in good order. Mr. Wood should be commended for the excellent condition, neat and prompt entries.

On motion duly made and seconded, the report of the Auditing Committee was accepted.

Report of the Resolutions Committee

Maurice G. Brooks, Chairman, read the following report:

WHEREAS, the Wilson Ornithological Society has been privileged to hold its Seventy-fifth Anniversary Meeting in Charleston, and

WHEREAS the Society and its guests have been entertained in the manner traditional to the Carolina Low Country,

THEREFORE, be it resolved that the Society expresses its sincere appreciation to the Honorable J. Palmer Gaillard, Mayor of Charleston, to the Charleston Museum, the Charleston Natural History Society, the Carolina Bird Club, the South Carolina Electric and Gas Company, John Henry Dick, and to all other individuals who have been our hosts.

BE IT FURTHER RESOLVED that the Society's special thanks are due E. Milby Burton and all the members of his local committee. Each has been untiring in making our visit a pleasant one.

The Secretary of the Society is requested to convey these thanks to appropriate organizations and individuals.

BE IT FURTHER RESOLVED that the W.O.S. extends to the National Audubon Society its commendation for the study that society is now sponsoring to determine the status of and the possible need for protective action to maintain the population of two of North America's most cherished birds, the Bald Eagle and the Golden Eagle. That the Audubon Society's efforts to accumulate data which will enable it to act from a scientific rather than a sentimental basis is worthy of the respect of ornithologists everywhere.

BE IT RESOLVED that the Society expresses its appreciation to Dr. H. Lewis Batts, Jr., for his outstanding contribution as Editor of *The Wilson Bulletin* during the past five years, to Dr. Merrill Wood for his important service as Treasurer of the Wilson Ornithological Society, and to Dr. Harvey I. Fisher for his devoted service to the Society during his term as an elected member of council.

BE IT RESOLVED that the Wilson Ornithological Society extends to Rachel Carson its commendation and sincere admiration for the courageous stand she has taken in a controversial matter of vital importance to the human and the plant and wildlife populations of this country. That they are grateful for her leadership in awakening to a consideration of a serious problem, at the cost of possible distress to herself, those millions of Americans who are or may be nonwillingly and nonwittingly subjecting themselves and their environment to what may be a disastrous misuse of pesticides.

Election of Officers

The Nominating Committee proposed the following officers for the coming year: President, Phillips B. Street; First Vice-President, Roger Tory Peterson; Second Vice-President, Aaron M. Bagg; Secretary, Pershing B. Hofslund; Treasurer, C. Chandler Ross; Elective Member of the Executive Council, H. Lewis Batts, Jr. (term expiring 1966).

The report of the Nominating Committee being accepted, and there being no nominations from the floor, the Secretary was instructed to cast a unanimous ballot for these nominees.

PAPERS SESSIONS
Friday, 3 May

1. Harvey I. Fisher, Southern Illinois University. *The Laysan Albatross on Midway.*
2. Elsa G. Allen, Laboratory of Ornithology, Cornell University. *John Abbott, Naturalist, 1751–1840. Biographical Notes and His Paintings of American Birds.*

3. David W. Johnston, Wake Forest College. *Factors Underlying Autumnal Migration in Birds—A Review.*
4. Arthur A. Allen and David G. Allen, Laboratory of Ornithology, Cornell University. *A Photographic Study of the Courtship Maneuvers of Waterfowl.*
5. Walter R. Spofford, State University Medical College, Syracuse, New York. *Winter Eagles in West Texas.*
6. James B. Shuler, Greenville, South Carolina. *Some Birds of the Cloud Forest and Adjacent Habitats in Chiapas, Mexico.*

The Blackbird Problem. A Symposium arranged by Oliver H. Hewitt, Cornell University.

7. Oliver H. Hewitt, Chairman, Cornell University. *Introduction.*
8. Brooke Meanley, Patuxent Wildlife Research Center. *Blackbird Populations and Migrations.*
9. Maurice L. Giltz, Ohio State University. *The Problem of Crop Depredation by Blackbirds.*
10. James S. Lindzey, Pennsylvania State University. *Methods of Blackbird Control.*
11. Maurice F. Baker, Alabama Cooperative Wildlife Research Unit. *Trapping Blackbirds for Banding.*
12. Roland Clement, National Audubon Society. *Ecology and Economics of Blackbird Control.*

Saturday, 4 May

13. David T. Rogers, Jr., University of Georgia. *The Effect of Age, Sex and Migration on Major Body Components in the Parulidae.*
14. James T. Tanner, University of Tennessee. *Determination of the Time of First Egg Laying in Temperate Zone Birds.*
15. R. Alan Lewis, Monroe Community College, Rochester, New York. *Aerophysiology I. Experimental Design in the Recording of Bioelectrical Events of the Unrestrained and Flying Bird.*
16. Jeff Swinebroad, Rutgers University. *Radar Observations of Migration over Southern New Jersey.*
17. Albert F. Ganier, Nashville, Tennessee. *Does the Chuck-wills-widow Transport its Eggs or Young?*
18. Harold Mayfield, Waterville, Ohio. *Fluctuations in a Local Population of Purple Martins.*
19. William Robertson, Everglades National Park. *Biology of the Dry Tortugas Terns.*
20. Oliver L. Austin, Jr., Florida State Museum, Gainesville, Florida. *Demographic Aspects of the Sooty Tern.*
21. Robert C. Stein, Laboratory of Ornithology, Cornell University. *Sound Production in the Song Sparrow.*
22. Jack P. Hailman, Duke University. *The Galapagos Swallow-tailed Gull is Nocturnal.*
23. Devin A. Garrity, New York, N.Y. *An Ecological Look at some Birds of the Galapagos Islands.*
24. Lawrence I. Grinnell, Laboratory of Ornithology, Cornell University. *Birds of East Africa.*
25. William E. Southern, Northern Illinois University. *The Application of Telemetry in Bald Eagle Studies.*
26. Willetta and John Lueshin, Wisner, Nebraska. *Life of Alexander Wilson.*
27. Ann Chamberlain, The Chicago Natural History Museum. *Bird Numbers and Populations.*

Attendance

Members and guests who registered totaled 254 persons. Twenty-five states, plus the District of Columbia and Ontario, Canada, were represented.

From **Alabama**: 5—*Auburn*, Maurice Baker; *Birmingham*, Mrs. B. Dean, Elizabeth Eddy, Mrs. Kenneth Grimly, Christine Leake.

From **Connecticut**: 3—*Bridgeport*, Harold Peters; *Old Lyme*, Dr. and Mrs. Roger Tory Peterson.

From **Florida**: 20—*Daytona Beach*, C. H. Ekdall, Mr. and Mrs. Fenn M. Holden; *Gainesville*, Dr. and Mrs. Oliver L. Austin, Beekman Lee Webb, Jr.; *Homestead*, William B. Robertson; *Jacksonville*, Samuel A. Grimes; *Maitland*, Margaret H. Hundley, C. Russell Mason; *Ormond Beach*, Jean M. Hudson, Roy D. Hudson; *Panama City*, Mr. and Mrs. Roy Hallman; *Tallahassee*, John C. Ogden, Joseph R. Patterson, Lora Patterson, Sally Patterson, H. M. Stevenson, H. L. Stoddard, Sr.

From **Georgia**: 9—*Athens*, David T. Rogers; *Atlanta*, William W. Griffin; *Augusta*, Mr. and Mrs. J. Fred Denton, Gary Ellis; *Carrollton*, Mr. and Mrs. Robert A. Sundell; *Savannah*, L. B. Davenport, Jr., Ivan R. Tompkins.

From **Illinois**: 18—*Carbondale*, Dr. and Mrs. Harvey I. Fisher, Evelyn Klemm, Robert D. Klemm; *Chicago*, Ann Chamberlain, R. M. Strong; *Decatur*, Mr. and Mrs. C. Turner Nearing; *De Kalb*, Alfred B. Jelland, Gwen Pinter, D. Jean Ridinger, William E. Southern, Jerrold Zar; *Evanston*, Mr. and Mrs. Cyrus Mark; *Springfield*, Mr. and Mrs. William A. Sausman; ?, L. G. Scott.

From **Indiana**: 2—*Indianapolis*, Mildred Campbell, Mrs. S. G. Campbell.

From **Kentucky**: 4—*Anchorage*, Mr. and Mrs. Burt L. Monroe, Sr.; *Louisville*, Mr. and Mrs. Leonard C. Brecher.

From **Louisiana**: 1—*Baton Rouge*, Mrs. Camille Cazedessus.

From **Maryland**: 5—*Baltimore*, Gladys Hix Cole, Pan Minke; *Laurel*, Allen J. Duval, Brooke Meanley, Chandler S. Robbins.

From **Massachusetts**: 1—*Chatham*, Robert V. Clem.

From **Michigan**: 11—*Ann Arbor*, A. J. Berger, Mr. and Mrs. Ralph Branch, Jean W. Cohn, John P. Hubbard, Mrs. Reuben L. Kahn, Haven Spencer, Harrison Tordoff; *Kalamazoo*, Dr. and Mrs. H. Lewis Batts, Jr.; *Marquette*, Mrs. Mary R. S. Ross.

From **Minnesota**: 3—*Duluth*, P. B. Hofslund; *Minneapolis*, M. I. Dyer; *Stillwater*, John G. Erickson.

From **Mississippi**: 2—*Crystal Springs*, Mrs. Fanny A. Cook; *Lawrence*, Mrs. Troy Hannah.

From **New Jersey**: 13—*Highstown*, Dr. and Mrs. William E. Parker; *Laurenceville*, Edwin D. Bloar, Jr.; *Mountainside*, Albert Schnitzer, Eva F. Schnitzer; *New Brunswick*, Philip Granett, Mildred Miskinen, Jeff Swinebroad; *Newfoundland*, Eva Marie Townsend, Frank Townsend; *Tenafly*, Sheafe Satterthwaite; *Westfield*, Mr. and Mrs. Norman B. Pilling.

From **New Mexico**: 1—*Las Cruces*, Paul B. Cors.

From **New York**: 26—*Buffalo*, M. Edna Blowers, Fred T. Hall, Mrs. Mercedeth Lovelace, Richard C. Rosche, Alice E. Ulrich, Edward C. Ulrich; *Ithaca*, Dr. and Mrs. Arthur A. Allen, David Allen, Lawrence I. Grinnell, Oliver Hewitt, Dr. and Mrs. O. S. Pettingill, Jr., Robert C. Stein; *New York City*, Roland Clement, Eugene Eisenmann, Mr. and Mrs. Douglas Orbison, Mrs. Carll Tucker; *Olean*, Dr. and Mrs. Stephen W. Eaton; *Rochester*, R. Alan Lewis; *Rye*, Devin A. Garrity; *Sayville*, V. Rimsky-

Korsakoff; *Syracuse*, Margaret Rusk, Walter R. Spofford; *Williamsville*, Harold D. Mitchell, Mildred D. Mitchell.

From **North Carolina**: 20—*Asheville*, Mrs. Elizabeth Phelps; *Durham*, J. P. Hailman; *Fayetteville*, Mrs. Neil A. Currie, Jr., Mrs. Roscoe Hauser, Jr., Mrs. Sam Rankin, Mrs. J. Alexander Shaw; *Greensboro*, Mr. and Mrs. F. H. Craft, Charlotte A. Dubois, Fred Hinton, Dr. and Mrs. Archie Shaftesbury; *Statesville*, Flippen Jones, Mark Simpson, Jr., Mr. and Mrs. Mark Simpson, Sr.; *Wilkes Barre*, Wendell Smith; *Winston-Salem*, David W. Johnston; ?, Gary Brown, R. L. Kendall.

From **Ohio**: 15—*Ashtabula*, Howard E. Blakeslee; *Canfield*, Mr. and Mrs. G. William Richter; *Chardon*, Marjorie Ramisch, Mildred Stewart; *Columbus*, Mr. and Mrs. Donald Borror, Maurice L. Giltz; *Lakewood*, Nancy R. Klamm, William A. Klamm; *Painesville*, Mr. and Mrs. Robert V. D. Booth; *Steubenville*, Earl W. Farmer; *Waterville*, Mr. and Mrs. Harold Mayfield.

From **Oklahoma**: 3—*Norman*, Robert D. Burns, George M. Sutton; *Tulsa*, Mrs. Walter A. McKinney.

From **Pennsylvania**: 9—*Langhorne*, Mr. and Mrs. John F. McIlvain; *Narberth*, Philip A. Livingston; *Philadelphia*, C. Chandler Ross, Mr. and Mrs. Phillips B. Street; *Pittsburgh*, Kenneth C. Parkes; *Scranton*, Elizabeth A. Taft; *State College*, James S. Lindzey.

From **South Carolina**: 38—*Charleston*, Mrs. John Boone, Jean W. Carter, Mr. and Mrs. E. Burnham Chamberlain, Mrs. Robert H. Coleman, Mr. and Mrs. Ernest Cutts, John H. Dick, E. Dingle, Mrs. Lois Doscher, Mrs. W. S. Gadsden, Mrs. Florence Bailey Gordon, Robert B. Hamilton, William C. Humphreys, Mr. and Mrs. B. F. McGucken, Mr. and Mrs. M. M. MacLennan, Dr. and Mrs. Harold S. Pettit, Anne Worsham Richardson, Marvin D. Richardson, Sr., Marvin D. Richardson, Jr., Ellison Williams; *Chester*, Mrs. W. Cornwell Stone, Sr.; *Effingham*, E. A. Clyde; *Florence*, D. C. McLean; *Greenville*, Rosa Lee Hart, May Puett, James B. Shuler, Martha Shuler; *John's Island*, Mr. and Mrs. T. A. Beckett, III, Patricia Dinger, Ruth Dinger, Wayne Dinger; *Wadmalaw Island*, Mr. and Mrs. B. Rhett Chamberlain.

From **Tennessee**: 11—*Gatlinburg*, Mr. and Mrs. Arthur Stupka; *Kingsport*, Arthur R. Garrett, Jr., Nancy Jane Nelmo; *Knoxville*, Mr. and Mrs. James T. Tanner; *Maryville*, Ralph J. Zaenglein; *Nashville*, Albert F. Ganier, Katherine A. Goodpasture, Mrs. Amelia R. Laskey, Jennie Riggs.

From **West Virginia**: 2—*Buckhannon*, Mr. and Mrs. Maurice Brooks.

From **Wisconsin**: 1—*West Bend*, Marvin E. Vore.

From **Washington, District of Columbia**: 2—Orville W. Crowder, George E. Watson, III.

From **Ontario, Canada**: 18—*Brockville*, Martin Edwards, Alden Strong; *Clarkson*, Dr. and Mrs. William W. H. Gunn; *Hamilton*, Eric W. Bastin; *Rouge Hills*, Dr. and Mrs. J. Murray Speirs; *Toronto*, Dr. and Mrs. J. L. Baillie, Dr. and Mrs. J. Bruce Falls, David Hussell, Mrs. E. Judges, Mr. and Mrs. John A. Livingston, Min McCleary, Ralph McCleary, William W. Smith.

Address not given:—9—Mrs. John Barton, Mrs. Ralph Bordman, Mrs. Willard Clark, Arnett Duchein, Mrs. Joseph Morgan, Sara Morrison, Mrs. Les Peebles, Elaine Rine, Rickey Young.

This issue of *The Wilson Bulletin* was published on 26 September 1963

SUGGESTIONS TO AUTHORS

Manuscripts intended for publication in *The Wilson Bulletin* should be neatly typewritten, double-spaced, and on one side only of good quality white paper. Tables should be typed on separate sheets. Before preparing these, carefully consider whether the material is best presented in tabular form. Where the value of quantitative data can be enhanced by use of appropriate statistical methods, these should be used. Follow the AOU Check-list (Fifth Edition, 1957) insofar as scientific names of United States and Canadian birds are concerned unless a satisfactory explanation is offered for doing otherwise. Use species names (binomials) unless specimens have actually been handled and subsequently identified. Summaries of major papers should be brief but quotable. Where fewer than five papers are cited, the citations may be included in the text. All citations in "General Notes" should be included in the text. Follow carefully the style used in this issue in listing the literature cited; otherwise, follow the "Style Manual for Biological Journals" (1960. AIBS). Photographs for illustrations should be sharp, have good contrast, and be on gloss paper. Submit prints unmounted and attach to each a brief but adequate legend. Do not write heavily on the backs of photographs. Diagrams and line drawings should be in black ink and their lettering large enough to permit reduction. Authors are requested to return proof promptly. Extensive alterations in copy after the type has been set must be charged to the author.

A WORD TO MEMBERS

The Wilson Bulletin is not as large as we want it to be. It will become larger as funds for publication increase. The Society loses money, and the size of the *Bulletin* is cut down accordingly, each time a member fails to pay dues and is put on the "suspended list." Postage is used in notifying the printer of this suspension. More postage is used in notifying the member and urging him to pay his dues. When he does finally pay he must be reinstated in the mailing list and there is a printer's charge for this service. The *Bulletin* will become larger if members will make a point of paying their dues promptly.

NOTICE OF CHANGE OF ADDRESS

If your address changes, notify the Society immediately. Send your complete new address to the Treasurer, C. Chandler Ross, Academy of Natural Sciences, 19th and Parkway, Philadelphia 3, Pennsylvania. He will notify the printer.

CITIES AND YEARS OF WILSON ORNITHOLOGICAL SOCIETY ANNUAL MEETINGS

The Wilson Bulletin

PUBLISHED BY THE WILSON ORNITHOLOGICAL SOCIETY
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The Wilson Ornithological Society

Founded December 3, 1888

Named after Alexander Wilson, the first American ornithologist.

Membership dues per calendar year are: Sustaining, \$6.00; Active, \$4.00.

The Wilson Bulletin is sent to all members not in arrears for dues.

The Josselyn Van Tyne Memorial Library

The Josselyn Van Tyne Memorial Library of the Wilson Ornithological Society, housed in the the University of Michigan Museum of Zoology, was established in concurrence with the University of Michigan in 1930. Until 1947 the Library was maintained entirely by gifts and bequests of books, reprints, and ornithological magazines from members and friends of the Society. Now two members have generously established a fund for the purchase of new books; members and friends are invited to maintain the fund by regular contribution, thus making available to all Society members the more important new books on ornithology and related subjects. The fund will be administered by the Library Committee, which will be happy to receive suggestions on the choice of new books to be added to the Library. William A. Lunk, University Museum, University of Michigan, is Chairman of the Committee. The Library currently receives 104 periodicals as gifts and in exchange for *The Wilson Bulletin.* With the usual exception of rare books, any item in the Library may be borrowed by members of the Society and will be sent prepaid (by the University of Michigan) to any address in the United States, its possessions, or Canada. Return postage is paid by the borrower. Inquiries and requests by borrowers, as well as gifts of books, pamphlets, reprints, and magazines, should be addressed to "The Josselyn Van Tyne Memorial Library, University of Michigan Museum of Zoology, Ann Arbor, Michigan." Contributions to the New Book Fund should be sent to the Treasurer (small sums in stamps are acceptable). A complete index of the Library's holdings was printed in the September 1952 issue of *The Wilson Bulletin* and newly acquired books will be listed periodically.

The Wilson Bulletin

The official organ of The Wilson Ornithological Society, published quarterly, in March, June, September, and December, at Kalamazoo, Michigan. The subscription price, both in the United States and elsewhere, is \$4.00 per year, effective in 1959. Single copies, \$1.00. Subscriptions, changes of address and claims for undelivered copies should be sent to the Treasurer. Most back issues of the *Bulletin* are available (at 50 cents each for 1950 and earlier years, 75 cents each for 1951–1958) and may be ordered from the Treasurer.

All articles and communications for publications, books and publications for reviews should be addressed to the Editor. Exchanges should be addressed to The Josselyn Van Tyne Memorial Library, Museum of Zoology, Ann Arbor, Michigan.

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THE WILSON BULLETIN

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CONTENTS

URRACA JAY
Cyanocorax chrysops
from a watercolor painting
by Don R. Eckelberry

A NOTE ON THE JAYS OF NORTHERN ARGENTINA

Don R. Eckelberry

The genus *Cyanocorax*, as now recognized, ranges from northern to southern tropical or subtropical extremes: southernmost Texas to northern Argentina. Of the Argentine species only the *Urraca Común* or "Common Jay" (*Cyanocorax chrysops chrysops*) pictured opposite is also found in the northwestern provinces, where it is represented by the race *tucumanus*. The other two species reaching Argentina are confined to the northeast.

In the course of a month's field work in Misiones I did not see *Cyanocorax cyanomelas*, nor to my knowledge did any of the hunters bring a specimen to camp, so I conclude that in the Tobunas area it is at least uncommon.

The "Blue Jay" of the region, *Cyanocorax caeruleus*, while seen in small groups from time to time was not as abundant as *C. chrysops*. *Cyanocorax caeruleus* is larger, more heavily built, dark eyed, and crestless (but for stiff, elongated feathers on the forehead which added to its somewhat raven-like appearance).

On 11 September 1959, I had been imprisoned by heavy rains. From the birds the hunters brought in I made the usual notes on fleshy parts and then selected *Cyanocorax chrysops* to occupy my painting efforts for the afternoon. Almost daily I had seen these jays trooping noisily through the forest interrupting my otherwise-directed caution with their great repertory of sounds resultant upon their amazed discovery of Man. I remembered the look one had when it saw me and peered and called and bounced excitedly and pumped its tail. I remembered its pale-eyed expression, its bizarre crewcut, and the way the whitish-blue feathers on the back of its head appeared to be bound down from the crest by an invisible string. This I tried to portray by showing it perched on an orchid-grown branch snapped from a convenient tree.

180 woodsome road, babylon, new york, 15 november 1963

MAINTENANCE BEHAVIOR OF THE AMERICAN GOLDFINCH[1]

Ellen L. Coutlee

A one and one-half year study of the general behavior patterns of the American Goldfinch (*Spinus tristis*) in Michigan has included a description and analysis of postures utilized during maintenance activities. These include locomotion, feeding, drinking, bathing, preening, defecation, and sleeping. Laboratory and field observations were compared with photographs to allow accurate descriptions of postures and sequences of behavior. In addition to presenting a general description of maintenance behavior, a basis is provided for further study of derived movements significant in aggressive and sexual displays.

METHODS

Field work was conducted at or near the University of Michigan Biological Station (Pellston, Michigan) during the summer of 1961 and at the Edwin S. George Reserve (Pinckney, Michigan) in the summer of 1962. Wild birds were studied by observing them with 7 × 50 binoculars. Because most individuals quickly became accustomed to the presence of a human being nearby, this method was often quite effective. Approach to within 10 or 20 feet of the birds was possible without noticeable changes in normal behavior. Use of a blind in the nesting areas provided closer observation at 5 to 10 feet.

Although field observations were invaluable in providing basic concepts of the gross behavior of the birds, close observation facilitated by laboratory confinement was essential. For this purpose, five nestlings were captured in August 1961, at the age of approximately 10 days, and were hand-reared for two weeks thereafter. They were fed a "paste" composed of boiled egg yolk, pablum, and milk. The young birds accepted this mixture readily and appeared to be in good condition throughout the study. Gradual inclusion of a seed mixture allowed a shift to the diet described below.

The captive birds were confined in a small cage (18 × 22 × 24 inches) during August and September, but were moved to a flight cage (3 × 3 × 4 feet) on 1 October. A flock of five House Finches (*Carpodacus mexicanus*) and a pair of Indigo Buntings (*Passerina cyanea*) were also present in this cage. The birds apparently adjusted well to these conditions, and only a slight degree of interspecific conflict was noted. After initial courtship had been observed in March and April, the pairs were isolated. Live dogwood in addition to willow and alder branches on which artificial leaves were placed provided nesting sites and cover.

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[1] Contribution No. 98 from the Department of Biology, Wayne State University, Detroit, Michigan.

A total of 350 hours of observation included field work during all portions of the day, and laboratory observations restricted to 15 to 50 minutes in the morning.

FEATHER POSTURES

A discussion of feather postures of the goldfinch is essential before complete descriptions of skeletal postures can be presented. Feather postures, as here discussed, pertain to the raising or lowering of the contour feathers in relation to the body surface. On the whole, these changes are quite subtle in the goldfinch. That is, little deviation from the relaxed position is seen, even in high-intensity displays. Feathers of the crown and forehead appear to be the most expressive, showing a greater degree of both fluffing and sleeking than the other contour feathers.

Relaxed.—In the normal, relaxed position, the tips of the feathers remain slightly above the body surface, resting upon each other and producing a smooth body outline.

Fluffed.—Fluffing is performed by raising all contour feathers, usually with the exception of those on the head. The feathers are raised to their full extent only during preening or when accompanied by shaking. Partial fluffing is noted during avoidance reactions, when the crown and forehead feathers are also prominently raised. No ruffled submissive posture was observed.

Sleeked.—The contour feathers are sometimes closely appressed to the body surface. In agonistic encounters, all feathers may be sleeked when high-intensity aggression is evident. Again, partial sleeking is the rule with no extreme change from the normal feather position. Feathers of the forehead and crown are more often sleeked than other contour feathers, as this occurs during fixation of seeds, perch, or opponent during feeding, bill-wiping, and aggression, respectively.

LOCOMOTION

Hopping.— Movement along the ground or from one perch to a closely adjacent one is performed by hopping. The bird flexes its legs, lowering its body almost to the ground and leaning forward slightly. Rapid extension of both legs propels the bird into the air. This is immediately followed by flexion of the legs, reorienting them so that the extended feet touch flat on the ground as the bird alights. Extension of the legs to the normal perching position completes the hop. This movement seems to be identical to that described by Marler (1956) for the Chaffinch (*Fringilla coelebs*).

Sidling.—When moving along a horizontal perch, the bird lifts one foot one or two millimeters and moves it a few millimeters to one side, replacing it on the perch. This is followed by a similar movement of the other foot in the same direction, allowing the bird to progress along the perch while continually facing in the same direction. Sidling may also be performed on slanting or vertical perches. In this case, the same movement of the feet is usually accompanied by flicking or fluttering of the lowermost wing. The wing movement may appear as a distinct flick with each "step" or may be a continuous fluttering as the bird moves up or down the perch.

Turning.—Perched birds often turn around so as to face in the opposite direction. This is accomplished by raising one foot, then pivoting on the opposite leg. When the body has turned through 180°, the first foot is lowered to the perch, the second raised slightly and rapidly turned about. Birds stopping in "mid-turn" can be seen perched with the feet pointing in opposite directions. This movement appears to be similar to the "pirouetting" described by Ficken (1962) for the American Redstart (*Setophaga ruticilla*). The goldfinch, however, does not utilize this pattern for moving along the perch. It is usually performed but once, and if it occurs twice in succession, the bird tends to return to the first position. Thus, after a series of turns, the bird still remains in approximately the same place on the perch.

Hanging.—The goldfinch sometimes hangs upside-down on the underside of perches or food plants. In most cases, both feet grip the perch, but occasionally the bird is suspended by only one foot. Since hanging usually occurs during feeding or pecking at the toes, the legs are flexed and the neck is bent in a "U" shape, allowing the bill to touch the toes or food. Movement in this position is usually accomplished by sidling, often accompanied by fluttering of the wings.

Takeoff.—Before actual flight occurs, the bird faces in the direction of flight, sleeks its feathers, and flexes its legs. The body is thus horizontal. The wings and tail are then raised and spread. This is followed by a rapid downward movement of the wings and tail in addition to extension of the legs, catapulting the bird from the perch. Actual flight may be preceded by wing flicks (rapid raising and lowering of closed wings) and tail flicks (the tail moved rapidly in a small arc or circle). Caged birds may turn the head upside-down as the bird looks toward the top of the cage just before takeoff.

Bounding flight.—The familiar undulating flight of the goldfinch is performed by alternation of flapping and gliding. Two to five wing beats are given in each trough, sending the bird upward. The wings are kept folded during a portion of this climb and the following glide downward. A second series of wing beats permits a second climb, and continuation produces the "bounding" flight. In most cases, each bound is punctuated by the sharp Per-chic′-o-ree display, the accent occurring during the wing beats. This flight vocalization varies considerably within and between individuals and may contain from three to six syllables, with the accent moving from one syllable to another on successive bounds. Sometimes the bounding flight is silent.

Flapping flight.—A more direct flight, usually associated with "true song," is produced through continual flapping of the wings. It appears similar to "butterfly" flight described by Conder (1948) for the European Goldfinch (*Carduelis carduelis*) and Hinde (1955–56) for several other fringillids, but the wing beats do not appear to be appreciably slower than normal. This flight is accompanied by a vocal display composed of an intricate combination of warbles, sliding squeals, and *swee-eet* notes. The whole constitutes a display which occurs frequently during the breeding season and seems to be a major factor in definition and defense of territory among the males.

Hovering.—Rapid fluttering of the wings produces hovering, or but slight forward progression. This, too, occurs during the breeding season in conjunction with aggressive and sexual behavior.

Alighting.—The movements involved here occur very quickly and I did not analyze them with high-speed photography. Laboratory observations show that alighting birds extend the legs slightly as they are brought forward. Rapid wing fluttering and an erect posture (the bird appearing to lean backward) are also apparent.

FEEDING

The American Goldfinch has been found to feed extensively on the seeds of plants belonging to the family Compositae, particularly the genera *Cirsium, Taraxacum, Lactuca, Aster, Hieracium,* and *Solidago.* Catkins of *Betula* or *Salix* as well as seeds of the Evening Primrose (*Oenothera biennis*) and Common Mullein (*Verbascum Thapsus*) are also taken. As evidenced by field observations and supported by Walkinshaw (1939) and Allen (1928), a few insects are eaten. Aphids and larvae of the Froghopper (*Philaenus leucophthalmus*) were eaten by goldfinches at the Biological Station. In most areas, these insects seem to act merely as a dietary supplement, since they are eaten in such small quantities. Where the supply of suitable composites was limited, as in one area under consideration during 1961, *Philaenus* larvae were more prominent in the diet. Laboratory animals were provided with a seed mixture containing oats, canary, rape, millet, radish, and sunflower seeds. A commercial food supplement and occasional mealworms (larvae of *Tenebrio* sp.) in addition to lettuce, radish, or other green leaves were also supplied. The birds were observed to eat all of these foods except the larvae.

Wild birds usually alighted either directly on the head of the flower or on the stem just below it. The bird's head and neck were then bent forward and down, and seeds pecked from between or just alongside the feet. On a few occasions, the birds reached upward, but extensive stretching was not noted. Horizontal stretching of the head and neck allowed the birds to grasp adjacent stems with the bill and feed from them directly or draw them closer. The wings were often fluttered and the tail was lowered and/or spread in order to maintain balance on swaying stems.

Seeds are held in the bill so that their long axes are parallel to the edges of the mandibles. Movements of the lower mandible, both backward and forward and from side to side, along with rapid manipulation of the seed with the tongue, cause the seed to rotate on its long axis. The seed is moved to the edge of the mandible and cracked by a scissors-like action of the two mandibles. After this it is rapidly hulled through continued rotation, and the husk is dropped from the side of the bill. In some cases, the seed was withdrawn into the oral cavity, then returned to the bill before it was cracked. The entire procedure was performed in two to three seconds in most cases. Sunflower seeds took as long as 30 seconds or more to crack.

On only a few occasions was feeding accompanied by vocalization. This consisted of a rapid "twitter," continued while cracking seeds. Although sounds were not usually made while actually feeding, loud warbles, squeals, and *sweet*'s were common from perches within feeding areas. In addition, short calls of *per-chee* or *per-chee-chee* were given when flying from one food plant to another.

Of necessity, captive individuals were fed from a dish placed on the floor of the cage. This placement provided an immovable food source and resulted in postures on the edge of the dish similar to those of normal perching. The wings were folded completely, so that they crossed at the rump, or were lowered slightly, giving a separation of one-fourth to one-half inch at the rump. Contour feathers were neither markedly sleeked nor fluffed. The legs were usually slightly flexed, the tail pointing directly backward or held to one side (Fig. 1). When eating seeds in rapid succession, the body was tilted forward and the head extended toward the seeds (Fig. 2). Seeds were picked up singly from directly in front of the bird or slightly to one side. The head was then raised, usually only to the shoulders, while the seed was husked and swallowed (Fig. 3).

A second type of feeding was observed during which movements were more rapid. At this time, the birds flicked their heads rapidly from side to side with the bill down among the seeds, resulting in a wide scattering of seeds from the dish. This movement was seen both when individuals were alone at the dish and when all five were present. It may represent searching for a particular type or size of seed, a displacement activity similar to bill-wiping (as described below), or simply a phase of normal feeding behavior. Again the head was raised between seeds, either to the horizontal or erect position.

One of the most outstanding characteristics of feeding by goldfinches is

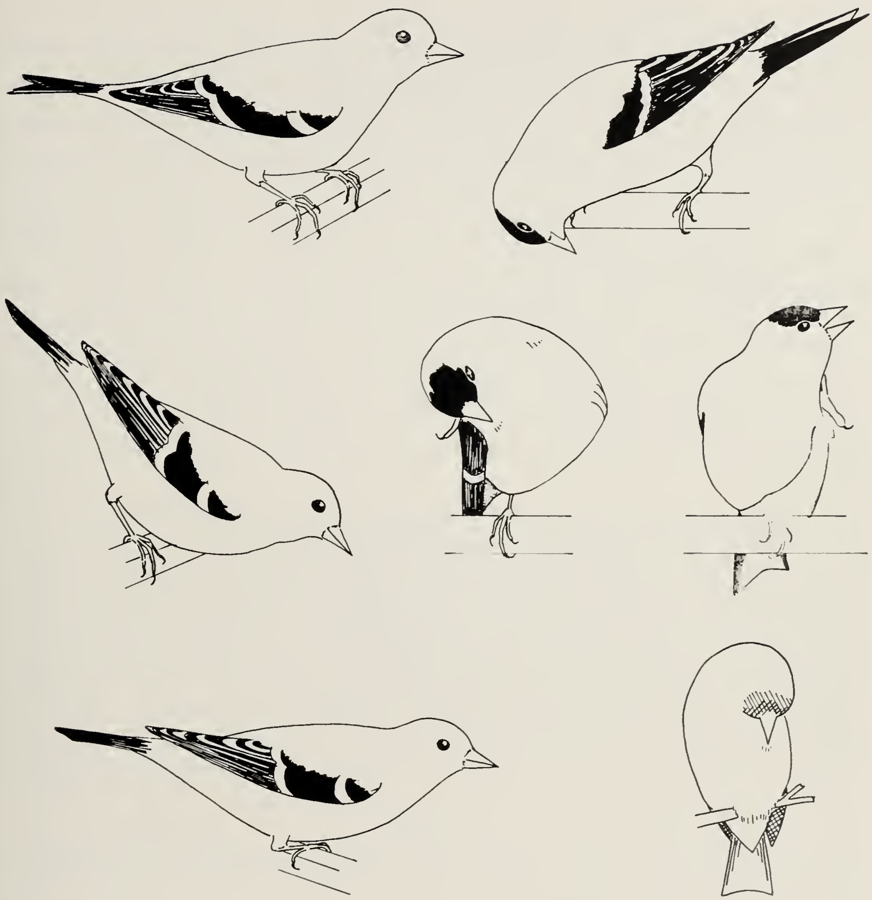

FIG. 1. (UPPER LEFT). Normal perching on food dish.
FIG. 2. (MIDDLE LEFT). Picking up seeds from food dish.
FIG. 3. (LOWER LEFT). Husking seeds.
FIG. 4. (UPPER RIGHT). Wiping head across perch.
FIG. 5. (MIDDLE CENTER). Scratching nape and crown.
FIG. 6. (MIDDLE RIGHT). Scratching throat and auriculars.
FIG. 7. (LOWER RIGHT). Preening breast.

the great use they make of their feet and the perch for manipulation of food. Wild birds utilized the feet to hold swaying branches or thistle tufts. In the laboratory, manipulation was seldom observed during feeding on small seeds such as canary, millet, or rape (2–3 mm in diameter), but was much more pronounced when sunflower seeds 3–5 mm in diameter were taken. A single seed was carried in the bill to a perch, where it was passed back and forth between the mandibles as attempts were made to crack it. Individuals often placed the seed next to one foot and grasped it with the toes of that foot, holding the seed under the toes on top of the perch. At other times, the seed was placed on the perch next to the bird. This was accomplished by resting the tip of the bill on the perch, then lowering the head slowly, keeping the bill in contact with the perch while opening it slightly allowing the seed to rest on the perch. The bird then raised its head, leaving the seed balanced on the perch, looked forward for a few seconds, then turned to retrieve the seed. Although this balancing was a common occurrence in the captive birds under consideration, the seeds often fell to the floor. It seems unlikely that wild birds utilize this pattern, since it was not often observed with small seeds similar to those normally eaten in the field, and wild birds do not usually carry seeds to perches. There is little doubt, however, that the goldfinch is extremely proficient in the use of bill, perch, and feet in manipulation of food particles.

Kear (1962) describes similar feeding activities in the European Goldfinch. This bird, like the American Goldfinch, feeds on thistle and other weed seeds in the wild. The feeding postures seem identical to those described above for the American Goldfinch. According to Kear, captive European Goldfinches as well as wild birds use the feet to a considerable degree in holding and manipulating seeds. In addition, a preference for small seeds is sustained and only minimal amounts of sunflower seeds were taken by captive birds. Kear suggests that the type and size of seed preferred is influenced by learning. This may also be the case with the American Goldfinch since the birds studied here became more proficient in dealing with large seeds as they matured. After one year in captivity, however, the large sunflower seeds did not form a significant portion of the diet, and canary or rape seeds were still preferred.

Green leaves placed in the cage were also almost invariably held with the feet. Pecking was always directed to the margin of leaves and small pieces were broken off and swallowed in rapid succession. Live trees or branches were systematically defoliated, the leaves being removed by severing the petiole. The same process was observed when branches with artificial leaves were placed in the cage. Similar behavior in captive American Goldfinches has also been noted by H. L. Batts, Jr. (personal communication) and Paul Mundinger (personal communication). Tordoff (1954) mentions the defoliating of Scotch Pine and cedar by captive Red Crossbills (*Loxia curvirostra*). He suggests that this may result from "a compulsion to twist, pry, and bite at objects," rather than a method of obtaining food. Of course, the crossbill normally makes great use of the bill in manipulating pine cones, and Tordoff indicates that denuding branches in the cage may satisfy this urge to pry and peck. In view of the fact that the goldfinch also uses its bill and feet to a great extent while feeding in the wild, defoliation of branches may indicate the same type of substitute activity in captive birds. This may well be the case since the birds did not attempt to eat leaves that had fallen from the branches and only occasionally pecked at the edges of attached leaves, most of their efforts being directed toward removing the leaves or pecking and stripping bark from the bare branches.

The social nature of the goldfinch is especially evident in feeding behavior. Communal feeding is the rule, with both sexes present in close proximity at major feeding areas. Captive birds showed a high degree of social facilitation correlated with feeding. When one bird began feeding, it was often joined by other individuals. In many instances, all five caged birds were noted on or near the seed dish at the same time. Wild birds also tended to feed in flocks, with as many as five individuals at once on a single thistle plant.

Feeding was usually followed by flying to a perch, fluffing and shaking the feathers, and/or bill-wiping. During wiping of the bill, the legs were flexed and the body turned so that it was almost parallel to the perch. The head was then lowered and the bill passed rapidly across the perch, from base to tip, removing food particles clinging to it. The process was usually repeated several times, the bird turning its head back and forth so that first one side of the bill, then the other, was drawn across the perch. This movement was performed either to the right of the body or to the left, alternately in random fashion.

DRINKING

Caged birds alighted on the edge of the water dish, wild birds just at the edge of streams, pools, or other sources of water. From the normal perching position the legs were flexed slightly and the head lowered and extended. The bill was then dipped into the water, almost to the nostrils. The bird then raised its head to or above the shoulders. These postures appear identical to those described above for feeding (Figs. 1–3). Often the bill remained closed during the first immersion, and drinking did not occur until the movement was repeated. Drinking was performed by opening the bill 2–3 mm at the tip, either as it touched the water or after it was immersed. The bill was then closed and the head raised, after which swallowing occurred. When drinking was complete, usually after two to four swallows, the bird shook its head, flicking water from its bill. Bill-wiping usually followed while the bird remained at the water source or after flight to a perch.

PREENING

One of the most common activities of the birds under observation was preening, representing about 17 per cent of the time of observation of caged birds. In addition to its functions in cleaning or rearrangement of displaced feathers, it apparently becomes incorporated into displacement activities, as shown by its increase during the spring when courtship and agonistic behavior were prominent. Ficken (1962) suggests that an exceptionally large percentage of time is occupied by preening, bathing, stretching, etc., in caged American Redstarts, since less time is spent in other activities (i.e., foraging), than is the case in wild birds. This may be true of the goldfinch, although wild birds also preen frequently. No analysis was undertaken of the actual time occupied by preening in wild birds. The birds were 15 to 50 feet from the observer, and dense vegetation usually prevented precise observation of preening activities. In the present analysis, then, only caged birds are considered. An effort was made to record each movement involved in an entire sequence of preening, or bout, which usually continued for one to three minutes at a time. The postures were described carefully, correlated with photographs, and the data analyzed according to sequences and frequency of preening major tracts. The following description of postures is presented as a basis for further study of this activity.

Preening of the head and neck regions was accompanied by scratching with the foot or moving the head against the perch. Slow wiping of the head across the perch, similar to bill-wiping, sometimes occurred when feathers at the base of the bill required preening (Fig. 4). More often noted was scratching of the head with one foot to reach crown, nape, chin, auricular, or malar regions. The following sequence will serve to illustrate the procedure followed in this scratching movement. The bird leans to the right, the right leg supporting the entire body weight. The left wing is lowered and abducted slightly, the left leg flexed and raised beneath it, then extended toward the head over the bend of the wing. Scratching is accomplished by extending the toes, then rapidly and alternately flexing and extending the leg. The head may be turned to one side to allow scratching of nape and crown (Fig. 5) or tilted upward to reach the throat and auricular regions (Fig. 6).

During preening of jugulum and breast, the legs are flexed and tail lowered, with the body tilted backward so that the back is almost vertical. Extreme flexion of the neck allows the birds to reach breast feathers with the bill (Fig. 7). The abdomen is preened in like manner, but in this case the legs are extended, the anterior part of the body tilted forward, the tail lowered, and the neck extended down and back (Fig. 8). Cleaning of the feet and legs is also performed from this position but is usually accompanied by sleeking of the ventral feathers (Fig. 9). At times one foot was raised one-fourth to one-half inch from the perch and the toes extended or flexed as they were pecked.

FIG. 8. (UPPER LEFT). Preening abdomen.
FIG. 9. (MIDDLE LEFT). Cleaning toes.
FIG. 10. (LOWER LEFT). Preening back, scapulars, or sides.
FIG. 11. (UPPER RIGHT). Preening under wing.
FIG. 12. (MIDDLE RIGHT). Fluffing and shaking.
FIG. 13. (LOWER RIGHT). "One-sided" stretch.

The sides and flanks were often preened by turning the head and neck to one side or the other while retaining the postures described above (Figs. 7, 8). In other instances, the bird lowered one or both wings and turned the head and neck to one side over the back to reach these areas (Fig. 10).

Extension of the neck over the back was also noted when back or scapular feathers were preened. Most often, the neck was turned toward the side to be preened, but occasionally movements were directed to the opposite side (i.e., right back preened with the head extended over the left shoulder).

The bend of the wing was preened either from the top in conjunction with the scapulars, from the front as in preening the side of the neck, or from the underside, the carpals moved slightly away from the body through abduction of the radius and ulna. Abduction of the phalanges, resulting in raising of the folded primaries, often to an angle of 90 degrees with the body, was noted when the alula or outer primaries were preened.

Partial extension and lowering of the wings allowed preening of primaries and secondaries from the upper surface. The remiges were reached from the underside by raising the partially extended wing and bending the neck beneath it (Fig. 11). Each feather was grasped near the base and drawn through the bill from base to tip both by partial closure or raising of the wing and forward movement of the head. Tertiaries and coverts were preened in the same manner but with much less movement of the head and wing: most preening was accomplished solely by "chewing" motions of the mandibles.

The rump and crissum were preened from the top (Fig. 10), the rump from the same position as the back, and the crissum by tilting the side of the tail upward toward the head. In addition, the crissum and anal ring were sometimes reached from the position noted in preening the abdomen (Fig. 8), the legs being extended and the neck bent far down beneath the body while the tail was bent forward.

Preening of the rectrices was accomplished by extending the neck over the back to the right or left, spreading the tail toward the same side, and grasping the feathers at the base. They were then drawn through the bill in the same manner as the remiges. Outer rectrices received the most attention with rearrangement of barbs or cleaning of inner feathers dependent on rapid fanning and closing of the tail.

The contour feathers usually remained raised throughout the process of preening, the areas being preened at any given moment sometimes presenting a more fluffed appearance. All preening was interspersed with shaking and fluffing (Fig. 12). These two movements usually occurred together, the contour feathers (except those on the head) being fully raised and the body then shaken. This was sometimes accompanied by rapid opening and closing of the wings and tail.

Stretching of wings and legs was also common. The "one-sided" stretch was performed by lowering and extending one wing, spreading the tail, and turning the head in the same direction while fully extending the foot and leg on the same side (Fig. 13). This posture is apparently identical to the "wing

TABLE 1
PERCENTAGE OF PREENING IN EACH MAJOR AREA (1,457 MOVEMENTS)

Region	Percentage of preening
Head and neck	28
Breast and abdomen	17
Sides and flanks	4
Back and scapulars	13
Wings	28
Crissum and rump	4
Rectrices	3
Feet and legs	3

and leg sideways" stretch described by Ficken (1962) for the American Redstart. It was usually followed by stretching of the opposite wing and leg in the same manner. Both wings were sometimes raised high over the back and either kept folded or extended fully, then lowered.

A detailed analysis of preening was undertaken for the six-month period from August 1961 through January 1962. The hand-raised birds probably hatched on 22 through 27 July, and preening was not recorded until 12 August (about the 18th day). Preening after this date in August appeared identical with that of later months when the birds approached maturity and so was included here. The percentage of observation time during which preening occurred was calculated for each month. The range during five of these months was 16 to 21 per cent with an average of 17 per cent. An extremely low figure of 9 per cent was recorded for September. During this month, the birds were housed in a small cage (18 × 22 × 24 inches), and the effect of crowding may have disrupted normal behavior patterns. A high degree of agonistic behavior at this time prevented extended periods of quiet perching and did not seem conducive to undisturbed preening.

Data obtained from all five birds during the entire period of observation each month were combined in an attempt to give a more general picture of the movements. Twenty-seven areas were considered, including notation of right or left side in bilateral tracts. These areas will be grouped here according to major tracts to facilitate presentation of the results. In order to tabulate the movements, a basic unit of measurement was required. One preening movement was designated as a period of preening (including scratching and mandibulating the feathers) of one area, without change in posture. Preening of a different area or facing forward to perch quietly thus indicated cessation of one movement.

In Table 1 the data are organized according to the percentage of movements during which each major area was preened. As indicated here, most

TABLE 2
SEQUENCES OF PREENING GIVEN PAIRS OF REGIONS

	Head and neck	Breast and abdomen	Sides and flanks	Back and scapulars	Wings	Rump and crissum	Rec-trices	Feet and legs	Total number
Head and neck	35	21	2	8	25	2	5	2	208
Breast and abdomen	27	19	8	22	16	5	0	3	190
Sides and flanks	17	32	9	14	17	7	2	2	48
Back and scapulars	12	15	10	26	26	6	2	3	168
Wings	18	15	2	15	47	1	2	0	292
Rump and crissum	17	27	0	10	4	21	19	2	42
Rectrices	18	15	6	6	25	21	10	0	33
Feet and legs	15	28	0	9	15	0	0	33	21

Numbers represent the percentage of movements from regions in the left-hand column to each of those heading the vertical columns. The actual number of movements for each region is given in the column to the right.

preening is directed to the head and wings. Since preening usually begins at the anterior part of the body, short sequences are often confined exclusively to the head and neck regions. Displacement activities such as bill-wiping and head-scratching, occurring during aggressive encounters, are also included here. Under the heading "wings" is included remiges, coverts, tertiaries, and alula. In view of the importance of the wings in flight, it is not surprising that these areas should receive a great deal of attention. Areas which were seldom preened included sides, flanks, rectrices, crissum, rump, feet, and legs. Fluffing, shaking, and stretching occurred frequently throughout preening bouts, accounting for 25 per cent of the total preening time. These activities are apparently effective in rearranging the feathers.

In Table 2 the same groupings are used to indicate areas preened consecutively. Here again, data from five birds for six months are combined. This table is read from left to right in horizontal rows. The figures represent the percentage of times regions to the left were followed by preening of those heading the vertical columns. For example, preening of the head and neck was followed by return to that area in 35 per cent of the cases observed. Total areas preened in each category are also given. It can be seen that the birds preened rather randomly but that some sequences were noted more often than others. For instance, preening of the back and scapulars was followed 52 per cent of the time by preening of the wings, back, or scapulars. Thus we find a tendency to return to the same or closely adjacent areas. This tendency is exemplified throughout preening sequences, as can be seen in Table 2 for head and neck; breast and abdomen; sides and flanks; back and scapulars; and wings, all of which showed return to the same or immediately adjacent tracts at least 50 per cent of the time.

Some possible sequences were never observed. For example, breast or abdomen to rectrices; wings to feet or legs; and rump or crissum to sides or flanks. These data again indicate that widely separated areas are not preened consecutively. It will be noted that five sequences involving feet and legs were not recorded. This may be due to the fact that, on the whole, these areas received little attention (as evidenced by Table 1). In addition, the feet were sometimes pecked when no further preening occurred. Thus, these were not included when considering sequences.

BATHING

Bathing was analyzed only in captive birds. It is initiated by the sight of water as the bird drinks, or by splashing of water on the bird while another bathes. The bird perches on the edge of the water dish, usually with ventral feathers fluffed. Just before bathing, birds were often seen to perch on the dish with wings lowered, vibrating and/or fluttering, tail raised slightly, head lowered, and breast feathers fluffed. These movements also occur when the bird is in the water and undoubtedly represent intention movements for bathing. If the bird flies to a perch after performing these movements on the edge of the dish, it almost invariably returns to bathe.

When sufficiently motivated, and with or without lowering and extension of the neck, the bird hops to the center of the dish. The legs are usually kept extended at first, keeping the feathers clear of the water. Actual bathing is sometimes preceded by complete turning in the dish, either to the right or to the left. The feet are kept close together, first one being raised and turned slightly, then the other. The bird thus remains in approximately the same place in the dish but faces in different directions. The bird may drink one or two swallows of water before bathing, while standing in the water. It then dips forward, wetting the ventral feathers. Next, the bird lowers and flutters its wings, both wetting them and throwing water over the back. Simultaneously, the tail is rapidly fanned and closed. Occasionally only one wing is fluttered, the tail being fanned toward the same side. This is then repeated with the opposite wing. Nice (1943) reports alternation of wing fluttering during bathing in the Song Sparrow (*Melospiza melodia*) but this is accompanied by an erect posture not seen in the goldfinch, the body remaining more nearly horizontal at all times. In some cases, the birds "walked" forward along the bottom of the water dish. The legs were flexed considerably, head and breast raised slightly, and tail pressed down to the bottom of the dish. Since the tarsometatarsus was almost parallel to the dish, most of the propulsion seemed to come from the fluttering wings. The entire sequence is repeated several times, after which the bird shakes, then flies to a perch and preens. The same movements described above for preening were utilized after bathing. In this case, however, movements were more rapid and much fluffing and shaking of contour feathers occurred. In addition, the wings were vibrated or "shuffled" almost constantly, while they were held a few millimeters from the body. These vibrations were interspersed with frequent flicking movements, during which the wing was rapidly raised about one-half inch, then lowered again, usually being extended and refolded rapidly. These movements obviously aid in ridding the feathers of excess water and rearranging and drying them.

DEFECATION

Defecation often occurred in connection with preening. It is also noted in fear-producing situations such as after aggressive encounters or when the bird is held in the hand. It is sometimes performed just after takeoff, but is most often observed when the bird is perched. The ventral feathers are fluffed, the legs flexed, and the fecal mass ejected. This is followed by shaking of the body and/or rapid erection and lowering of anal ring, along with opening and closing of the cloacal aperture. Relaxation allows the contour feathers to resume their normal position. In some cases the cloaca or anal ring is pecked, but the fluffing and shaking movements usually seem sufficient to rid the bird of waste material which may cling to the feathers. Tail-flicking after defecation, as described by Marler (1956) for the Chaffinch, was not observed in the goldfinch.

SLEEPING

The American Goldfinch sleeps in a posture similar to that for most passerines. The legs are flexed fully, one usually being raised into the ventral feathers. All contour feathers except those covering the head are fluffed so that the proximal half of each wing is completely hidden. The head is turned back over one shoulder and pushed beneath the feathers of the scapular tract, so that the bill apparently rests on the body and the entire crown is covered. The tail is lowered somewhat and both the wings and tail remain completely closed.

SUMMARY

A study of maintenance behavior of the American Goldfinch was conducted from March 1961 through July 1962. Observations and analyses of postures and movements of caged birds were supplemented by field work during the summer months.

A description of basic feather postures is followed by a discussion of various types of locomotion. These include hopping, sidling, turning, hanging, takeoff, flight, and alighting. Movements occurring in each of these categories are described in detail.

Types of food and feeding behavior are described. The manipulation of food particles with the bill and feet is especially evident in this species. Social facilitation, as manifested during feeding, is discussed. Drinking involves movements similar to those occurring during feeding.

A description of postures and movements involved in preening is given. Preening for a six-month period is analyzed according to sequences and frequency of preening major areas. Head and wings received most attention with feet, legs, and rectrices being preened infrequently. Movements appear to be random, but there is a tendency to continue preening in the same area in which it is begun.

Bathing, defecation, and sleeping are also described and discussed.

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THE BIOLOGY AND POPULATION STRUCTURE OF STARLINGS AT AN URBAN ROOST[1]

William L. Thompson and Ellen L. Coutlee

In winter Starlings (*Sturnus vulgaris*) often congregate in large numbers at special roosting places in cities where they may become a nuisance because of their noise and excrement. In the Detroit area during at least part of the winter the largest number of birds roost on the supporting beams below the Ambassador Bridge over the Detroit River connecting Detroit and Windsor, Canada. These birds follow well-established routes from the residential areas where they have fed during the day to the bridge, most of them flying in groups of 20 to 100 over the city toward the bridge. Some also come from the southeast from Canada, but usually fewer than from the Detroit side of the river. The Wayne State University campus is located along the main flight route over Detroit; and there is a lesser roost in Mackenzie Hall on the campus.

From December 1959, through November 1961, birds at Mackenzie Hall were banded, and the population structure of the roosting birds was studied. The project was terminated in November 1961, because remodeling of the building prevented further access to the roost.

We wish to thank Mr. Gordon Peace, Manager of Mackenzie Hall, for allowing us access to the roost, and to his maintenance crew for their cooperation. We also thank the following persons for their help during the project: Retta Thompson, Elsie Townsend, Roger Eriksson, Douglas Larkins, Dominic DeGiusti, Margaret Weiss, Ralph O'Reilly, Mr. and Mrs. Neil Kelley, Mr. and Mrs. Lawrence R. Lenz, and Robert Raikow. We are grateful to Stanley Gangwere for his critical reading of the manuscript.

BEHAVIOR OF BIRDS AT ROOST

Shortly before sundown groups of Starlings fly near the Wayne State University campus en route to the large Ambassador Bridge roost. Often a few birds leave the flock to join other Starlings perched and calling on or near Mackenzie Hall or flying about the roof of the building. Sometimes a few will begin to leave the flock, then change their direction of flight, and rejoin the main body going to the bridge. As the Starlings arrive in the area of the roost, either at Mackenzie Hall or at the bridge, they usually alight on prominent perches near the main roost, but not on the roost itself. Jumber (1956) has described a similar preroosting assembly of Pennsylvania Starlings. At the Ambassador Bridge many birds alight on the suspension cables of the bridge, others on a large storage tank about 200 feet away, and still

[1] Contribution No. 101 from the Department of Biology, Wayne State University, Detroit, Michigan.

others on power lines beside and below the bridge. At the Mackenzie Hall roost, birds alight in trees across the street from the building. The birds remain there for several minutes, calling and singing until after sundown, when they begin to fly up to the roost. There is usually a period of circling around it before alighting on it, often to rise and circle again. This process may be repeated many times before the entire group of birds is settled at dark.

Just after daybreak, well before sunrise, the birds fly from the roost, returning apparently by about the same route as they followed the evening before to feeding areas in other parts of the city.

On the Ambassador Bridge the Starlings roost on ledges on the concrete bridge supports, where they have no roof above them, and on beams below the bridge, where they have a roof above them but no protection on the sides or below. Those on the outer structures do not perch in contact with each other, but maintain a regular individual distance. In the roost on the Wayne State campus the birds congregate on beams just below the roof overhang on the outside of the building, as well as inside the attic. It is much warmer inside than out, and there is much space available inside, but the Starlings remain mostly at the edge of the attic, where they may pile on top of each other, several deep. The accumulation of birds at the edge of the attic leaves much apparently suitable roosting space unoccupied. Even after dark the birds call noisily as they climb over each other on the perches, settling down for the night. In the winter the birds tend to crowd into tight places were they have close physical contact with the building structure and with other Starlings. During the summer, however, when there are fewer birds at the roost, they seem to avoid contact with each other, although they continue to perch in corners and in beam joints in the attic. This difference in behavior was especially noticeable because in winter the birds could be picked off the perches by hand easily, offering almost no resistance, whereas in the late spring and summer months they were spaced farther apart and moved away when they were touched, making capture much more difficult.

When flashlights were turned on in the Mackenzie Hall roost the birds flew about in an erratic manner, fluttering from beam to beam and into the light. Those birds perched near the openings to the outside often took flight from the roost. At first the birds were captured by attracting them to the light, but it was found that they could be obtained in greater numbers and more easily by crawling to the edge of the attic in the dark and simply picking them off their perches. This procedure resulted in little disturbance to the roost as a whole. Occasionally when caught the birds gave a loud alarm call, which usually caused some other roosting individuals to fly, but it did not cause an exodus of the whole colony, nor prevent the subsequent return of many individuals to the roost.

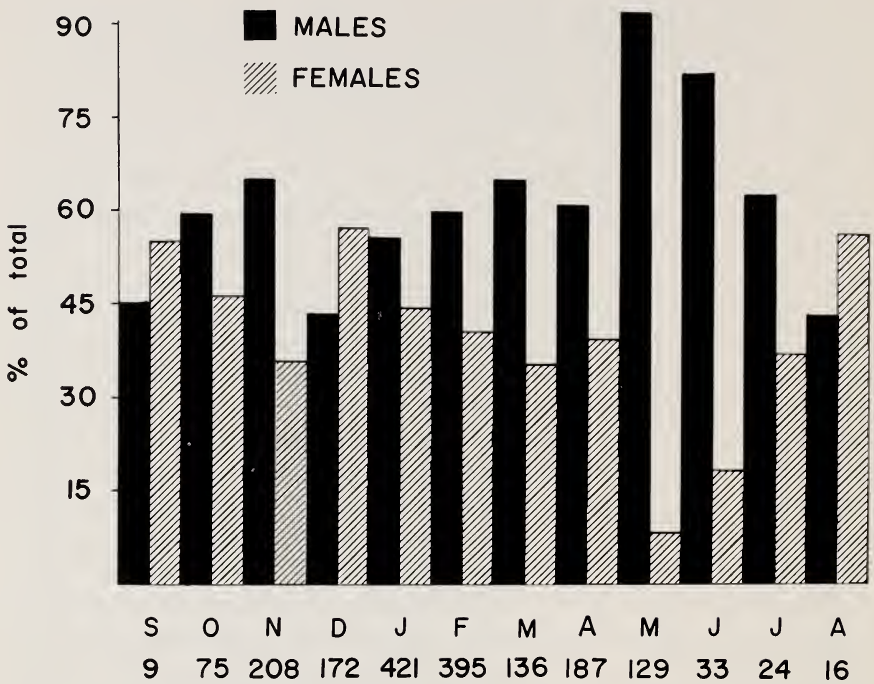

FIG. 1. The percentages of male and female Starlings at the Mackenzie Hall roost by months throughout the year.

The Mackenzie Hall roost was used, also, by feral pigeons nesting there throughout the year. No birds other than the Starlings and pigeons were found there.

STARLING POPULATION STRUCTURE

Sex and age composition of roosting population.—Birds picked off their perches were placed in burlap bags and carried to a room below the attic, where they were weighed, sexed, banded, and plucked of a few hackle feathers for later age determination. They were then released through an open window. At least some returned immediately to the roost, as was shown by our sometimes catching them again later the same evening.

No actual counts of birds at the Mackenzie Hall roost were attempted because of the confusion of birds entering, and because the number of birds roosting outside the attic could not be determined. Nevertheless, a rough approximation of the number roosting inside at different times was obtained from photographs. On the basis of these we estimate that during the cold winter months, from November through February, slightly more than 1,000 Starlings occupy the roost. The number drops to about 25 during the late summer months of August and September, when many Starlings occupy communal roosts in trees in suburban areas.

Birds were sexed by iris and bill color differences as described by Kessel (1951) and Davis (1959). The length of the iridescent portion of hackle feathers was used as an index of age, also as described by Kessel and Davis. The percentages of males and females in the roosting population at the Mackenzie Hall roost throughout the year are shown in Fig. 1. The samples suggest marked fluctuations in numbers of males and females from month to month. These fluctuations are possibly due to sampling errors and may not reflect any actual discrepancies in sex ratios at the roost. If they do reflect actual fluctuations in the population as a whole, we cannot account for them. The marked decrease in number of females during May and June, however, probably does represent a real change in the composition of the roosting population, since we would expect to find the breeding females at their nests instead of at the communal roosts at this time of year. This may also account, at least in part, for the gradual, rather steady decline in number of females noticed from January through April.

Delvingt (1961*a*) cites a classification by Carrick of the stages of the bill coloration cycle from the yellow of the full breeding condition to the black of the refractory period, and back again to yellow. The data presented here have been arranged in a slightly different way, Carrick's six stages having been grouped into four. The timing of the color change is of particular interest because of the marked difference in the rate of change within the roosting population in the spring and summer. The transition from the black of the late summer and fall to the full yellow of winter and spring is gradual, but the change from yellow to black in late summer is very abrupt. Figures 2 and 3 indicate that males and females undergo these changes in bill coloration at about the same time, although there is a slight lag in the change of the female bill to its characteristic breeding coloration. The increase in number of black-billed females in January shown in Fig. 3 may be due to sampling or may represent a change in the composition of the roosting population. Delvingt (op. cit.), too, found that females lag behind males in change of bill color from black to yellow, and, also, that young birds of both sexes assume the yellow bill later than adults. We do not have enough data to analyze age differences in rate of change. Witschi and Miller (1938) indicate that the winter color change from black to yellow takes about two months in wild Starlings in Iowa. Since the color of the horny bill covering does not change once the pigment has been deposited during formation of the covering by the stratum germinativum at the base of the bill, a change in bill color can occur only by wearing away of the old covering at the tip and its replacement by a new, differently colored horny covering at the base. Witschi and

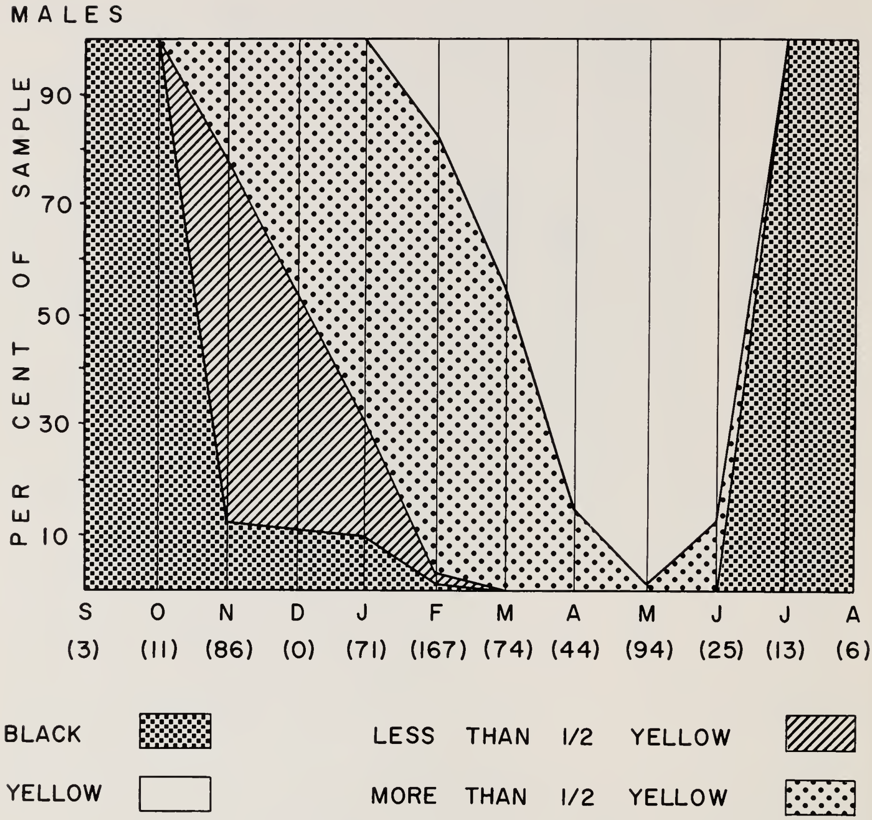

Fig. 2. Annual bill color changes in male Starlings captured at the Mackenzie Hall roost, by months.

Miller do not indicate whether the reverse change takes the same amount of time, although their lack of comment would seem to indicate that they believed it does. Nichols (1945) recorded a much more gradual change from yellow to black in the summer than our records show, but there is a suggestion in his data, also, of a more rapid change in summer than in winter.

We can account for the differences we observed in rate of change of bill color in spring and fall in at least two ways. Either there might be more rapid wear and replacement of the bill covering in summer at the time of molt than in winter, or the birds using the roost in summer may represent a primarily nonbreeding segment of the population. It is possible that a rapid growth of the horny bill covering occurs at the beginning of the molt, and that the overhang of horny material beyond the bony portion of the bill simply wears away faster than at a slower growth rate. Studies of individual

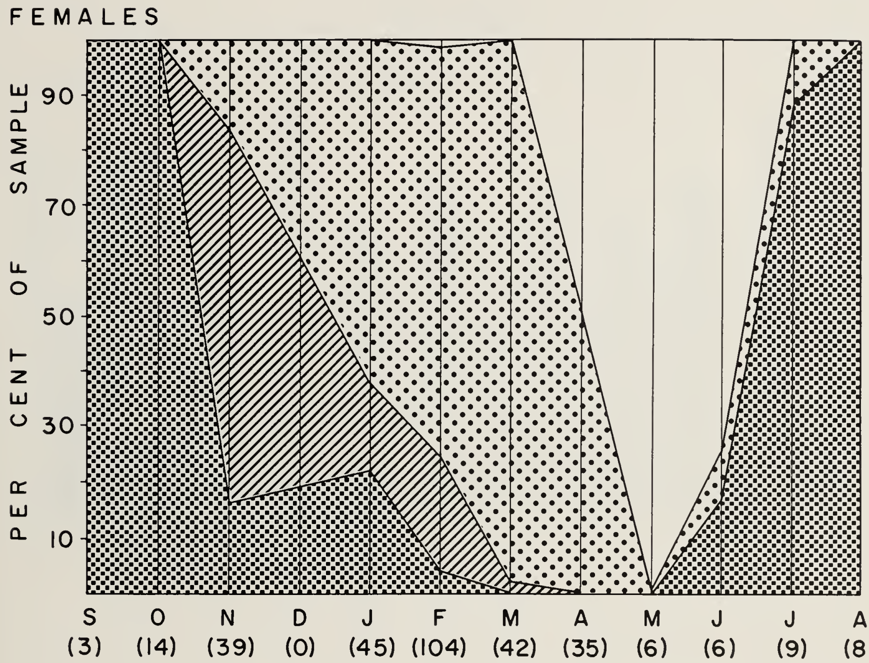

FIG. 3. Annual bill color changes in female Starlings captured at the Mackenzie Hall roost, by months.

wild Starlings would be necessary to determine whether this can account for the rapid change in bill color seen in the roosting population.

At first glance, and in view of Nichols' observations of bill color change in New York Starlings, the second alternative seems more likely, but still it is difficult to account for the abruptness of the change in fall. Why should breeding birds which have been using the roost suddenly stop using it, and just as suddenly be replaced by others which have been roosting elsewhere, and which have completed the two-month period presumably necessary to change from yellow to black? There are few individuals involved in these midsummer samples, but the inadequate sample size is not a satisfactory explanation of the problem, since the sample seems to represent a large fraction of the birds occupying the roost at that time. From the data available it is not possible to resolve the question. We need more evidence from the Detroit population as a whole, including birds not using the roost.

It has generally been found that Starling populations have an unbalanced sex ratio in favor of the males (Kessel, 1957; Davis, 1959; and Coulson, 1960). On the basis of our combined data for all seasons of the year the percentages of males and females at the Detroit roost were 60.7 per cent and

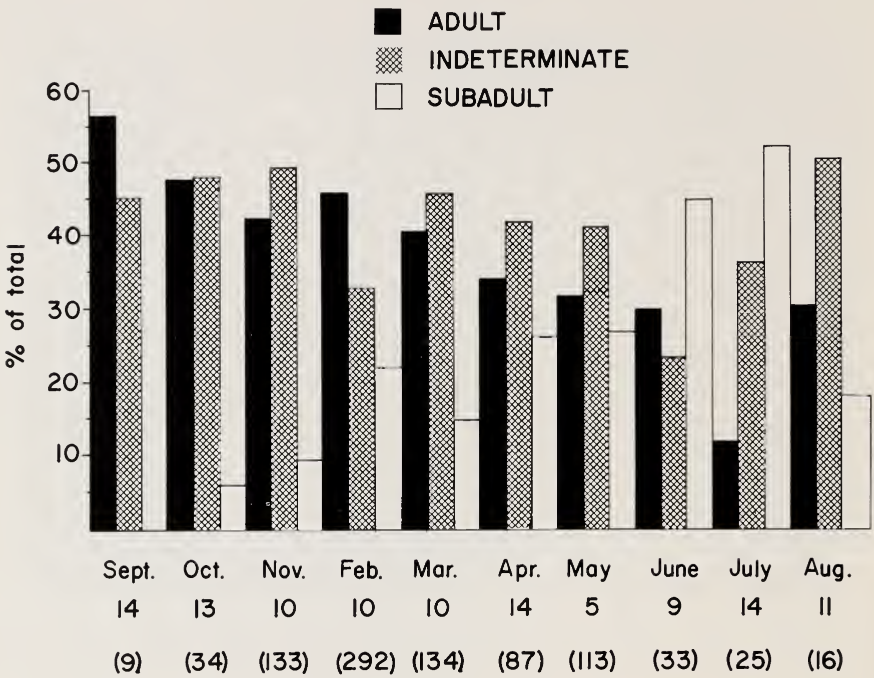

FIG. 4. Age composition of the roosting population of Starlings throughout the year.

39.3 per cent, respectively. It is apparent, however, that since during the breeding season the percentage of females at the roost drops markedly, lumping the data for all seasons would give a false impression of the sex composition of the Starling population at large. Using the data from November through March as Davis (op. cit.) did in calculating sex ratios of roosting Starlings in Baltimore, we obtain 56.6 per cent males and 43.4 per cent females.

At the Baltimore roost Davis found that the subadults, or first-year birds, had a more balanced sex ratio than the adults. Presumably, then, the females have a higher mortality rate after hatching than do the males. Coulson (1960) has suggested that this greater female mortality results from more females than males breeding during their first year and in being more subject to predation while nesting. We did not begin aging the Starlings until February of the second year of our study period, and so we do not have data on birds of known age for the entire period from November through March. For 96 subadult birds banded in February, March, and November of 1961, however, ratios of 64.6 per cent males and 35.4 per cent females were obtained. For 240 adults examined during the same period the ratios are 62.4 per cent and 37.1 per cent females. The sex ratios of the two age groups are approximately

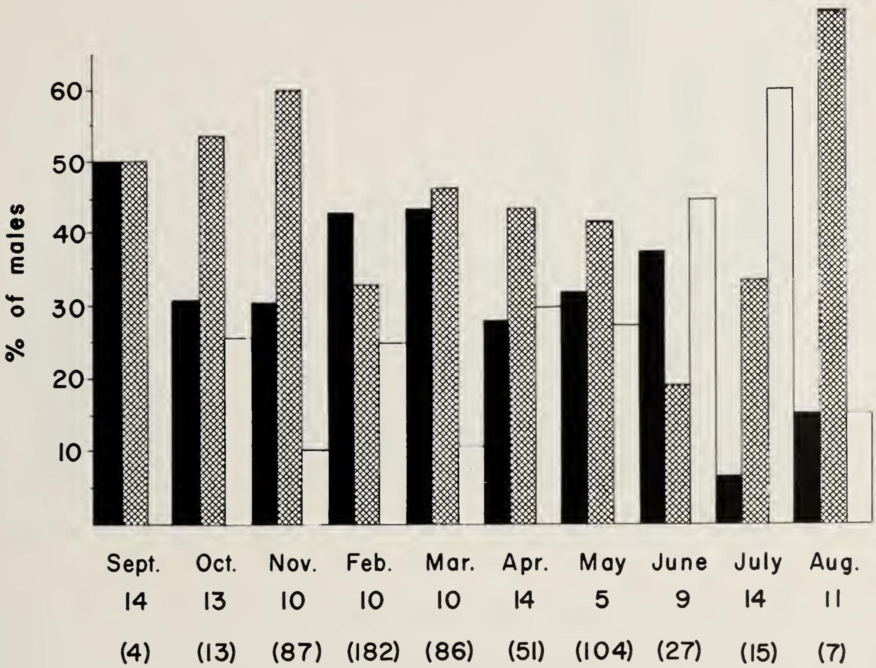

FIG. 5. Age of male Starlings occupying the roost at various times of the year.

the same, unlike the situation in the Baltimore roost studied by Davis, or the British banding records examined by Coulson.

Changes in age composition of the roosting population throughout the year are shown in Fig. 4. There is a noticeable decline in the proportion of adults occupying the roost during the breeding season, followed by an increase in the fall. There is a corresponding increase in the proportion of subadults from fall through the next summer. The abrupt decrease in proportion of subadults in late summer is presumably due to their molting and moving into the categories of indeterminate or adult, according to their feather structure. Likewise, the rapid increase in the proportion of indeterminate birds in late summer doubtlessly results from recruitment from the ranks of the subadults of the previous season. It appears from Fig. 4 that birds of the year do not begin to occupy the communal roost until fall, when the number of individuals of all age groups using the roost increases, and when the large flights to the roost begin.

Figures 5 and 6 reveal some differences in the age composition of the male and female segments of the roosting population. Whereas in the fall and early winter there are more males of indeterminate age than adults, there are more

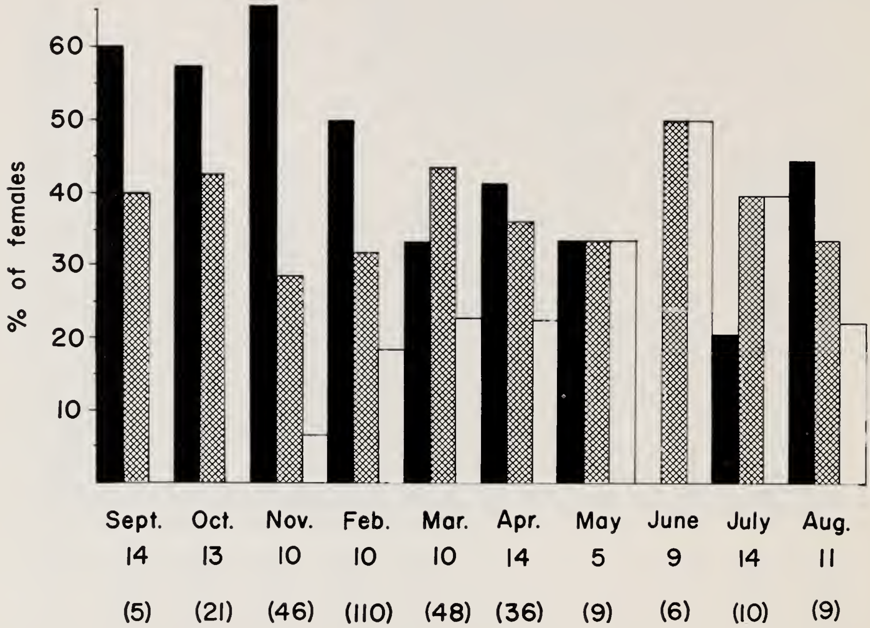

Fig. 6. Age of female Starlings occupying the roost at various times of the year.

adult females than indeterminates. These proportions suggest that, as Kessel (op. cit.) found, some adult males begin to occupy nesting territories in the fall and roost in the nest holes. The females, on the other hand, may not begin to roost in nest sites until much later, in early spring.

Although the increased proportion of subadult and indeterminate females on the roost during May and June might seem to suggest that some female birds less than one year old do not breed, the presence of a bird at the roost does not necessarily mean that it is not breeding, for we found one female roosting in Mackenzie Hall which had a well-developed egg in the oviduct, detected by palpating the abdomen. Witherby (1930) also found females in breeding condition at a communal roost in spring.

Seasonal weight fluctuations.—Birds were weighed routinely throughout most of the two-year study period. Each Starling was placed in a cardboard tube to be weighed. The weight of the bird was determined by substracting the weight of the tube from the total. Figure 7 shows the seasonal variation in weight of males and females. Each narrow vertical line represents the range of variation of the sample, while the wide vertical line indicates twice the standard error of the mean to either side of the mean, and the horizontal line represents the mean of the sample. Both males and females are signifi-

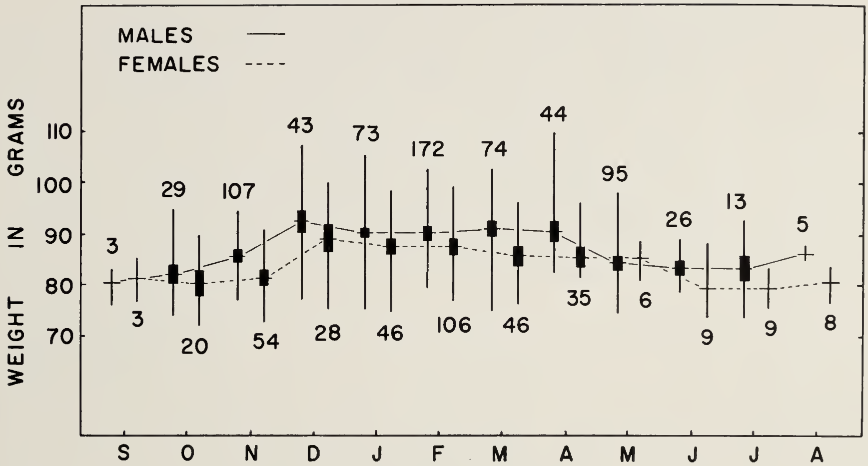

FIG. 7. Seasonal variations in weight of male and female Starlings occupying the roost, by months.

cantly heavier during the winter than during the summer, but there is considerable overlap in the range of variation. The minimal weights remain about the same during all seasons, but the maxima are higher in the winter than in the summer.

The lower summer weights could be due to several different factors, including a decrease in the number of breeding adults and a proportionate increase in the number of subadults and indeterminates. We have data on the weight variation in different age groups for only one year, but Fig. 8 indicates that the same pattern of seasonal variation is found in the subadults as in the adults. Following the late summer molt, either postjuvenal or postnuptial (prebasic of Humphrey and Parkes, 1959), the birds gain weight until they reach a maximum in early winter. This weight is maintained, with minor fluctuations through the winter, until spring, when it declines, reaching a minimum shortly before or at the time of the annual molt.

BANDING RETURNS AND RECOVERIES

During the period of study from December 1959, through November 1961, a total of 1,872 Starlings was banded at the Mackenzie Hall roost. Of these, 169 were recaptured there at some date subsequent to their first capture. This seemingly small return, only about 9 per cent, may be explained by assuming that we are dealing with a large, stable population of birds which uses the roost regularly, or by assuming that the roost is occupied by a constantly changing assemblage of birds from night to night. The second

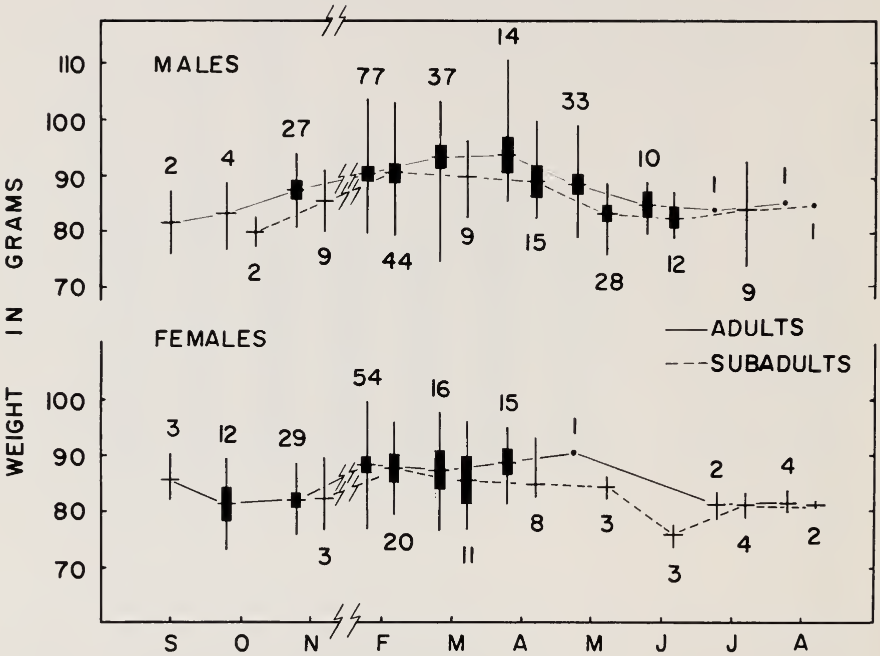

Fig. 8. Seasonal variations in weight of adult and subadult male and female Starlings occupying the roost, by months.

explanation appears to be the correct one because, if the population were stable, we would expect the number of recaptures to increase each time we visited the roost, but this was not the case. It is quite possible, of course, that the experience of being grabbed off the roost, thrust into a bag full of other birds, weighed, plucked of a few hackle feathers, banded, and finally tossed out a window discourages the banded birds from returning. If so, we might expect a decrease in the number of birds using the roost after each of our banding excursions, but no such decrease was apparent.

The evidence suggests that even if birds do return to the roost, they do not usually return to a given spot. One exception to this was a female taken in the same general area during banding sessions in three successive months. We usually took birds from parts of the roost which had the greatest concentrations of individuals, and this practice would tend to increase the likelihood of recapturing marked individuals if there were a strong tendency for birds to return to particular places each night.

It seems, then, that the Mackenzie Hall roost is occupied by a constantly changing population of Starlings. If our banding operations did disrupt what would otherwise have been a stable population, and thus produced this rapid turnover, the places of those birds which left evidently were taken by others, thus maintaining a fairly constant number of birds occupying the roost from time to time, the actual number depending on the season.

As is usually the case, the number of reported recoveries of banded individuals away from the banding site was very small. Only 23 of the 1,872 Starlings banded have been reported to date. One bird banded in Memphis, Tennessee, was recaptured at the Mackenzie Hall roost. Except for this Starling which had traveled a distance of at least 590 miles, all the other birds banded at the Detroit roost have been reported within a radius of 200 miles, and all north of the roost.

Judging from the recovery data, the Starlings which occupy the Mackenzie Hall roost are mostly from local breeding populations. Some, however, are from breeding populations a short distance to the north and east. This agrees with Kessel's (1953) diagram of the main migration route of Starlings in the Midwest. According to her map, Starlings from southern Ontario pass around the west end of Lake Erie, and would thus come through the Detroit area. Several of our winter-banded birds have been recovered in southern Ontario in the spring and summer.

DISCUSSION

It has been demonstrated for several species of birds that the ability to survive the rigors of severe winter weather depends not so much on the birds' ability to withstand cold, per se, as on the availability of food, since birds probably can maintain their normal body temperature if their energy supply is maintained. It would appear, on the basis of Fig. 7, that the Detroit area Starlings are able to find an adequate food supply in winter, since they reach and maintain their peak body weight during the coldest months. The annual cycle of the Starling is well suited for winter survival. Reproductive development begins as early as November, although nesting does not actually begin until April. The most energy-demanding periods in the annual cycle of most birds are the rearing of young and the annual molt, and these are usually timed to coincide with seasons when there are rich food resources available. For the Starlings in the Detroit area the care of young is completed by the middle or the latter part of June, and the molt begins in July. It is completed by September, which leaves two months for the birds to build up their fat reserves before the severe, cold weather comes.

The immediate stimulus for leaving the feeding areas and flying toward the roost remains obscure, but probably involves light intensity, as Jumber (1956) suggests. Once in the vicinity of the roost, however, the birds seem to be responding more to social stimuli than to be seeking warmth and protection from the cold. It was mentioned earlier that some individuals often leave groups flying toward the Ambassador Bridge to join birds already perched near or flying about the Mackenzie Hall roost. After their arrival in the vicinity of the roost the birds usually congregate on conspicuous perches until a large number has assembled, and then they fly together to the main roost shortly after the sun has set, and it begins to grow dark. Late arrivals reaching the vicinity of the roost at this time go directly to the roost without such preliminaries.

There can be no doubt that the sheltered, warm environment provided by a roost, such as the attic of Mackenzie Hall, is of great advantage to the Starlings during the winter. Any means of reducing heat loss, and thereby conserving energy, is of great benefit to birds and may enable them to survive during very cold weather, when their energy intake is likely to be low and their energy expenditure in maintaining body temperature is very high. The Starlings not only utilize shelter, but they sometimes also perch side by side, in contact with others around them, and sometimes piled several deep. For those in the middle of the mass of roosting birds the heat loss must be small, and even for those at the periphery the heat loss must be considerably reduced by having so many warm bodies close by. Thus, it is not only the shelter but also the presence of many other Starlings that is advantageous. Communal sleeping places are known to be used by other birds (Welty, 1962: 127; Frazier and Nolan, 1959; French, 1959; and Knorr, 1957) and mammals (Sealander, 1952) in very cold weather, and in these the practice presumably conserves energy stores by reducing heat loss. It is interesting to note that, as Delvingt points out (1959), continental European Starlings do not roost in masonry constructions, but usually in trees or vines. Large numbers of birds roosting together in evergreen trees with a dense foliage would be partly protected from the wind, and probably would provide some mutual protection from the cold. In England, in the late nineteenth century, Starlings began to occupy buildings in London. The practice of roosting in buildings was soon established in the United States by the descendants of the stock introduced from England.

At Mackenzie Hall the Starlings apparently seek physical contact with other birds at the edges of the attic, near the openings to the outside through which the wind whistles on cold, windy nights, leaving the warmer interior of the attic virtually empty of roosting Starlings. The number of birds roosting on the rafters outside under the roof has not been counted, and it may well exceed the number inside. There, the primary protection afforded by the building seems to be a roof above the perch, since the birds roost on the exposed north and west sides, as well as on the more protected south side. There is room for many birds to perch side by side, however, and they may provide some mutual protection and warmth. On the Ambassador Bridge, where there is much more space available for perching, the Starlings apparently do not perch in contact with each other. They maintain an even spacing on the exposed outer ledges and beams that they occupy. During severe weather, however, most of the birds roost on beams under the bridge where they are not visible from below and it is not possible to determine how they are spaced on these perches. It is unlikely that the birds on the outer perches derive much thermal benefit from their neighbors, or from the bridge itself. Those underneath, however, are probably more protected.

Birds which gather in great roosting aggregations in summer and early fall, such as Starlings, redwings, and grackles, must derive no energetic benefit from their numbers and proximity. Such roosting habits must be explained in other ways. Lack (1954) has reviewed the evidence for protection from predation which flocking affords, but Delvingt (1961*b*) pointed out that predators are successful in raiding Starling roosts. It seems then that we cannot explain the advantage of social roosting to the birds in summer in terms of energy conservation or protection from predators, and yet it is difficult to believe that there is an entirely different motivation for summer and winter roosting because the flocking behavior is so similar at the summer and winter Starling roosts. The strongly social behavior of the birds at the roost suggests that the proximal stimuli are largely social and are not concerned entirely with finding a warm place for the night, although Marples (1934) has given some evidence for warmth as a primary factor in the choice of roosting sites by some British Starlings, and individual Starlings often perch on house chimneys on cold days, taking advantage of the heat coming out. It appears that a combination of factors is involved in the choice of roosting site. The site must be large enough to accommodate many birds, and it must offer some protection. The large summer and winter aggregations, with their rather ritualized preassembly and concerted movement to the roost, exhibit a marked gregariousness and social cohesion. It would be unwarranted to state that social attraction is the only factor involved in the choice of roosting sites. Still, even in midwinter, groups of birds may roost on exposed masonry ledges, protected by a single wall, exposed on three sides to the weather. It surely cannot be warmth alone which draws them together. It seems likely that once the strong antipathy to others of the same species shown during active defense of territory wanes, the social tendencies gain the ascendancy. This change is not a simple hormonal one, if such a change can be considered simple, because even breeding birds may resort to communal roosts, thus alternating territorial and social behavior within a single day. Even though the aggregations of birds in the summer and fall may provide for no energy gain, the gain obtained during the winter may be sufficiently great, at least in birds such as the Starlings, which spend the winter in cold climates, to perpetuate the sociality in other times of the year through natural selection.

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COURTSHIP IN THE RING-NECKED DUCK

S. Dillon Ripley

In spite of there being an able monograph on the Ring-necked Duck (*Aythya collaris*) (Mendall, 1958), as well as occasional notes on breeding behavior from Audubon (1843) to Johnsgard (1955), in general the species has not been reported on extensively during courtship, which has been well defined by Morris (1956) as, "the heterosexual reproductive communication system leading up to the consummatory sexual act."

The spring of 1962 was the first one in which considerable sexual activity among the ringnecks in our captive population at Litchfield was observed. In March, two pairs were released on the main pond. The four birds paired up at once and proceeded to swim about as two separate couples. Both pairs maintained, however, a certain relation to each other. Normally they swam perhaps 40 to 50 yards apart, but in the same area of our large two-acre pond. The pairs thus were moderately close or in contact while swimming and displaying. The greatest activity periods during late April and May occurred in sunlight from about 10 AM to 12 or 1 PM. At other times display activity was less frequent. The display postures of these Ring-necked Ducks are described and discussed below.

NECK-STRETCH

One male approaches his own female and lifts his head extending his neck fully. The female, if she is overtly responsive, lifts her head also, extending the neck. This is called "neck-stretching" by Hochbaum (1944) and is presumably homologous in an evolutionary sense to the "chin-lifting" of *Anas* species. At this time the head plumage of the male is erected and puffy. Neck-stretch may occur at the commencement of each encounter perhaps every 10 minutes during the typical 3-hour period, and again rarely during the less active hours.

MALE THREAT

The other male may leave his female and approach male No. 1. If this occurs, male No. 1 is likely to contract the plumage of the head as if he were about to dive underwater, lower the head pointing toward male No. 2, the interloper, in a "threat" posture. Such a threat almost always prevented male No. 2 approaching any closer to female No. 1. Three or four times in the spring I saw one male approach closely and attempt to display or to chase the female of the other pair. On two of these occasions the female of the other pair joined her mate in rebuffing the male physically as described in the next paragraph.

FEMALE THREAT

Male No. 2 may turn away, but never responds with a corresponding threat gesture. The females have not been noted in threat postures. Instead, on occasion, one will gather herself and make a sudden rush at a male, not her own mate.

MUTUAL DISPLAY

If the female meets the initial Neck-stretch with a Neck-stretch of her own, the pair will often proceed to swim together. This is similar to Johnsgard's (1955) description when he writes that, "the female showed no return response, except occasionally to swim ahead with a burst of speed." As they swim together, sometimes joined at a distance by the second pair, also swimming purposefully, the male will make the "Head-throw" (Fig. 1), coinciding with high cheeplike noise described by Audubon (1843) and

Fig. 1. Head-throw of male Ring-necked Duck.

Johnsgard (1955). This note must be equivalent in a biological sense to the "ick-ick" note given during the Head-throw of the Canvasback (*Aythya valisineria*).

The Head-throw of the ringneck is complete, the crown of the head resting for a fraction of a second on the back feathers between the wings.[1]

BURPING

A variation of the Head-throw occurs at times when the neck is slightly stretched and raised in a forward thrust. I have never heard any call at this time, although the posture appears to be homologous in an evolutionary sense to the "burping" of the surface feeders or the uttering of the *coo* or *qu-err* courting notes of the Canvasback or Redhead (*Aythya americana*).

LATERAL THREAT DISPLAY

A type of threat display I saw this spring apparently does not appear in the literature. At certain moments when one male approaches the other male near the latter's mate, there is no typical male threat of the type described above. Rather, both males swim very slowly approximately side by side and one to three feet apart, facing in the same direction, and appear to compress the feathers of one side, the side facing the rival, in such a way as to remind me of the typical compressed lateral male to female display of the Golden (*Chrysolophus pictus*) or Lady Amherst (*C. amherstiae*) Pheasants. The posture is erect and stiffened but the neck is not greatly stretched. Viewed head-on (Fig. 2) the two

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[1] Not all males, at least in captivity, will perform the Head-throw. I believe this is the reason for the essentially incomplete records of breeding display. Perhaps the physiological condition of the birds is crucial. It is not apparent why displays occur at such different levels. Lorenz (1941) refers to "levels of intensity" among the surface-feeding ducks, as producing varying rates and degrees of display, and it has seemed to me in the past that there is probably a correlation between the emotional and physiological states of the birds under conditions of captivity which may result in not always showing a complete and entire set of heterosexual communication signals leading up to copulation.

FIG. 2. Two male Ring-necked Ducks showing lateral threat display.

birds appear lopsided as they are not symmetrical in outline, one side rather flattened, one normally rounded. It would appear to be a lateral threat display, with the compacted feathers of the normal threat display related only to the side facing the rival, and with a modified Neck-stretch position.[2]

After this display has ceased, the interloping male always swam away, impressing me that in fact threat had been involved and that the threat had been successfully overcome by this distinctive posture.

COPULATION

Copulation follows the pattern described by Hochbaum (1944) for the Canvasback. I have not found any significant display associated with the act, nor have I noticed post-copulatory displays aside from stretching and wing flapping.

SUMMARY

Certain display postures of the Ring-necked Duck are described and contrasted with the previous known literature. A type of lateral display related to the typical threat display, with an added component from the Neck-stretching display, is described, apparently for the first time.

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PEABODY MUSEUM, YALE UNIVERSITY, NEW HAVEN, CONNECTICUT, 9 JULY 1962

[2] Since observing this lateral threat display in the ringneck, I have been on the watch for it in other displaying pochards, and have now seen it in two males of the Southern Pochard (*Aythya erythrophthalma*).

COMPARATIVE BEHAVIOR OF THE YELLOW-HEADED BLACKBIRD, RED-WINGED BLACKBIRD, AND OTHER ICTERIDS

Robert W. Nero

The Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) is a sex-dimorphic, polygynous, colonial, marsh-nesting species whose usual nesting substrate is emergent vegetation, e.g., bulrush (*Scirpus*), cattail (*Typha*), or phragmites (*Phragmites*) in fairly deep water. The species has been studied from several aspects by Ammann (1938), Fautin (1940, 1941*a*, *b*), Linsdale (1938), Roberts (1909, 1921, 1936), Wetmore (1920), and others, and Bent (1958) has a good summary of their reports. Since in none of these studies has the behavioral aspect been of primary concern, however, some basic behavior patterns may still be described for this species.

The following notes are concerned chiefly with agonistic, courtship, and mating displays, and related behavior of the "Yellowhead." Observations were made mainly near Regina, Saskatchewan, from 9 May to 6 June 1957, and from 8 May to 6 June 1958, at irregular periods, but usually in the early morning and late afternoon. In 1957, most observations were made at a small roadside colony (6–10 males) about 7 miles south of Regina, and a few observations were made at a larger but less accessible colony near the southwest city limits. Both of these colonies were destroyed in 1958 as a result of drainage and drought, and in that year I studied a small colony in a cattail marsh near the end of effluent pipes from the City Power Plant (in the Regina Waterfowl Park). The birds in this colony were relatively tame because they were accustomed to workers from the power plant regularly walking along the pipes. I took still and motion pictures throughout the study and made observations from a platform on top of the pipes 10 feet above the water, directly adjacent to three territories. In 1959, this colony was broken up early in the season because of low water levels. I used mounted birds to elicit behavior, and some unexpected and significant behavior resulted.

"Display" is used here in the sense defined by Moynihan (1955*a*:240): "those peculiarly standardized and often exaggerated performances, including all vocalizations and many movements and postures, which have become specialized and modified as social signals or releasers."

The Red-winged Blackbird (*Agelaius phoeniceus*) or "Redwing" has been used to a large extent as a model for comparison, and references are made on this basis throughout this report. For certain displays I have attempted a survey of the icterine literature, based largely on the abundant material recently made available in Bent (1958). I have made comparisons with only a few non-icterine species and, as a matter of convenience, have relied on a study of the Chaffinch (*Fringilla coelebs*) by Marler (1956).

Certain nomenclatural difficulties were settled by reference to the American Ornithologists' Union Check-list (1957), Eisenmann (1955), Hellmayr (1937), and Parkes (1954).

VOCALIZATION

Male song.—Ammann (1938) and others have described two types of song for the Yellowhead: One is the short "accent song" which has clearly defined syllables and usually involves little plumage erection or body movement. The other is the "buzz song" which begins with short *cow* notes and terminates with a long, sustained "buzz" accompanied by considerable body movement (see Song-spread below). As in the song of the Red-winged Blackbird, the last phrase is given with varying emphasis (Nero, 1956:9–10). It is my impression that the "accent song" is a low-intensity or incomplete version of the "buzz song" given when the motivation is weak. The "accent song" appears often to evoke similar calls from other males. Immature males (first year) occasionally give both songs in much the same way as the adults, though in somewhat more musical tones.

Female song.—Female song (in Song-spread, see below) consists of a series of harsh, nasal, reedy, or buzzy sounds similar to the "buzz" portion of male song.

Call notes, alarm notes, and scolding notes.—(1) *Tsheck*: A short, harsh call note given by both sexes, but harsher and louder in the male, is the most frequent vocalization apart from song. Although its function is not clear it appears to indicate general wariness or alertness and may also help to maintain social bonds.

(2) *Clerrk*: The male has, in addition, this alarm call which is soft, somewhat trilled, metallic, and lower and softer than the *tsheck* call. Males gave this when I approached them, and when confronting a male dummy (but not attacking it). Females occasionally uttered a similar call.

(3) "Hawk call": A shrill, chattering call was often given by the male (with extended neck, ruffled plumage, and spread tail) at the appearance and approach of birds of prey (Fig. 1). This has been noted previously by Wetmore (1920:404), Linsdale (1938:133), and Dawson (*in* Bent, 1958: 116). The reaction to raptorial birds (and others apparently providing a similar stimulus) varied from the soft *clerrk* to a high-pitched, rapidly repeated, and trilled note: *prill-prill-prill.* Such calls were usually picked up and repeated by most of the males in sight. These calls were given by one or more birds to Common Crows (*Corvus brachyrhynchos*) (two occasions), Franklin's Gulls (*Larus pipixcan*) (two), Red-tailed Hawks (*Buteo jamaicen-*

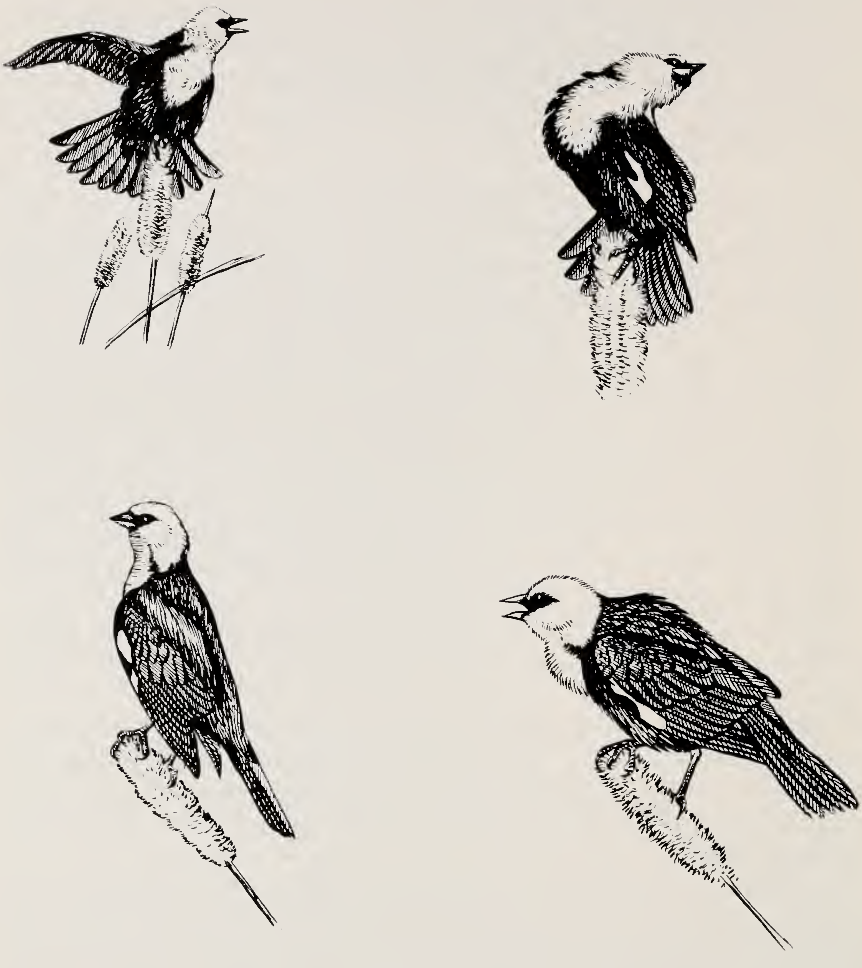

Fig. 1. Song-spread display, male Yellowhead (above); alarm posture (lower left); and "hawk call" posture (lower right).

sis) (two), Marsh Hawks (*Circus cyaneus*) (five), and a Short-eared Owl (*Asio flammeus*) (one). The "hawk call" was given in each case (by many birds), but only the owl was chased. Often the call was given while perched, but occasionally males flew up into the air and circled, as described by Linsdale (1938:133). Once the call was given by several males to a low-flying crow, then one male flew up in hovering flight beneath the crow, giving the full call. On another occasion males gave the soft *prill* notes while out of sight as a Red-tailed Hawk soared high overhead. Good reactions were obtained experimentally by placing a mounted female Marsh Hawk in a male's territory in his absence. Nearby birds gave the *clerrk* call, but when the territory owner suddenly returned, he at once gave the full "hawk call" while circling overhead. Once I saw a female Yellowhead dive into the cattails as a Marsh Hawk flew over. A male I was watching at a feeding place off the marsh showed an immediate alarm reaction when the "hawk call" was given by birds on the marsh. He stopped moving, held his head high with bill straight ahead and feathers compressed, and, with feathers on the back of the head and neck erected, he remained in this tense alarm posture for several seconds afterwards (Fig. 1). Wetmore (loc. cit.) reported that distant feeding males returned to the marsh when birds on the territory gave this call. I noticed a male once clearly give this call as it arose from a field, heading toward its far-distant territory. In this situation the call seemed related to the aggressive "flight-song" of the Red-winged Blackbird (Nero, 1956:10–12), which seems to have no counterpart in the Yellowhead. Chapman (1930: 355, 370) describes a "rapid cackling alarm note" for the Wagler or Chestnut-headed Oropendola (*Zarhynchus wagleri*), which appears to be related to this alarm call of the Yellowhead.

(4) Female scolding or alarm calls: These are of two main types: harsh, short, and repetitive *yah-yah-yah*, and high-pitched, reedy, and screeching sounds. (When chasing females in sexual chase males occasionally uttered a series of similar, loud, harsh notes.) Females also frequently called *wheesh-wheesh* when leaving the territories to go to feed.

Precopulation and copulation calls.—Both sexes have a low, soft, rapid, and repetitive or trilled call (*pree-pree-pree . . .*) which is often given continuously during precopulation and copulation. This was heard in the male chiefly during copulation; once it was accompanied by a noticeable vibration of the throat feathers. A similar call is given by the Redwing (Nero, 1956: 32).

AGONISTIC BEHAVIOR

Male Song-spread.—Song-spread is a term which has been applied to the combination of primary song and plumage display of the Redwing. (The term is comparable to "ruff-out" as used by others for other icterids.) A similar and homologous display is given by the Yellowhead (Fig. 1). As in the Redwing, the form of the Song-spread given by the Yellowhead is variable, from a short or weak version of the song with little plumage display, to the extreme song and posture. Usually the tail is down and spread, the plumage of the back and throat is erect, and the wings are held out to some extent. Just as the wings are sometimes kept out after the close of song, they may be sometimes returned before the song ends. Song is invariably accompanied by some erection of the yellow feathers, at least, and usually by a fluffing or erection of most of the body plumage. Whatever the extent of song, it is usually preceded or accompanied by a lowering and spreading of tail feathers.

The display is invariably asymmetrical, the right wing nearly always being held out either alone or to a greater extent than the left one, and the head and neck being turned far to the left, so that the bird sings over its left shoulder. This peculiar habit was noted previously by Linsdale (1938:132), Ammann (*in* Bent, 1958:117), Roberts (1936:299), and Fautin (1940:79). During Song-spread the wings may be held below, at, or above body level, but in extreme display the wings, especially the right one, are held upward, usually highest at the climax of song. They may be held up briefly after the close of song.

Song-spread may be given in the absence of other birds but it is usually directed toward one or more birds, and especially in response to the song of others. Song is elicited by intruding males, neighboring males, new males and females, and even the mate. As in the Redwing, it may be given alternately with other agonistic displays in territorial encounters. It appears most extreme when directed toward birds flying over the territory, especially females.

Frequently both wings are displayed to such birds in a combination of Song-spread and Elevated-wings (see Courtship below). The response to males and females flying slowly overhead often appears to be similar. A similar situation has been reported for the Redwing (Nero, 1956:131). It may be that the birds flying slowly overhead are seeking territories or "challenging" (Nero, 1956:134), or appear to be, thereby eliciting more extreme display.

Song may also be given with the full-stretch posture (neck to full length) without any spreading of the wings. Since Song-spread often is given during territorial disputes and since it often precedes attack it may be considered to function mainly in a warning or threat sense, but, as in most birds, it apparently also functions to attract females. Certainly, it draws attention to the displaying bird.

Female Song-spread.—Female song is relatively simple and usually is given from an upright position. As in the male, it is accompanied by varying degrees of plumage display; in its extreme aspects it approaches the full Song-spread of the male, but the song is rather limited. Females in full Song-spread apparently also sing over their left shoulders. Song-spread is given almost always to other females, either flying overhead or intruding on the home territory, and it often precedes fighting. It is far less frequent than male display and evidently is less common and more specifically directed to other birds than is Song-spread in the female Redwing. Nevertheless, female Yellowheads are equally belligerent and often are involved in agonistic behavior with other females. Several extreme Song-spreads were given to nearby females by a highly disturbed female whose nest had just been "robbed."

Male Song-spread in the Icteridae.—Song-spread display, in which the male emits a brief song accompanied by some plumage display, appears to be homologous in many icterids. Hudson (1892:273) states: "In the Troupials . . . there are many that accompany singing with pretty or grotesque antics." The Song-spread of the Redwing, the Yellowhead, and Brewer's Blackbird (*Euphagus cyanocephalus*) (the "ruff-out," Williams, 1952:5), for example, appear to be basically similar. Lanyon (1957:32) suggests that "expansion posturing" of the meadowlarks is similarly related. A corresponding relationship appears to be evident among several other icterids, namely the Tricolored Blackbird (*Agelaius tricolor*) (Lack and Emlen, 1939); Rusty Blackbird (*Euphagus carolinus*) (pers. obs.); Great-tailed Grackle (*Cassidix major*), Boat-tailed Grackle (*C. mexicanus*), and Common Grackle (*Quiscalus quiscula*) (Bent, 1958; Selander and Giller, 1961; Skutch, 1954), Shiny Cowbird (*Molothrus bonariensis*), Screaming Cowbird (*M. rufo-axillaris*), and Brown-headed Cowbird (*M. ater*) (Friedmann, 1929); the Yellow-rumped Cacique (*Cacicus cela*), Montezuma Oropendola (*Gymnostinops montezuma*) (Skutch, 1954); Wagler Oropendola (Chapman, 1928); and probably others. Most characteristically, the tail is lowered and spread, the wings are held out to some extent, and various parts of the plumage are erected, the contour plumage being fluffed in many.

Although different parts of the plumage are apparently displayed prominently by different species, e.g., humerals in Redwings, scapulars and rump feathers in Brewer's Blackbird, neck feathers in Common Grackle, flanks in Wagler Oropendola, etc., a comparative study will require very careful examination of these relationships. We tend to note especially the erection of the colored parts of the plumage and overlook less noticeable parts which may, however, be significant in tracing relationships. If a comparative behavior study is ever to be made of the Icteridae, as has been done for the Anatidae (Delacour and Mayr, 1945), a more detailed analysis of Song-spread (and other displays) than has been made will be necessary. Note, for example, that Redwings in Song-spread (see Nero, 1956:11) erect or fluff-out nearly all parts of their plumage; the red secondary wing coverts are most noticeable and attract our attention, but if other parts, say the nape or rump feathers, were conspicuously colored, then these would also be given special mention. We also tend to see in the erection of colored plumage an explanation of its function and origin, but this may not necessarily be so. For example, although the cream-colored nape feathers of the Bobolink (*Dolichonyx oryzivorus*) are erected and obvious in Song-spread display, they may have a more significant function and may have evolved in relation to another display, such as Nodding (see beyond). I think, on this basis, that we shall have to be cautious in our assessment of the relationship of plumage and behavior.

Female Song-spread in the Icteridae.—Song in female birds is relatively uncommon (Nice, 1943:131) but it has been reported for a number of icterids in which it is accompanied by plumage display; it appears homologous to Song-spread of the male. Skutch (1954:335), in a summary of the Icteridae, states: "In many tropical species the female has a well developed song but does not quite equal the male in richness of voice." Female song or Song-spread has been observed or reported for the Redwing (Proctor, 1897; Dubois, *in* Bent, 1958:141; Nero, 1956:10), Common Grackle (Eyer, 1954:47), Brewer's Blackbird (Williams, 1952:5), Bullock's Oriole (*Icterus bullockii*) (Miller, 1931), Rusty Blackbird (pers. obs.), Boat-tailed Grackle (Robert K. Selander, pers.

corresp.), and others. It appears chiefly in agonistic encounters with other females. In polygynous species, e.g., the Red-winged and Yellow-headed Blackbirds, females defend an area around their nest against other females; in the monogamous Bullock's Oriole the female shares in the defense of the male's territory, but her hostility is still directed toward other females (Miller, op. cit.).

A female Rusty Blackbird, when disturbed at her nest, repeatedly gave song (like that of the male) when confronting the observer, the less aggressive male of the pair usually remaining at some distance and in relative silence (pers. obs.). This suggests a hostile function for song in this species. Selander (pers. corresp.) notes a further function of female song:

"In Brewer's Blackbird (Williams, 1952) and in the Common Grackle, mutual Song-spread of male and female is a very conspicuous part of the early stages of pair-formation. In these species the female is not dominated by the male, with the result that male and female behave much as do two males confronting one another. In the Boat-tailed Grackle, on the other hand, females are at all times and in all places completely dominated by the much larger male. There is no possibility of her contesting with a male of nearly twice her mass (the degree of sexual dimorphism is, of course, related to the mating type). In a sense then, she has no need for the Song-spread to indicate her "resentment" at the approach of a male—she merely flees. There is no long period of mutual display in *Cassidix* as there is in *Euphagus*, since there is no pair-bond formed.

"In the Great-tailed Grackle the male is not quite so completely dominant over the female, and, in correlation, Song-spread is occasionally directed to the male.

"In sum, I would say that female Song-spread, like male Song-spread, has threat function, but the degree of importance it may have in female-to-male relationships depends on the particular dominance relationship existing between the sexes. In some species it apparently has a very important function in pair formation; in other species it has none."

Bill-tilting and Flight Bill-tilting.—A characteristic agonistic display in the Redwing and many other icterids is a posture in which the head is raised with the bill tilted upward, a position which may be held for several seconds. This has been variously termed Head-up, Pointing, Bill-tilting, etc. In the Redwing it is usually given in agonistic situations between males, and between females. It is given while perched or standing, usually in silence and with the plumage compressed (in strong contrast to the erect plumage in Song-spread displays). It is given most frequently, and often alternately with Song-spread, by disputing males on territory boundaries (Nero, 1956).

In the Yellowhead, Bill-tilting while perched is seen only rarely, but it is replaced by Flight Bill-tilting which is believed to be homologous (Fig. 2). For example: it is given most often by aggressor birds in the course of driving an intruder from the territory; when dummy males (stuffed birds) were offered to territorial males, on their territories, Flight Bill-tilting invariably preceded actual attack.

Flight Bill-tilting has been reported previously for the Yellowhead by Ammann (quoted *in* Bent, 1958:103): " 'He proceeds toward the female in one or more short, jerky flights—thus causing the wings to beat very loudly, with bill pointing almost straight up.' " (I am inclined to believe that this

Fig. 2. Flight Bill-tilting (upper left); Nodding (upper right); agonistic behavior to dummy (below).

display, although given in the presence of the female in this observation, was probably directed toward neighboring males.) Linsdale (1938:133) also noted this display as follows: Two males disputing along a territorial boundary ". . . made short flights, getting scarcely more than a foot above the ground and moving, altogether, only 3 or 4 feet. Once one went as far as 10 feet. In these flights the wings were flapped violently, but the bird moved slowly, and the body was held with the bill pointing upward 80° above the horizontal."

In Flight Bill-tilting a bird flies toward an opponent with slow, flapping flight and as it approaches the second bird it rises upward with full strokes and momentarily closes its wings, and with its head and neck thrust upward to full length, until its body is nearly vertical. At this moment forward movement is nearly halted and flight is noticeably labored. A moment later the bird drops to a perch and at once assumes a different posture, e.g., Nodding (beyond). While flying, its feet hang down loosely and the tail may be raised occasionally as if for balance. During a dispute both birds may change perches several times, drawing closer to each other, or, as one moves away, the aggressor, or both birds, may give Flight Bill-tilting in the short flight to a new perch. When making a long flight toward an opponent (or a dummy) Flight Bill-tilting was not given until the bird had approached to within several yards or feet. While usually given to other males, on one occasion a male so displayed to his mate, and at another time a male gave this display to a neighboring female which was scolding on the adjacent territory.

Flight Bill-tilting is also given by females to other females in much the same way and in the same situations as described for the male. Bill-tilting (while perched) has been observed occasionally in females (given to intruding females). On two occasions a female gave Bill-tilting while walking toward another female which was then driven off. Wetmore (1920:403) describes a male Brown-headed Cowbird running while giving Bill-tilting, and I also have seen this.

A kind of Flight Bill-tilting was suggested for the Redwing (Nero, 1956:134) in which intruding males while in flight over a territory abruptly tipped their bills upward, and on 15 May 1958 (at Regina), a male was definitely seen giving Flight Bill-tilting while engaged in a territorial encounter with its neighbor. However, it is comparatively rare in this species. Flight Bill-tilting evidently occurs in the Eastern Meadowlark (*Sturnella magna*); Saunders (*in* Bent, 1958:58) reports on three males that were competing for the attentions of a female, thus: "The males vied in following her, first one then another arching his body, pointing his bill up, and flying jerkily toward her at an elevation of from 3 to 6 feet." Lanyon's description of "jump-flights" in meadowlarks (1957:32) appears to represent the same behavior.

On 3 May 1960, at Regina, Bill-tilting and Flight Bill-tilting were elicited from a male Western Meadowlark (*Sturnella neglecta*) during attempts to record the unusual vocalization of this bird. A well-mounted male Western Meadowlark with bill somewhat elevated was placed on the ground near the bird. It responded with extreme Bill-tilting, tail-flashing, and small "jump-flights" (with Flight Bill-tilting) over the dummy. No song was given. Finally, it attacked the dummy, pecking at its head (but its behavior also resembled copulation). At times it had held its bill upright in Bill-tilting for extended periods of several seconds.

Flight Bill-tilting has also been described for the Brown-headed Cowbird: "At once a second male came flying in, and, suddenly checking when two or three feet from the bush, extended the bill straight up and in this attitude came down slowly to a perch three feet from the first bird" (Wetmore, 1920:402). On 15 June 1958 (Emma Lake, Saskatchewan), a group of male cowbirds contesting over a few females in a tree were seen giving this display between courtship displays (Song-spread and Bowing). It was regularly given by each male as it flew toward another to displace it from its perch. On 2 June 1958, at Regina, several males, when following and courting a female which was feeding and rapidly moving along on the ground, regularly gave short hop-flights and Flight Bill-tilting. Selander states (pers. corresp.) that Flight Bill-tilting is common in this species.

It may be misleading to consider Bill-tilting and Flight Bill-tilting together since they may have slightly different functions. However, no such differences are apparent. The hostile or agonistic aspects of "tilting" are quite clear and in a general sense tilting may be termed threat display. Both kinds of tilting, for example, invariably occur with other hostile displays (in the Yellowhead: Song-spread, Crouch-bristling, Nodding, and actual attack). Frequently, attack immediately follows tilting, with no noticeable change of attitude. This all suggests that tilting is indeed a threat display ". . . 'designed' to intimidate an opponent, to make the opponent retreat or flee" (Moynihan, 1955*b*:256). Tilting may be related in origin to a similar attitude seen in the Jackdaw (*Corvus monedula*) where ". . . the rivals threaten each other by drawing themselves up to their full height [with beaks up] and flattening their feathers. This attitude implies the intention of flying upwards and onto the back of the adversary" (Lorenz, 1952:165). Sleeking of the head and neck feathers, which is a common aspect of Bill-tilting and Flight Bill-tilting, is interpreted by Marler (1956:60) as a flight intention movement in the Chaffinch. In the Yellow-headed Blackbird and other icterids, sleeking may have been derived from an intention movement to fly, but it seems likely that its functional significance lies in the emphasis it gives to the bill.

Other aspects of tilting suggest that it may function as an appeasement display in the sense used by Moynihan (op. cit.:257): ". . . 'designed' to prevent attack by directly reducing the actual and relative strength of an opponent's attack drive, without provoking escape by the opponent or any general reaction by neighbors and companions." For example, tilting does not necessarily precede attack; it is sometimes given by a bird moving away from its opponent, and it is most frequent and protracted in bouts between adjacent males on territory boundaries. Moreover, in the Yellowhead, territorial encounters are also often accompanied by Tail-lifting display (below), which is considered to have an appeasement function. Withdrawal tendencies are also apparent, especially in the Redwing where tilting is sometimes given laterally or with averted posture. It seems to me that tilting may have arisen out of escape/attack conflict, the display (extended neck, upright bill, and compressed plumage) representing strong escape tendencies. Regardless of origin of the display, its function seems clearly to be hostile, whether in a direct threat sense or as appeasement. Further study of the display in these and other species will be needed in order to clarify its origin and function.

There are some differences between Bill-tilting in the Redwing and Flight Bill-tilting in the Yellowhead, in addition to the obvious aspect of motion, although these differences are related to this aspect. In the Yellowhead, the display is given by only one bird at a time, whereas in the Redwing frequently it is nearly mutual; the display of the Yellowhead is very brief, compared to the several-seconds-long display of the Redwing; and it is usually given while advancing, not while maintaining a rather definite position. There may be some significance to these differences as related to territorial defense and aggressive tendencies, but I am unable to see this. Perhaps the main point here is that we are looking at displays which have been similarly derived and which have similar functions but which represent different levels of development and ritualization. I think that the Yellowhead Flight Bill-tilting is the more primitive display.

Alternation of Song-spread and Bill-tilting has been described in the Nicaraguan Grackle (*Cassidix nicaraguensis*) by Belt (1874:214), who notes in particular the contrast between the fluffed plumage of Song-spread and the compressed plumage of Bill-tilting; he adds: ". . . its sudden change in appearance after delivering its cry was ludicrous. It appeared as if it was ashamed of what it had done, and was trying to look as if it had not done it—just as I have seen a schoolboy throw a snowball, and then stand rigidly looking another way." Armstrong (1947:251) comments on the Bill-tilting display of the Nicaraguan Grackle (and other birds) as follows: "The connexion between static posturing and dark plumage deserves investigation. The colour black has a strong emotional valency and is common as a psychological weapon. Also, to stand perfectly still is one of the most surprising things such a volatile creature as a bird can do." The ritualized nature of Bill-tilting in the Icteridae, which apparently occurs most frequently in the blackest ones, may be related to these factors.

"Courtship behavior" in the meadowlarks apparently involves Bill-tilting. Saunders (quoted by Bent, 1958:58–59), for example, states that in the "usual courtship display" the male Eastern Meadowlark "'. . . raises his body to its full height, stretches his neck to its full length, and points his bill to the zenith . . . the female's reaction to this performance is to raise her body to its full height, stretch her neck, and point her bill. . . .'" Lanyon (1957:39) describes different behavior which fits the general pattern. It would appear that Bill-tilting occurs more often between male and female meadowlarks than in pairs of either Redwings or Yellowheads. One wonders whether this apparent stronger aggressive behavior on the part of the female meadowlark to males is related to the nearly similar size of male and female in this species and to possibly their strong similarity in color and form. Selander points out, e.g., that such aggressive behavior never occurs in *Cassidix*; the female being completely dominated at all times by the male (pers. corresp.).

Nodding.—Nodding is a deliberate downward movement of the head which often appears in agonistic situations. In Nodding, the neck is arched so that the bill points down (Fig. 2). It varies from merely a slight arching of the neck and downward-directed bill to an obvious lowering of the head with the bill nearly touching the feet; it is usually held only momentarily, though it may be repeated often. When giving this display on the ground the tarsi are flexed slightly so that the body is lowered. Erection of the back feathers coincides with or reinforces Nodding. Usually the head is not lowered below body level; often the body is held more or less erect. It is often given by disputing males on the territory boundaries where it may precede or follow Flight Bill-tilting (see above), and it may be given during aggressive repulsion of an intruder. It is often given in between Song-spread displays. It is invariably directed toward (or nearly toward) an opponent or stimulus source. Since observing Nodding in the Yellow-headed Blackbird I have noted its occurrence in the Red-winged Blackbird, but it evidently occurs less frequently in this species. I suspect that there is some relationship between Nodding and Bill-wiping. The latter display occurs frequently in agonistic situations in both the Brown-headed Cowbird and Red-winged Blackbird, and is possibly less common in the Yellowhead. According to Selander (pers. corresp.), in *Molothrus ater* Nodding is an intention movement to Bill-wipe. Although Nodding has not been seen in female Yellowheads it may be mainly because there have been fewer observations of female/female conflicts. On one occasion a female was observed giving an aggressive "song"—evidently to another female—a harsh, nasal *rahh-rahh* and *rahh-rahh-rahh*—while on the ground in a horizontal position with head lowered and bill pointing down. This was also given while the female was perched on cattails. The posture appeared to be related to Nodding.

Nodding also seems to have some relationship to a display involving the nape feathers reported for the Bobolink. In one case a male, perched on a fence near a female which was giving distraction display on the ground, several times gave "a sudden deep bowing movement in which the fully erected, buff-colored nape feathers were directed down toward the female. This bowing posture was held for some time even after the female had moved quite far ahead of the male. The significance of the male's display at this time was not clearly apparent . . ." (Nero, 1955:34). Townsend (quoted by Bent, 1958:33), in speaking of the courtship display of the Bobolink, says: "He erects his buff nape feathers, points his bill downward. . . ." It seems possible that Nodding is a well-developed display in the Bobolink, although this needs to be verified, and that the conspicuous nape feathers are related to this particular display.

Possibly related behavior has been observed in some other icterids. Chapman reports (1928:154) that once when a female Giant Cowbird or Rice Grackle (*Scaphidura oryzivorus*) (see Parkes, 1954, regarding generic name) attempted to enter a nest of a Wagler or Chestnut-headed Oropendola and confronted the female oropendola, she held her bill down then curled her head downward until her bill touched the lower breast. This observation seems related to recent studies of apparent appeasement behavior in the Brown-headed Cowbird (Selander and LaRue, 1961). Male and female cowbirds in captivity persistently approached other species and Nodded, presenting their nape with erect plumage. Preening of the cowbird's nape feathers by the other bird was the surprising response and this was interpreted as an appeasement situation, which, in the wild, would be of advantage to female cowbirds when intruding on foreign territories.

Selander (pers. corresp.) states: "The nod as such probably has some value in appeasement by concealing the bill from direct view of the opponent and by averting the eyes (it is also opposite of the bill-tilt). I wish I knew what its evolutionary connection with other nodding behavior was. E.g., the male Red-eyed Cowbird [*Tangavius aeneus*] makes a very conspicuous nod before the female as he is courting. This is most interesting: he is before the female, hopping toward her with quivering wings and erect plumage; suddenly the wings stop and for one-half to one second he holds the nod—and his cape is well displayed. Then he begins to quiver the wings again. Then he may stop and

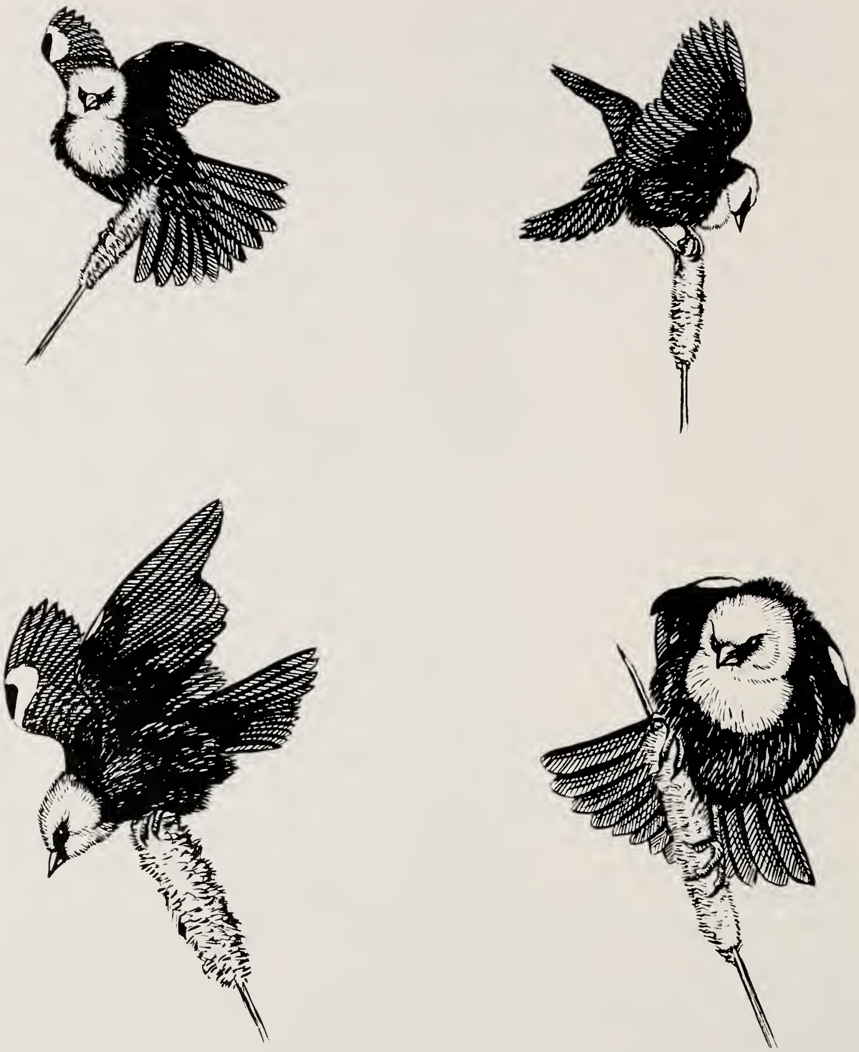

Fig. 3. Courtship display--Elevated-wings and Bowing (above; lower left); precopulatory display—Crouch-bristling (lower right).

nod. Of course this nodding and that of *Molothrus* and your birds is very similar structurally to the prolonged preening invitation dispaly of *Molothrus* and *Tangavius*. About all I can say is that in every case in which it has been seen the nod has appeasement function. The parasitic cowbird 'wishes' to appease some other species in order to approach and induce preening, and the Yellowhead presumably reduces the attack or escape 'drive,' of an opponent by nodding. This same sort of display or posture occurs in a great variety of other birds from eagles to parakeets."

FIG. 4. Precopulatory behavior to a female dummy—first phase (upper left), showing Crouch-bristling; second phase (upper middle, right, and lower left); Song-spread display to dummy (lower right).

Crouch-bristling.—This term may be used to describe a crouched and hunched posture in which the plumage of the upper back, breast, and head is fully erected; the tail is fully spread and lowered and the wings are held out somewhat (Fig. 3). The displaying bird faces its opponent with its head held low and parallel with or lowered beneath the body level, but with the bill forward. The yellow plumage on the top and back of the head is noticeably erected which, together with the black pattern of the lores, etc., gives strong emphasis to the bill. Crouch-bristling is regularly given in agonistic situations where it appears to have a threat function. A very similar if not identical display is also addressed to the female in general sexual situations and in precopulation (Fig. 4, first phase). The occurrence of such a display in sexual situations still appears to be agonistic in nature. Crouch-bristling is clearly related to "crouching" in the Redwing (Nero, 1956:17), as well as the "peck-gesture" as defined by Laskey (1950:159) for the Brown-headed Cowbird. The "threat-posture" of the Song Sparrow (*Melospiza melodia*) is similar (Nice, 1943:156), as is the " 'head-forward' display" and the " 'crouching' posture" described by Marler (1956:37, 103) for the Chaffinch: the former display functions in fighting, the latter in courtship. Marler's observations are more detailed than ours and a complete comparison cannot be made. However, his material serves as a useful guide in explaining Yellowhead behavior. " 'Head-forward' display is always associated with an obvious intention to attack which is checked, it seems, by a conflicting tendency to escape" (Marler, 1956:39). The " 'crouching' . . . display is similar to an extreme form of the 'head-forward' posture. . . ." In the " 'crouching' posture" both aggressive and escape tendencies appear to be active, while a copulatory tendency is not yet in evidence (Marler, 1956:103, 105). (This is discussed further under Precopulation.) I am unable to differentiate between Crouch-bristling as it appears in agonistic and sexual or courtship situations in the Yellowhead; however, my observations are far from complete. In a filmed sequence of a male confronting and then attacking a male dummy, the initial behavior with compressed plumage, wings out and frequent withdrawals, suggests strong escape tendencies. At one time the bird gave Crouch-bristling, appeared more confident, and showed less escape tendency and more approach or attack tendency. He soon attacked the dummy, knocking it over, and then went into Tail-lifting display (discussed below).

Crouch-bristling usually is given prior to supplanting an intruder. On the open ground this often takes the form of an aggressive though somewhat indirect, rapid, sidling gait, or "shouldering." This may be succeeded by an even more aggressive action (actually attack behavior)—the "direct-run," with head down, bill forward and sometimes open, etc., straight and fast toward an opponent. The "direct-run" usually displaces an intruder and is probably comparable to the "direct-flight" which routs an intruder perched on the cattails.

A filmed sequence of a female attacking a female dummy shows a behavior similar to that of the male, including shouldering, tail down and spread, head sometimes hunched, feathers on top of head flattened and level with back, bill forward, wings out from the body and at times partly lifted over the back, and primaries at times touching the ground. Crouch-bristling occurs but is less noticeable, although nearly all feathers of the body are involved, including the wing coverts. In actual attack the female landed on the dummy; squatting on her tarsi and braced with her tail she pecked at the head of the dummy. The posture somewhat resembled copulatory behavior. More complete apparent copulatory behavior in an agonistic situation was given by a female Baltimore Oriole (*Icterus galbula*) to a female dummy in brief experiments made in June of 1958 by Richard W. Fyfe (pers. commun.). A mounted female oriole was placed on a lawn in precopulatory pose (tail and head up, wings partly out) where a pair of orioles were frequent visitors. Both male and female attacked the dummy. The more aggressive female approached the dummy giving the alarm *chirr* and Open-bill, then attacked the dummy by standing on top of it and pecking at the head (and cloacal region?); several times the female went through exact motions of copulation (judging by Fyfe's photos), as did the male, including lowered tail, squatting on tarsi, and wing fanning. Redwing males, in addition to often attacking male dummies, frequently also attempted to copulate with them in experiments performed by myself and others. The subject of males' copulating with dummies is discussed by Nice (1943:206–208); however, I found no mention of attempted copulation (or similar behavior) by a female bird to a female dummy. Selander (pers. corresp.) states: "Females of *Cassidix* regularly mount female dummies and perform the complete masculine copulatory pattern. Here there is no conflict between tendencies, only a simple 'release' of the pattern by the dummy. I have a good idea as to why this occurs only in *Cassidix*, not in *Euphagus* and the rest. In those species other females are potential rivals and there is a premium on female territoriality and associated aggressive reactions to the close approach of other females. In the promiscuous *Cassidix*, on the other hand, there is no rivalry for males, and in a sense, the masculine pattern is not inhibited by other tendencies. Thus, when a female sees a female dummy, the masculine pattern is stimulated and is free to express itself. Also, since the masculine pattern is unusually strong in males of promiscuous species (a male *Cassidix* will mount a dummy fifty or more times in a row), perhaps it is also unusually strong in the female."

Tail-flipping.—Tail-flipping is a common display and seems to indicate general nervousness or alarm. It consists of a quick flip of the tail: the tail is lowered, spread, closed, and returned, all in one quick movement. It is given by both sexes and is alike in Yellowhead and Redwing. Marler (1956:157) described Tail-flipping in the Chaffinch, and considered it a flight-intention movement. This display is more noticeable in the meadowlarks where it is reinforced by a conspicuous white tail pattern and where it may have greater significance. However, flashing of the black tail of Yellowheads and Redwings is surprisingly conspicuous when viewed against the skyline or the marsh vegetation which is their usual habitat.

Tail-lifting.—As indicated by Ridgway (1902:347), the female Yellowhead has a yellowish anal tuft (or circlet), the male, yellowish or orange feathers in the anal region. In a recent examination of several specimens it was determined that both sexes have a colored anal circlet, and that in the male there is in addition a prominent colored patch involving the feathers immediately posterior to the anal circlet and including the basal portions of some of the under tail coverts. There is considerable individual variation in the extent of this patch. The yellow cloacal patch of feathers (including the anal circlet) is evidently related to a display in which the tail is raised or lifted, though not usually spread, thus revealing the cloacal area. This display has been termed Tail-lifting. In display the tail is raised from just above the horizontal to a nearly vertical position, depending upon the situation and presumably the motivation, and held briefly, for several seconds or for a few minutes (Fig. 5). The plumage is usually compressed and the head may be held high. It appears in moments of contest or conflict between males, between females, and between male and female. It is more prominent in the male. In a few cases it appeared to be given in flight in agonistic situations, especially in connection with Flight Bill-tilting. At low intensity Tail-lifting is often given from fortuitous positions, but in high-intensity displays the bird

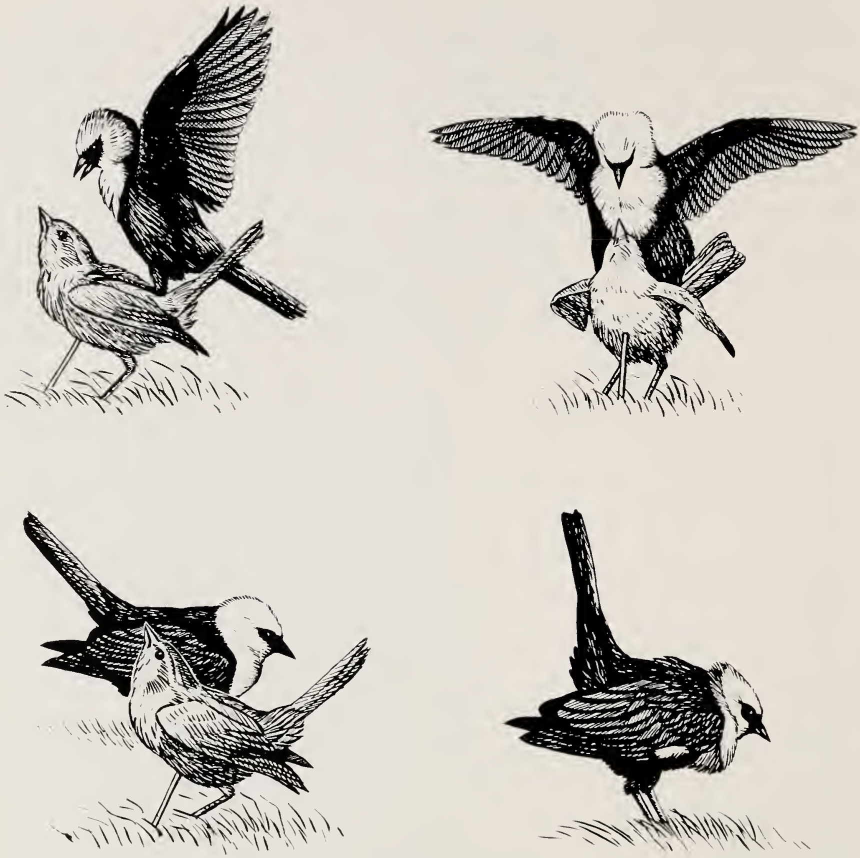

Fig. 5. Copulatory behavior to a dummy (above); Tail-lifting display to dummy (below).

faces away from its opponent, thus fully displaying the cloacal region. This display may be related to, and may stem from, precopulatory display of the female (or the appeasement aspect of this—see below) since other elements of this latter display also appear, e.g., slightly spread primaries. Moreover, in the female an apparently advanced form, similar to female precopulatory display, is given in much the same way. It has occurred to me that the origin of the colored cloacal patch in the Yellow-headed Blackbird, and its relationship as a part of an appeasement display, may be related to the protruding cloaca of the female in extreme precopulatory display. In both sexes, Tail-lifting apparently functions as appeasement. Still, the more aggressive Tail-lifting member may Tail-lift first. The following field notes serve to illustrate typical situations:

16 May 1958, 7:00 AM: Two Yellowhead males, one holds its tail up and its primaries out from its body exposing the cloacal patch; performed this rather deliberately three to five times with its posterior toward the other male. They move about on the cattails, keeping together, with Bowing, Crouching, and Song-spread in between. These two are newly engaged in contest; one is contesting for space with an already established male. They maneuver back and forth on the territory edge (newly formed). Later one drives off the other.

19 May 1958, 7:00 AM: Two males on territory border, both with tails up and reversed momentarily as they first meet. They move with Flight Bill-tilting and again one (highest position) elevates tail while facing away.

20 May 1958, 8:11 AM: Male in noisy flap flight for three feet—by his female but also near adjacent male on territory border. First male holds tail up sideways as the males meet and move apart.

27 May 1958, 8:10 AM: Female resting on water pipe in strange territory, as a male approaches her she lifts her tail, then flies away.

8:36 AM: Female in Tail-lifting to another female; as her mate approaches she maintains the Tail-lift and gradually shows precopulatory behavior, but the male is only aggressive and attacks her.

9:00 AM: A female very aggressive to a neighboring female with Flight Bill-tilting and Song-spread, then actual attack; at attack the other female goes into Tail-lifting (or a facsimile of precopulatory display), at which the mate (of both these females) approaches and attacks the aggressor female.

10:00 AM: Two females fight, one puts tail up and gives wing flutter (much like precopulatory display), but the male is not nearby.

An interesting Tail-lifting display which provided additional features was given repeatedly by a male involved in behavior to a female dummy on 3 June 1958. A complicated sequence of events, lasting 5–8 minutes, including Song-spread, Precopulation, and Copulation, and alternating with Tail-lifting was repeated several times during the course of half an hour and was filmed (Figs. 4, 5). Following each copulatory phase the male suddenly underwent a surprising transformation from a very active state to a nearly rigid and transfixed behavior in which Tail-lifting predominated.

A typical sequence: the male walks around the dummy to face it, sometimes being sideways to it, with his tail lifted part way and with a few deliberate Nods. Holding his wings out loosely he stops, moves mechanically, braces his feet, cocks his tail higher and higher, while emitting a kind of clicking sound, until his tail is straight up. Then suddenly he swings about to fully face away from the dummy. After a few minutes of this behavior the male suddenly breaks into Song-spread and then rapidly goes into precopulatory behavior. It appears that there was some conflict between sexual and agonistic behavior in this situation. Under usual circumstances Tail-lifting, apparently functioning as appeasement, may arise out of conflict. In a filmed sequence in which a male Yellowhead attacked a male dummy, Tail-lifting was given with the tail spread rather fully. Initially the male kept his plumage sleeked, his wings out, his tail fully spread, and generally appeared very wary (Fig. 2). Finally, as he "gained confidence," he fluffed his plumage, crouched low, and then knocked the dummy over. Tail-lifting then occurred, the spread tail being raised gradually as the male turned from the dummy; he stopped, facing directly away from the dummy, with the spread tail held nearly veritcal.

Tail-lifting occurs normally in one other common situation. Males feeding together on the ground often walk about with their tails up. This is also common in Redwings (Nero, 1956:13), cowbirds, and possibly other icterids. Bent (1958:444) writes of the Brown-headed Cowbird: "While feeding it often holds its tail erected high in the air, with the wings drooping below it." Nichols (1960) illustrates a cowbird using "tail-up posture while feeding." And he states: "Tentatively, I interpret the protracted tail-up silent foraging of the cowbird as a rudimentary and fractional display indicating emotions which, when reaching full development, will give rise to complex tail-up displays with invitation application." It is possibly appeasement behavior here too, where males in close association show some agonistic behavior. In the Redwing when a male is feeding together with other males on the ground, the red coverts are usually kept concealed (Nero, 1956:9), behavior which indicates an appeasement or nonaggressive situation. Tail-lifting is not otherwise common in the Redwing. I have seen Redwing males lift their tails high on only a few other occasions. In one case a male, perched on a fence-post and greatly disturbed at my presence on its territory, gave alarm cries while holding its tail high.

In the Brewer's Blackbird there is an "elevated tail display" (with tail somewhat spread), which may be related although "it is never addressed to another male and has no significance as a threat . . ." (Williams, 1952:7–8). Since there is no cloacal patch (of colored feathers) in either the Redwing, Brewer's Blackbird, or cowbird, it may be that this display has not developed to the same extent in these species as in the Yellowhead, although clearly functioning at a low level, at least in the Redwing and cowbird, in apparently the same way. It would be of considerable interest to know whether a comparable display is given by other icterids which have a striking color pattern in the cloacal region, such as the Black-billed Oropendola (*Xanthornus augustifrons*), Green Cacique (*X. viridis*), Curve-billed Cacique (*Cacicus uropygialis*), Mexican Cacique (*Cassiculus melanicterus*), and others. Of course, the Green Cacique has an inverted display (Armstrong, 1947:144) in which these colored parts may also function.

A display in which the tail is raised and spread (or fanned) occurs in the Baltimore Oriole, but in this case the display is given (so far as has been observed) while facing the stimulus object, and the striking dorsal pattern of the rectrices appears to be significant.

On 9 June 1958, at 2:30 PM, I briefly observed a tail-raising display in this species when a male flew down to the ground near a dummy female oriole which had been placed on a lawn in a "normal" posture. As soon as the male came into sight he appeared to be responding to the dummy and directing his attention to it. At first he appeared alert, with quick movements, compressed plumage, and with body held low and tail parallel to the body. He hopped about in this manner giving a soft *whit* call repeatedly and a harsher *brrr* call, both of which seemed to denote alarm or anxiety. Then, facing the dummy, but still some distance away, he lowered his body almost to the ground and cocked his tail, fully spread, straight up and held it there for a few seconds. Then, reverting to the earlier pose, he gave a long outpouring of song in the manner of a Catbird (*Dumetella carolinensis*), with squeaks, rolls, *whirr*'s, and intermittent chatters. During this continual song the tail was frequently lifted momentarily.

SEXUAL BEHAVIOR

I have not been able to determine the behavior patterns that are associated with pair formation in the Yellowhead. The male's initial behavior to new females appears similar to that directed to his mate. For the most part, as in the Redwing, the female simply appears on the male's territory and either stays or leaves. The male gives Song-spread, engages in territorial disputes, etc., and "courts" the female. Courtship behavior or Symbolic-nesting is primarily male behavior apparently directed to the female but usually oriented away from her. The female's role in Symbolic-nesting is mainly passive. The male similarly "courts" newly arrived or unestablished females as they fly overhead or when perched nearby. Sexual-chasing also occurs during this period but it is restricted to an already formed pair. Symbolic-nesting and Sexual-chasing are the two chief aspects of intersexual relations prior to nest building. Both also occur, but to a lesser extent, following nest building. The chief intersexual behavior during and following nest building is Mating or Precopulatory Behavior; this behavior is evident in both the male and the female and, of course, leads to copulation. Throughout the period of association of a pair, agonistic behavior, apart from Sexual-chasing, which appears to have some agonistic connection, is also evident; it consists primarily of hostile behavior of the male to his mate.

Courtship or Symbolic-nesting.—Descriptive terms which were applied to the courtship behavior of the male Red-winged Blackbird are "Symbolic Nest-site Selection" and "Symbolic Nest-building" (Nero, 1956:21). These terms may be appropriately applied to quite similar behavior patterns of the Yellow-headed Blackbird, which may, however, be conveniently covered by the single term Symbolic-nesting. This term has been applied to a sequence of male behavior or aspects of the sequence in which, at least in its extreme form, the male performs nest-building movements, although the female alone builds the actual nest. Other movements which occur more often are linked (in a "complete" sequence) to the nest-building movements and are suggestive of nest-site selection behavior. Various aspects of Symbolic-nesting may be recognized in the Chaffinch (Marler, 1956:74, etc.), as well as in many other species (Nice, 1943:178–179). The sequence of Symbolic-nesting in the Yellowhead includes the following displays or movements: Elevated-wings, Flapping-flight, Dropping, Crawling, Bowing, and Pecking or Building. It seems useful to use the term Symbolic-nesting even though further study may show that some aspects of the sequence are not really related to nesting behavior. For example, the Elevated-wings display may have originated or may actually function in an agonistic sense. Included below are (1) a general description of Symbolic-nesting, followed by (2) a more detailed description, and (3) a comparison with similar behavior of other icterids.

(1) Symbolic-nesting includes the most noticeable display, apart from Song-spread, of the Yellowhead, appearing at first glance as a display of the wings, often accompanied by a slow and awkward short flight. Wetmore

(1920:403) stated: "In the most common display the male started towards the female from a distance of 30 or 40 feet with a loud rattling of his wings as a preliminary. The head was bent down, the feet lowered and the tail dropped while he flew slowly toward his mate. The wings were brought down with a slow swinging motion and were not closed at all so that the white markings on the coverts were fully displayed, the whole performance being reminiscent of a similar wing display of the Mocking-bird [*Mimus polyglottos*]." Linsdale (1938:133) also noted certain aspects of the display: "Another elaborate display often accompanied the song of the male. In one form of this display the tail was spread, both wings were raised high over the back, and the body feathers were raised. The birds seemed to have difficulty in maintaining a balance during this performance."

A closer look reveals a definite pattern of even more elaborate form. Briefly, the male raises his wings over his back (Elevated-wings), flies slowly and awkwardly for some distance (Flapping-flight), then suddenly Drops down into the vegetation where, still holding his wings upright, he Bows and then awkwardly Crawls through the vegetation with tail down and spread, often stopping to Bow and Peck (Fig. 3). This sequence of behavior is usually given in the presence of the mate or to new females, either perched within the territory or flying by. Most often the male flies away from the female and Bows while facing the opposite direction from her, but the male may also Drop near the female, or even approach her. Usually the female follows the male as he Crawls, and she faces him from nearby as he Elevates his wings and Bows. At times this display may immediately precede precopulatory behavior but it is then given rather abruptly. In one case a female was seen to go into slight precopulatory behavior—tail and head up—after following the male. Usually, however, Symbolic-nesting is not directly connected with precopulatory behavior. Song-spread display may occur during or before the Elevated-wings display and at these times the wings are not lowered as usual but are kept erect. Symbolic-nesting is most common during the period preceding nest construction. It may also be given in noncourtship situations, such as when the female is alarmed by a disturbance at the nest. Often, only portions of the sequence, especially Elevated-wings and the Flapping-flight are given. Some illustrative field notes follow:

12 May 1957, 6:20 AM: Male with female—flies away from her with slow, flapping flight and noisy wings, then suddenly Drops onto the cattails to pose with wings held upright—in this pose he Bows and then Crawls rapidly through the cattails; the female follows him, her tail and head held up momentarily in precopulation.

24 May 1957, 6:30 AM: Female in nest-lining stage. She returns to the territory with a billful of fine stems, giving a *grrk* call note to which the male responds at once with Song-spread; he then flies toward her in slow flapping flight, Drops into the cattails

near the nest with elevated wings, disappears in the cattails, then comes out and moves away.

29 May 1957, 5:50 AM: A male elevates his wings and tips forward (Bows) when a a female flies overhead.

19 May 1958, 7:30 AM: A male flies rapidly toward his female, she leaves the territory, he gives Song-spread. She returns, he flaps past her with slow flight, lands on top of the cattails with wings elevated, bows stiffly (with "Growl"?); as she moves closer he Drops into the cattails still holding his wings upright.

20 May 1958, 7:41 AM: Male raises wings high over back, flaps to a new position, Crawls through the cattails with wings upright; he burrows down out of sight—the female comes over and follows him.

(2) The Elevated-wings display is usually symmetrical, both wings being held and moved in about the same way; since the entire wing is moved as a unit an awkward flapping appearance results. Flapping usually begins while the bird is perched, suggesting flight onset. One can readily predict when a bird is about to fly by the extent of flapping, although often the wings may be elevated and flapped sporadically (and without the rest of the sequence), presumably as the level of intensity rises and falls. On one occasion observations were made of an individual which showed gradually increasing intensity; at first the primaries quivered slightly, then the wings were lowered and gradually held out from the body, and slowly, with slight shaking, raised higher and higher until they were above the level of the body. Increasing intensity of the display is apparently indicated by the higher position of the wings. Ordinarily, the wings are first brought up above the body and held in that position before the bird flies, but occasionally this display may arise during normal flight. At this time the beat of the wings is suddenly considerably slowed. The slow, awkward, or impeded flight during the display sequence (at which time the white patches are quite noticeable), has been termed Flapping-flight; it is noticeably different from normal slow flight.

It should be noted that the tail is fully spread throughout Flapping-flight (in the Redwing, too) and this may also affect the flight. The peculiar V-shape of the tail of the Common Grackle in courtship display and at other times (see Bent, 1958:397) may be related; Eyer (1954:51) thought it was an adjustment for slow flight. (However, Ficken, 1963:69, suggests that the V-tail is "probably a long-range sex-recognition character.") The Red-collared Whydah (*Euplectes ardens*) of Africa also has a slow flight display associated with courtship in which the long tail is deeply keeled, evidently in the same way as in the grackle (Emlen, 1957:209).

Occasionally, a distinct but muffled, rattling sound, possibly produced by the primary quills, may be heard during Flapping-flight. Wetmore (1920:403) and others have mentioned this; Linsdale (1938:132) said that "the dull whistle made by the wings could be heard distinctly for 50 yards or farther. . . ." The ordinary heavy wing flapping during this flight display is noisy, but the apparent quill rattling is quite distinct. Skutch (1954:263) notes something similar for the Yellow-tailed Oriole (*Icterus mesomelas*): "Often while flying it makes a crashing sound, apparently with its wings." He also reports a noisy flight for the Giant Cowbird: "The flight of the males of many species of the troupial family is accompanied by a characteristic sound made by the passage of the wind through the primaries. This does not depend entirely on the size and weight of the bird, for the wings of some of the smaller orioles are resonant in flight. The sound made by the male Giant Cowbird as he flies is particularly loud, and of a peculiar quality suggesting that his feathers are stiff and vibrant" (op. cit.:316). It has been described for the Wagler Oropendola by Chapman (1928:133), who states that it is "evidently produced by the passage of the widely radiating, emarginate primaries through the air." So far as I could determine, there was no specific situation in which the sound was heard, although a few times it was noticed that the flight was directed toward a new female. Once it was given at the onset of a sex chase (see below) and there was some suggestion that it was directed to neighboring males. I think that it may be given in moments of high intensity, functioning to attract attention, and emphasizing the flight.

The Flapping-flight usually carries the male to a spot where he then Drops and Crawls, but often, depending on the situation, two or more rapid flights from point to point with wings constantly elevated may occur before a male stops and Crawls. As soon as the male Drops down onto or into the vegetation (e.g., bulrush or cattails), and this is usually done precipitously, he Bows, slanting his body and head downward. Since he often lands with wings Elevated (frequently most extreme at this point) he sometimes appears to be losing his balance and toppling forward. The spread and lowered tail probably acts somewhat as a brace or balance. At times he lands with wings outspread or even down. Bowing may be hurried and awkward or slow and precise and sometimes may be rapidly given more than once (up to three times). Occasionally Bowing occurs without any preliminary flight. In fact, the whole sequence of Elevating, Flapping, and Bowing may be given while perched. This happened several times when a male hurriedly displayed to a female flying rapidly overhead.

Immediately following Bowing the male begins Crawling through the vegetation, often working through dense clumps. Throughout this behavior the wings are held upright. After Crawling a few feet the male often stops, Bows again, and Crawls to a farther point. Usually he then stops displaying (remains quiet sometimes) and quietly emerges to rest on top of the vegetation at that spot or else returns to a favored perch. Although difficult to observe because of the situation, sometimes the male indulges in a further display associated with this pattern, called Symbolic nest-building in the Redwing (Nero, 1956:23–26). During Bowing the male may pick at bits of the vegetation or perform other movements suggestive of nest building; this suggests that Bowing behavior may be related to the motions of nest building. This is the usual behavior and it is probably the basis for the following reports. Wheelock (1904:510) states: "In a few rare instances I have known him to make a pretence of nest-building a few feet away from the real cradle, either to amuse himself or to deceive me, for the loosely woven affair was never regarded seriously by the female. She sometimes perched near it, regarding with amusement the masculine attempt at housekeeping, and with a scornful flirt of her tail went back to her own cosy nest." Ammann adds (1938:116) that he observed males casually pecking at a few strands attached loosely to the reeds near finished nests.

Sometimes, as in the Redwing (Nero, 1956:23), an actual nest may be used in connection with the display:

22 May 1957, 5:45 PM: One male, which is still without a female, returns to his territory and lands on an old nest, sits quietly giving Song-spread; picks at the outer shell of the nest and inspects the interior (just as on the previous day). The nest is well below the level of the cattails.

6:08 PM: He returns to the territory and again lands on the old nest; sits on the edge of the nest, singing, for several minutes.

6:40 PM: He returns to the territory with Flapping-flight, lands hard on the edge of the nest, Bows into it with wings outspread, then sits above the nest and gives Song-spread, full but with no wing movement.

6:50 PM: He returns again to the territory (having gone off somewhere as before) with a flourish—obviously excited—along with several females which have come back from feeding; the females all go elsewhere and as they fly by him, he repeatedly Bows; later, as another female flies overhead, he Bows and Crawls excitedly toward the nest.

24 May, 6:05 AM: He is on the nest! Gives Song-spread, hops on the edge of the nest, lifts tail? Hops off and down into the cattails.

The behavioral sequence of Symbolic-nesting of the Yellowhead (Elevating, Flapping, Dropping, Bowing, Crawling, and Pecking or Building) is remarkably similar to that of the Redwing. I have been able to detect only two distinct differences. "Quill-rattling," as in the Yellowhead, has not been observed in Redwings, and, on the other hand, the "growl" vocalization of the latter species, given during the Bowing phase, seems not to have a parallel in the Yellowhead. On some occasions I was almost sure I had heard a slight, harsh note given at this time by displaying Yellowheads, but more often there was no sound apparent even though I was close to performing birds. If it is given by Yellowheads it must be very soft and very slight.

(3) Elements of the sequence of behavior termed Symbolic-nesting appear to occur with varying emphasis (and related plumage patterns?) in several icterids and this suggests that it may be a basic pattern of behavior in this family. Friedmann (1929: 344) was aware of certain similarities, stating: "This type of display, i.e., ruffling the feathers and bowing or bending forward, is common to many Icteridae such as *Agelaius*, *Quiscalus*, *Xanthocephalus*, *Cassidix*, *Cassicus*, *Ostinops*, *Gymnostinops*, etc., so that there is a definite tendency in the whole family to develop this type of courting attitude." And Skutch (1954:334) pointed out that in this family "there are certain widespread

types of display which appear with modification in diverse genera." Because of a paucity of information and because of the difficulty of interpreting published material, much of it predating the period of behavioral studies, it is difficult to make a comparative study. Part of the confusion in the literature results, of course, from a tendency to lump all behavior between male and female under "courtship," and in many cases in the field one can do little else, especially when viewing birds for which the stage of the breeding cycle may be unknown. Courtship and Mating appear to be two distinct features in the Yellowhead and Redwing; one would expect a similar situation in other icterids and I have attempted to assess the literature on this basis.

First of all, one can state that there is a striking similarity between the courtship display of the Redwing and the Yellowhead, the essential difference being that the Yellowhead tends to spend more time on top of the cattails with elevated wings, so that a general impression is obtained of a great deal of Elevating and Flapping display. The Yellowhead also tends to Bow more often, at least while out in sight, than the Redwing; its displays, in short, are more conspicuous. The courtship display of the Tricolored Blackbird seems to be very similar to that of the Redwing and Yellowhead (Lack and Emlen, 1939:226), although it is given more commonly than in the Redwing (Gordon H. Orians, pers. corresp.).

There is no indication in the literature that the Common Grackle gives Symbolic-nesting as such; however, the extensive symbolic building which has been observed in this species (Peterson and Young, 1950:467; and especially Eyer, 1954:59–61), and other behavior, suggests the existence of the complete pattern. Eyer (loc. cit.) indicates that abortive building by both male and female is chiefly seen during a period of a week or so after selection of the nest site. After the female begins actual construction of the nest the male continues to follow her and "guards" her, accompanying the female on nearly every trip to get nest material, "following her with his courtship flight in its extreme form." The display flight of the Common Grackle seems to be a simple form of the Flapping-flight (in Symbolic-nesting) of the Redwing and the Yellowhead. It is also possible that the extended aerial displays of the meadowlarks and the Bobolink are similarly related.

Although at first glance the well-known display of the Brown-headed Cowbird may not appear to resemble Symbolic-nesting as described in the Yellowhead, I am convinced that it is directly related. In the cowbird, Song-spread regularly is immediately followed by Elevating and Bowing, so close as to be almost one, but the distinction still can be made: Song-spread is marked by the "bubbling, guttural notes . . . *bub ko lum* . . . after this . . . begins the display proper . . ." (Friedmann, 1929:164). Then, with fluffed plumage, the bird raises its wings, sometimes more than once, and topples forward or Bows. It is this part of the display which I relate to Symbolic-nesting. What is missing, of course, is chiefly the slow flight to a potential nest site, and this may be related to the parasitic habits of the species, that is, the male has no nest site to which to fly. The relationship of similar displays of other cowbirds, as, for example, the Shiny Cowbird, to that of the Brown-headed Cowbird, is fairly clear.

The inverted display of the Montezuma Oropendola and Green Cacique (for illustrations, see Skutch, 1954:288, and Armstrong, 1947:144) can also be related to the Elevating and Bowing of the Yellowhead in just the same way. (More so to the cowbirds, of course, since in the Brown-headed Cowbird the display occasionally carries the bird quite upside down.) Gilliard (1958:375) describes Montezuma Oropendolas as ". . . hanging completely inverted, at the same time waving their wings." It has occurred to me that if Yellowheads nested high in trees as do oropendolas, instead of in marshes, then the resemblance would be even more apparent. The Yellowhead flies slowly across the marsh, displays with Elevated-wings and some Bowing, and then drops out of sight in the nesting substrate where it gives its deepest Bowing display. On the other hand, the oropendolas nest high in trees; the more noticeable aspect of a similar sequence of behavior would certainly be the latter part, and I think that this is what has been described. Judging by the number of species which have a "noisy flight," including oropendolas, the slow flight to a potential or actual nest site may be more prevalent in the Icteridae than the present reports indicate.

Of course, as previously pointed out (Friedmann, 1929; Nero, 1956:24–26), some male icterids (Bay-winged Cowbird, *Molothrus badius*, and Shiny Cowbird) occasionally do build nests. On this basis one can expect to find a range of behavior among these birds from normal nest-building behavior by the male to ritualized patterns which have evolved from nest-building movements. Hence the term Symbolic-nesting may not apply equally well to all. It is also likely that certain elements of this sequence will have been selected out and emphasized, and others dropped, thus deleting, so to speak, portions of the pattern. Nevertheless, with this in mind, it should be possible to build a comparative scheme around this framework.

It is also clear that elements of Symbolic-nesting may function in slightly different ways in different species. The display of the Brown-headed Cowbird, judging by Laskey's observations (1950:161), appears to be directed toward other males as an intimidation gesture. This may partly explain the occurrence of displays by various male cowbirds in the absence of a female as noted by Friedmann (1929:325).

Beecher (1953:326) calls attention to the adaptive convergence of African weavers and American blackbirds, some of which have a very similar plumage (e.g., *Agelaius phoeniceus* and *Euplectes axillaris*) and nest in colonies in similar habitats. Emlen's description (1957) of the courtship behavior of several species of *Euplectes* suggests that there is a close similarity in courtship habits as well. He describes two types of courtship behavior directed toward females: a simple pouncing flight, and a perch display. Essentially, a slow flight characterized by plumage display ends by a sudden terminal drop or pounce into the grass, where a perch display is then assumed. I think that this can be equated with Symbolic-nesting as described above for the Icteridae. Skead's recent description (1959) of courtship behavior of the Red-shouldered Widowbird (*Coliuspasser axillaris*) (equals Red-shouldered Whydah, *Euplectes axillaris*) shows an even greater similarity: after a flight across the territory with feet suspended and wings in a " 'rowing' revolving action" at times, the male suddenly dives into the grass with wings extended, near a female or some distance from her, "as though inviting her to the place." Once down in the grass he evidently weaves the outline of nest frames and presumably the female is invited to make use of these. The similarity of plumage between this species and the Redwing, as pointed out above, is often mentioned as an outstanding example of convergent evolution; it is therefore of interest to note the similarity of behavior in these two birds.

Sexual-chasing.—Pursuit of the female by the mate alone or by the mate and an accompanying group of males is common in the Yellowhead and appears similar in all respects to that which has been described for the Redwing (Nero, 1956:26). A pair is nearly always the basis for a chase, which appears to be chiefly agonistic behavior arising out of the courtship situation. (Ammann, 1938:102–103, states that males attempted to copulate at the close of sex chases but this was not supported by my observations.) Chasing was observed practically throughout the period of observation. Frequently, chases arose through activities of the female which brought her into prominence, for example, flights carrying nest material, quarrels with other females, sudden return of the female to the territory, etc., but often chases seemed to be suddenly initiated by the male. Chases ended abruptly as the male withdrew or captured the female. In six cases (out of 26 recorded chases) the male caught the female and held onto her rump feathers (once in midair); each time both birds ended up in the water. Most chases were limited to the territory but occasionally went outside it. Group chases, involving two or more males, occurred nearly as often as single chases. Paired birds were involved in most episodes, but a few times strange intruding males or wandering females initiated chasing. Aggressive behavior seemed to predominate in the male during chasing and occasionally a vocalization was given which also seemed aggressive—once the "hawk call" and rapid song, and once a call resembling female alarm. Twice females were recorded calling—once a harsh call (similar to the aggressive screech given to other females) and once definite scolding notes. Aggressive behavior by the male to his female is frequently seen and does not always lead to chasing but is probably a part of the pattern. Males rather constantly strike at their mates or show signs of aggression when the females quarrel or even merely sing to other females, especially new ones (on the territory) which the male may be courting. Again, this is quite similar to that which has been reported for the Redwing. (In 1958, a female Redwing was frequently attacked, when she sang or scolded, by a Yellowhead male from an adjacent territory.) The following field notes illustrate Sexual-chasing and some of this aggressive behavior:

12 May 1957, 6:45 AM: A male suddenly chases his female, she gives a nasal *hah-hah* like the aggressive screech to other females, and they fly rapidly around the territory three times, and then stop suddenly.

24 May 1957, 7:15 AM: Female B returns to the territory from a long distance flying about 5 feet above the cattails and carrying a long piece of grass; Male B at once withdraws from an encounter with another male out on the edge of the territory to drive at her—he chases her out of the cattails and into the air with noisy wings, he then suddenly leaves her.

8 May 1958, AM: Female attacks a dummy female, her mate chases her into an adjacent territory, and then the owner of that territory comes flying over with flapping wings (displaying to the female?), which leads to a group chase involving four males; it finally breaks up on the first territory.

9 May 1958, 6:50 AM: A male Bows and Elevates to newly landed female, and then strikes at his first female, which repeatedly drives at the new female. The male is quick to strike at his mate when she moves toward the new bird. He Bows deeply; the new female stays hidden in the cattails.

9 May 1958, 6:55 AM: A male seizes his female after a short chase, they end up partly

in the water—he holds her by her back feathers while she flounders and gives alarm screech—he suddenly lets her go.

19 May 1958, AM: A male drives at his mate with a harsh call when she lands (too) close to a new female.

Precopulation and copulation.—I observed copulation six times on the following dates in 1957: 24 May (7:45 AM), 29 May (6:05 and 6:15 AM); and in 1958: 9 May (7:07 AM), 19 May (5:00–5:30 PM—two). Attempted copulation or precopulatory behavior was recorded on 28 other occasions. Precopulatory behavior and attempted copulation in response to a dummy female was observed and filmed on 3 June 1958; the behavior in this situation appeared to be similar in nearly all respects to that which was earlier observed under normal conditions.

Precopulatory behavior of the female Yellowhead is generally indicated by a posture similar to that of the Redwing and other icterids: the tail is raised, the bird crouches on its tarsi with breast lowered to the ground, the head withdrawn with bill pointing upward, the wings held out and shivered (a combination of movement of the primaries being rapidly spread and closed while the whole wing is raised or lowered), and there is a vocalization (with open bill). At high intensity the tail is held nearly vertical, the rump is higher than the head, the precopulation call is constant, and wing shivering is rapid. Various degrees of display indicate increasing and variable intensity; no vocalization, short sporadic displays, display without movement, momentary wing shivering, etc. As in the Red-winged Blackbird, in initial precopulatory behavior, or very early stages, occasional slow, hovering flights occur (with rapidly beating wings held mainly below body level), sometimes while carrying nest material. On one occasion when a female was in precopulatory slow flight a low, continuous "whirring" sound was heard which was evidently produced by the wings. Once (19 May 1958) a female flew a short distance while giving the precopulatory display (tail and head up). The female had been in precopulatory behavior on the cattails; her mate approached aggressively and she then flew off away from him in the same pose —a very unusual appearance. This has also been recorded in the Redwing (Nero, 1956:32). Tail-raising and Wing-quivering are sometimes given alone.

There is a peculiar relationship between female precopulation and an apparent appeasement display (see Tail-lifting). Frequently, the female lifts her tail as the male approaches her in aggressive display or movement, and her behavior seems to deter him. In one instance a female was seen to raise and then lower her tail (no other display) as her mate suddenly flew past and behind her. Except for the appearance of this same behavior between aggressive females it might have been overlooked and considered to be low-intensity precopulatory display brought about by the aggressive approach of the male. On the other hand, what appears to be low-intensity female precopulation often draws an aggressive response from the mate, and occasionally a subsequent aggressive reply from the female. For example:

> 19 May 1958, 4:15 PM: Female in precopulation, her mate drives at her aggressively and forces her into the water, both come up wet. A moment later she returns to the territory; as soon as she lands she gives signs of precopulatory display; approached by her mate, she is in precopulation; he comes in aggressively and she turns to bite at him. She goes to build on the nest—he sits off to one side.

Similarly, a female in precopulation may suddenly stop giving this display at the approach of the male. An even more complete response by the male may be met with aggression from the female:

> 20 May 1958, 8:21 AM: Female returns to her territory giving an excited call, her mate at once goes into slight Elevated-wings and Crawl, then, by a rapid, hopping movement approaches the female who is sitting up high on the cattails in precopulatory display; the male moves about her then he reaches toward her (with neck extended) at which she pecks at him, and so it ends.
>
> 27 May 1958, 6:45 AM: Female with tail up, head back, wings out (precopulation) but sitting still: male approaches her, droops his wings somewhat, gives a song, Hops about female, moves toward her posterior and she faces about to peck at him, he jumps back and it ends.
>
> 7:30 AM: Female in precopulation, male flies to her, and she drops the pose, then, as he approaches aggressively, she raises her tail and runs off; as he nears her she pecks at him, and he leaves.
>
> 8:01 AM: Female in precopulation, male approaches and female turns to peck at him.

I presume that this situation is one of lack of synchronization or lack of readiness to copulate by one or both. In the Chaffinch: "As the season proceeds the female, although constantly aggressive towards female rivals, becomes more so towards the male, with a sudden increase in intensity at the start of nest building. . . . This continues right up to the onset of copulation, though once the female solicits fully, attacks on the male usually become uncommon . . ." (Marler, 1956:116). Unreceptive female meadowlarks "assumed a semi-crouch position, with feathers held tight against the body and bill gaped and pointed directly at the advancing male. From the latter posture, the female could further repulse her mate with pecking gestures" (Lanyon, 1957:39).

Female precopulation (low and high intensity) also brings about other responses from the male (aside from full male precopulation, below) which presumably indicate a low response in the male, namely, Symbolic-nesting or parts of it (Elevating, Bowing, Flapping, Dropping, Crawling). Occasionally males responded with Flapping-flight and "quill-rattling," and extreme Song-spread. Sometimes female precopulation was even apparently ignored by the mate.

Male precopulatory behavior usually originates in response to precopulation of the female. Since usually the male is some distance from the female when she begins to display he must first approach her. In doing this the male typically flaps heavily to the ground (or lower level of the marsh vegetation) or across the cattails closer to the female. Then, with wings only partly out or raised, with head hunched and bill down, tail spread and down, back feathers erected or often lifted (very similar to Crouch-bristling), he runs rapidly (if in the open) or climbs awkwardly over objects in his path to approach the female. Occasionally male behavior appears to be elicited by remote stimuli as indicated by the following note:

29 May 1957, 6:30 AM: Male flies slowly from his territory to an open field nearby. He lands and then at once raises one wing high and with head down runs rapidly along on the ground in the direction away from the territory for about 60 feet—a startling performance since no females are apparent. A few minutes later a male (same?) flies slowly toward some females feeding on the ground far away from the slough—when about 50 feet from them, he raises both wings high overhead and Drops straight down, landing like a butterfly with both wings still held stiffly upright—then, with head down, he moves along the ground with one wing upright and the other out sideways as if for balance. This looked like incomplete precopulatory behavior.

Wetmore (1920:403) stated: "Or they clambered stiffly along, hobbling over masses of bent-over rushes, with heads bent down, tails drooping and back humped, appearing like veritable clowns." When approaching a female perched upon the cattails, there is, of course, more use of the wings, though they are never spread out in display as in the Redwing. Song-spread may be given occasionally during the approach. This is considered the "first phase" of precopulatory behavior (Fig. 4). In the Redwing this leads directly to mounting (Nero, 1956:32–33). The Yellowhead sometimes mounts directly following this behavior, but usually some part of the following behavior, here called "second phase" precopulatory behavior, occurs (Fig. 4). The male, when within several feet of the female, may rapidly hop up and down on flexed tarsi, alternately springing away and back again, and around or toward her in a hunched or upright posture, pause briefly at her side to scratch at her back with one foot, move around to her posterior, then, with flapping wings raised high, quickly mount. Finally, in copulation, the wings are flapped vigorously, the tail is thrust down and the neck is stretched up but with the bill pointed down (Fig. 5). Copulation usually occurs several times in succession, the male dismounting, hopping away (sometimes in front of her) and circling back and remounting, up to a dozen times or more and usually not less than three or four times. In one case a male mounted a female eight times or more in less than half a minute. Specific notes on precopulation and copulation sequences follow:

20 May 1958, 7:47 AM: A male flaps heavily to ground near a female, approaches her with a very rapid run, hunched, wings not spread—near the female (which is in pre-copulation pose) the male frenziedly jumps up and down and around in a circle (not around her). Once he spread out his wings (Song-spread?) while standing near the female. He leaves. Female had been in precopulatory pose throughout.

24 May 1957, 7:50 AM: Suddenly see male and female in action in field near marsh—female in full precopulation—male approaches her bristling, with bill down and sidling (looks just like behavior given earlier this morning to an intruder male). He reaches out one foot and claws at the back of the female, mounts partly, then off, back around to the rear of the female as she goes from an aggressive posture with open bill to full precopulatory display. It ends incomplete.

27 May 1958, 7:20 PM: Female in precopulatory pose but standing up high—male comes toward her, crouching and with wings partly out and dragging, when close he holds his head higher with the yellow feathers all erect and hops about in front of the female, then at her side—it just ends when the female suddenly drops her pose.

29 May 1957, 6:05 AM: Female on ground in precopulation, male feeding about 20 feet away—no apparent sound from the female but the male suddenly walked over, bristling, by her—as he neared her he clawed at her back with one foot, then mounted and copulated, thrusting his tail down against her body—he jumped off on the left side, circled to his left and back to remount again, all very rapidly, and remounted at least eight times.

Observations of an incomplete sequence recorded on film suggest that clawing of the back of the female by the male is related to conflict of escape and copulation tendencies. The male's quick retreat at her first movement is indicative of his escape tendency which is presumably related to her aggressive behavior at this stage, as has already been noted. No doubt, the escape tendency is stronger in the male until the full precopulatory posture and behavior is assumed by the female. In the Brewer's Blackbird "copulation does not ensue unless at the male's close approach she stops the wing action and stands rigid" (Williams, 1952:6).

Movies made of precopulatory response by a male to a female dummy afforded additional details of this behavior which appeared to be similar to behavior under normal conditions. In one sequence, in the curious Hopping, the male crouches deep on his tarsi with breast feathers touching the ground, back feathers erected, and bill down. From this position he suddenly springs upward, turns sideways in the air and lands several inches away on his tarsi again, drops his throat to the ground, then springs sideways, thrusting up from the "prone" position to come down in the same manner; when he lands two hops from the dummy, he has his head up and proceeds to hop in the upright posture toward the dummy, the yellow plumage of the head and throat strongly erected (Fig. 4, upper middle). With one more upright hop he is at the side of the dummy, standing at full height and reaching out one foot to scratch at the back of the dummy (Fig. 4). Occasionally he walks about between "bounces." At a distance he hops in the crouched or prone position but as he gets closer he gradually gets more upright, finally standing fully upright at the side of the dummy.

The peculiar hopping by which the Yellowhead male sometimes approaches the female in precopulatory display has no obvious parallel in the Red-winged Blackbird, but something similar has been noted in several other icterids. Hudson writes (*in* Friedmann, 1929:40) for the Screaming Cowbird: "'. . . with tail and wings spread and depressed, the whole plumage raised like that of a strutting turkey-cock, whilst the bird hops briskly up and down on its perch as if dancing.'" Friedmann (op. cit.:41) notes that this species "hops up and down on its perch . . . the male kept getting closer to the female with each jump. . . ." An even likelier description is given for the Shiny Cowbird although it was considered an unusual variation: "A male was chasing a female and the latter flew on to a fence post. The male then lit on the fence wire about three feet from the post, fluffed out all his body and head feathers, bent his tail forward and under, and arched his wings to nearly a horizontal position. Then he bent forward very slightly and suddenly jumped up into the air and lit on the same wire about ten inches nearer the female than before. No sooner had he touched the wire than he bounced up again, coming down just about a foot nearer the female. Again he bounced up and landed very close to her when she flew off and he followed. During the entire performance he maintained the same position that he assumed before the first bounce" (Friedmann, op. cit.:70).

Similarly, Chapman (*in* Friedmann, op. cit.:323) observed for the Red-eyed Cowbird "'. . . occasionally one would rush up to another with a series of bouncing hops. . . .'" And Friedmann (1925:549), describing behavior of a male of this species to a female stated: ". . . bent his head so that his bill was touching the feathers of his breast for its full extent. Then he suddenly bounced up and down four times, each bounce taking him about an inch from the ground. . . . In its habit of bouncing up and down it resembles two Argentine species (*Molothrus bonariensis* and *Molothrus brevirostris*) more than it does *M. ater*." Skutch (*in* Bent, 1958:459) also notes this behavior in the Red-eyed Cowbird. Skutch (1954:318) uses nearly the same words to describe the behavior of a Giant Cowbird.

It is difficult to tell if there is any similarity, but Bendire (*in* Bent, 1958:221) says of the Hooded Oriole (*Icterus cucullatus*): "'. . . a male in second-year plumage was observed hopping round and round his mate in a tree. . . .'" An observation by Tyler (1923) of behavior of a Baltimore Oriole may also be related.

Hopping may arise primarily when the sexually aroused male is thwarted by an unreceptive female. Skutch (op. cit.:320) has indicated that the female Giant Cowbird is usually indifferent, or hostile, to this display by the male. Also, considerable variation in the extent of this display has been noted in the Red-eyed Cowbird by Friedmann (1929:324). This is also true of the Yellow-headed Blackbird; in this species Hopping occurs typically in incomplete sequences of mating, rather than when copulation actually ensues; in five observations of sequences leading to completed copulation, Hopping was seen only once; it was seen on five other occasions, however, in incomplete sequences. And it occurred repeatedly when a male was responding to a female dummy. On one occasion it occurred and at great length even though the female appeared to be completely receptive. The origin of the Hopping display may be explained as a conflict between the sexual tendency and the escape tendency. The "wary" scratching of the female by the male prior to mounting, and the quick retreats in the face of the female's aggression would seem to substantiate this belief. It is of interest to note that copulation in the Yellowhead usually involves several successive mountings, whereas in the Redwing, where this display has not been observed (even though copulation was elicited in numerous experiments with dummies), copulation is invariably attained by one or two mountings. The upright posture with arched neck, etc., when close to the female has been described for other species. Lanyon (1957:39) says of the meadowlarks: "The male began this behavior with the basic expansion posture but the crown feathers were more obviously erect. He strutted about in the vicinity of the female, holding his body more erect than during territorial encounters, with the bill pointed downward toward the expanded chest. This 'strutting' which was confined within a radius of a few feet from the female, constituted the mating approach of the male." Skutch (1954:318), reporting on the behavior of the Giant Cowbird, states: "Approaching a female, he would plant himself squarely in front of her and draw himself up until he towered above her and seemed to be thrice her height. Arching his neck, he depressed his head until his bill rested among the out-puffed plumage of his breast, and he erected the feathers of his cape until they surrounded his head as an iridescent black ruff, in the midst of which his red eyes brightly gleamed."

Scratching of the back of the female by the male in mating behavior has been reported for at least one other icterid, the Western Meadowlark. According to Lanyon (1957:40) a male approached its mate, "pawed her back momentarily with vigorous scratching motions of his feet and then mounted." Also, Robert W. Ficken has taken movies which show this behavior in the Common Grackle.

The "first phase" of Yellowhead precopulatory behavior (i.e., running toward the female in Crouch-bristling) is apparently analogous to the " 'crouching lopsided' posture" of the Chaffinch, and "second phase" (Hopping back and forth in crouched posture, then upright posture, etc.), analogous to the " 'upright lopsided' posture" (Marler, 1956:104–107). According to Marler, in the former display both escape and aggressive tendencies appear to be active while a copulatory tendency is not yet in evidence; the latter display shows an increase in copulatory and escape components. Note the similarity between the hopping "dance" of the Yellowhead (in "second phase") and the " 'precopulatory dance' " of the Chaffinch (op. cit.:120). Several members of the genus *Coliuspasser* bob or pump the whole body up and down in precopulation apparently in a similar manner (Emlen, 1957).

Summary of precopulatory and copulatory behavior and comparison with other icterids.—Precopulatory behavior of the Yellowhead in its "first phase" consists of a hunched and crouched posture with wings held out to some extent, tail broadly spread and down, and fluffed or erect plumage. Parts of the plumage may be more erect than the rest. On the whole, the "first phase" of mating behavior appears to be strongly related to agonistic displays (Song-spread, and Crouch-bristling, e.g.) combining the spread tail and open wings and crouch of these with a slow and "wary" approach to the female. Attack and escape tendencies appear to be in conflict. "First phase" precopulation display of the Redwing male is very similar to Redwing Song-spread display; "first phase" precopulatory display of the Yellowhead closely resembles Crouch-bristling. In the Brewer's Blackbird Song-spread (called "Ruff-out") and the "male precoitional" displays merged imperceptibly when males responded to dummies and the two could not be distinguished (Howell and Bartholomew, 1952:140–141). Components of "first phase" precopulatory behavior may also be recognized in the Bobolink, Tricolored Blackbird, Common Grackle, Boat-tailed and Great-tailed Grackles, and several cowbirds (see Bent, 1958; Friedmann, 1929; Selander and Giller, 1961:60). Frequently this "first phase" leads directly to copulation; this is the invariable pattern in the Redwing. In the Yellowhead, and apparently other icterids (above), however, a "second phase" is common, in which as the male nears the female he assumes an upright posture with head erect and bill depressed while squatting on lowered tarsi. He frequently Hops ("jumps," "bounces") closer to the female, while maintaining this posture, springing up from the ground and coming down again on lowered tarsi. Even in the Yellowhead, where this display is common, it is sometimes omitted or appears only briefly. This posture is apparently related to the act of copulation which it resembles in some details except that the wings are usually closed. Escape and sexual tendencies appear to conflict in this situation. The recording of this behavior for the several cowbirds and the Yellowhead suggests a common bond between these species. The apparent absence of this behavior in the Red-winged Blackbird suggests that the Yellowhead is more closely related to the cowbirds than to the Redwing, though according to Beecher (1951), *Agelaius* has stemmed from *Molothrus*, and *Xanthocephalus* from *Agelaius*. The concealed red-pigmented head and breast of *Agelaius phoeniceus*, and evidently *A. tricolor* (Nero, 1954:151–152), may indicate in addition that these species are not as closely related to the ancestral cowbird as has been supposed (Beecher, 1950:57).

Female Wing-flipping.—Female Wing-flipping as reported for the Redwing (Nero, 1956:13–16) is associated with postnesting behavior, but it is included here because of its intersexual nature. Although Wing-flipping has not been observed in the Yellowhead, one observation suggests its possible occurrence. On 3 June 1958, a female which had young in the nest and which was disturbed at my presence, became more and more "loose-winged," i.e., held her wings out from the body slightly and hanging loosely, as she became more anxious and as she moved closer to her mate.

SUMMARY

Yellow-headed Blackbirds were studied in May and June (1957, 1958) at the height of the breeding season on small marshes near Regina, Saskatchewan. Emphasis was placed on agonistic, courtship, and mating displays, and related behavior. Motion and still pictures were taken in conjunction with dummy birds used to elicit a variety of displays, though in nearly all cases these observations were supported by records of behavior in normal circumstances.

Agonistic displays of several types were recorded. Song-spread—the typical combination of plumage display and song—was given by both sexes, being directed mainly to members of the same sex. Flight Bill-tilting replaced typical icterine Bill-tilting as a common threat display given especially by males in territorial disputes. It was also found to occur commonly in the Brown-headed Cowbird, evidently occurs in the Eastern Meadowlark, but is rare in the Red-winged Blackbird. Nodding, a sudden lowering of the head with bill downward, was a male display commonly seen during aggressive encounters. It appeared to be related to submissive or appeasement display of the nape as seen in other birds. Crouch-bristling describes an aggressive "head-forward" type of display seen in both sexes; displays given by males in courtship situations appeared identical. This display is apparently similar to a courtship display of the male Redwing.

Tail-lifting appeared primarily as an appeasement display of the male in agonistic and conflict situations; it showed some resemblance to female soliciting behavior. Similar display was given by females to females, and on some occasions to males.

Courtship behavior consisted mainly of a sequence of behavior, or aspects of this, called Symbolic-nesting in which the male displayed his wings, flew away from the mate or a new female in slow, awkward flight, suddenly dropped down into the nesting substrate, and then crawled along, still with elevated wings, and then went through motions suggestive of nest building. The female tended to follow the male closely. This was similar to that which has been reported for the Redwing; portions of the sequence have been reported for a number of other icterids and it is suggested that this is a basic pattern in this family. Sexual chasing occurred during the courtship period and was also similar to that which has been reported for the Redwing.

Mating behavior of the female appeared much like that described for the Redwing. Male response consisted of a posture similar to aggressive Crouch-bristling. Copulation ordinarily included several rapidly successive mountings. The peculiar Hopping behavior, etc., has been found in a number of icterids, especially *Molothrus*, *Tangavius*, and *Scaphidura*, though not in the Red-winged Blackbird. This suggests that the Yellowhead is possibly more closely related to the cowbrids than to the Redwing, or, at least, that this behavior is primitive.

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THE MOCKINGBIRD'S "TAIL-UP" DISPLAY TO MAMMALS NEAR THE NEST

Jack P. Hailman

The reaction of adult Mockingbirds (*Mimus polyglottos*) to mammals during the breeding season has been mentioned by several field observers (e.g., Michener and Michener, 1935; Laskey, 1935), but apparently never described in detail. This paper presents various observations on the Mockingbird's predator-display during the nesting season of 1958. The observations are principally of a single pair of Mockingbirds which successfully raised two broods; a few observations could have included neighboring birds.

Mockingbirds displayed to four species of mammals: dogs (*Canis familiaris*), a cat (*Felis domestica*), a human (*Homo sapiens*), and a Gray Squirrel (*Sciurus carolinensis*). The specific behavior pattern discussed here is termed the "Tail-up display."

OBSERVATIONS

Displays to dogs and general description.—The display and attacks of Mockingbirds were directed at dogs more commonly than to any other mammal; more than a dozen reactions were noted. Moving dogs of a variety of sizes and colors were the object of display and/or attack; a few times Mockingbirds postured at sitting or lying dogs, but never did they dive at them. The display of the Mockingbird toward this "potential predator" consists of highly stereotyped posturing and a special call, usually given only in the vicinity of the nest or young.

The displaying bird orients itself facing the dog and cocks its tail vertically, spreading it slightly so that the white of the outer tail feathers lines the edges of the tail. The body is held nearly horizontally, with the head directed at the dog. The bird utters a loud, sharp *klok*, and simultaneously fans the tail to its fullest extent, suddenly flashing the white outer tail feathers; the species' common rasping *zzzzz* call often follows. The display is "successful," in that the dog displayed to usually leaves the area; however, no dog showed particular interest in the Mockingbirds, and it is difficult to judge exactly how much effect the display has in causing the dogs to depart from the nest area.

In several cases, dogs did approach the nest, and this provoked the birds to attack, even though the dogs showed no overt hostility toward them. In these cases, the Mockingbird usually dived from the rear and slightly to the side of the moving dog and displayed its tail and wings quite prominently in the swoop. Several birds observed swooped to one side of the dog and then the other alternately for as many as eight passes without a break. Occasionally a diving Mockingbird actually struck a dog with its claws. The dogs nearly always tried to avoid attacks and two small dogs fled from a diving bird.

Other dogs reacted by lowering their heads and tucking their tails between or beside their hind legs.

Displays to a cat.—There was but one cat in the neighborhood of the Mockingbird's nest, and all observations described concern this animal. The Mockingbird's displays to the cat were stereotyped and identical to those given to the dogs. The only difference noted was that the mere presence of the cat, whether near the nest or not, always provoked intense calling and posturing from the pair of Mockingbirds which nested in our yard. Even if the cat were sitting quietly in the grass as far as 50 feet from the nest, the Mockingbirds often displayed to and dived at the animal. Judging by the intensity and frequency of display, the cat was certainly a stronger "releasing" stimulus-object than were the dogs observed.

Displays to a human.—The Mockingbird infrequently displays toward human beings, but will not do so if the nest is approached or examined. However, on the day I banded the nestlings, I was discovered at the nest by one of the parents. The same stereotyped Tail-up display given to the dog and cat was also directed toward me. Both parents postured from a telephone wire and a nearby fence, but neither dived at me and neither approached closer than 4 feet. One variation in the display was noted, however. During two very intense displays, when one individual was about 5 feet from my face, the wings were seen to be spread slightly and then closed again to the body. The white patches in the wings were not visible, and the motion appeared to be incipient.

Displays to a Gray Squirrel.—The Mockingbird's reaction to a Gray Squirrel was observed once, in late afternoon on 14 August, about three weeks after the fledging of the second brood.

My attention was attracted to a black locust tree in the yard by the loud *klok*'s and *zzzzzz* calls of several Mockingbirds. A Gray Squirrel was clinging to the tree trunk about 12 feet from the ground. Above the squirrel, five Mockingbirds were calling and displaying, while below, our dog was standing at the foot of the tree looking up. Only two of the Mockingbirds were plainly visible from where I stood, and both were giving the Tail-up display in full intensity. Whenever the squirrel moved slightly, one of the birds dived with ruffled wings and returned to its perch to display. When the squirrel tried to descend, the dog jumped at it and began barking. Two Mockingbirds continued to display at the trapped squirrel (and perhaps the dog), and I noticed that the other three birds were the fledged young. The two birds doing most of the displaying, presumably the parents, gaped at the squirrel several times, and one may have been snapping its bill. The bird closest to the squirrel opened its wings slightly, in a manner similar to that of the bird which had displayed to me.

The reactions of the young birds were also interesting. These birds, probably the second brood raised in the yard, were about three weeks out of the nest and still in the "dependency period" (that is, although they had left the nest, they still depended upon one or both parents for food and/or protection). The young birds also gave the Tail-up display, but their behavior differed somewhat from that of the adults. The young birds did not utter the *zzzzzz* call, and only occasionally gave the sharp *klok* which sounded similar to that of the adults. The display did not appear intense, and was definitely not oriented toward the squirrel. In fact, the Tail-up display of the young seemed totally without direction or relevance.

The squirrel pressed itself closely against the tree trunk, with its tail out straight behind and ears held normally. It made no sound. Finally, the dog gave up waiting and trotted away, and the squirrel began to descend the tree again. As soon as it moved, one of the adult Mockingbirds dived at it, and continued diving until the squirrel had reached the ground. The other adult dived once or twice while the squirrel was descending, but returned to the tree. When the squirrel reached the ground, it bounded off with the most pugnacious Mockingbird in pursuit. This bird continued to dive at the squirrel until the latter had climbed a tree on the other side of the yard.

DISCUSSION

In the displays described above four elements were noted: (1) a sharp "predator call," often followed by a rasping call; (2) the raised and suddenly fanned tail; (3) gaping and bill-snapping; and (4) flicks of the wings. The first two elements are the only ones invariably characteristic of the display. The third may be given in extremely aggressive situations involving no formal display (e.g., Hailman, 1960*a*). Wing-flicks, particularly as representing incipient flight ("flight intention") may occur in any display bout in which the bird would be likely to move about (e.g., Hailman, 1960*b*:467). However, the wing-flicks might also have represented incipient wing movements of a "higher intensity" display (see below).

Predator-recognition.—It seems likely from the results of several investigations (see review in Thorpe, 1956:62 ff., 121 ff., 300 ff.) that the extent to which birds innately "recognize" predators (i.e., respond to with an appropriate behavior pattern such as mobbing, bunching, alarm calls, or predator-displays) varies among species. The observations reported here suggest that recognition by the Mockingbird of the Gray Squirrel as a predator "is probably handed on from generation to generation, not so much by the experience of the dire results of attack but by the alarm displayed by the parent birds or by members of other species when they see one of these enemies" (Thorpe, 1956:121). This process, by which learned traditions may be transmitted, is a typical example of "secondary conditioning," one of several kinds of social learning separated by Klopfer (1959).

Relation of the Tail-up display to "Wing-flashing."—Selander and Hunter (1960) described displays given by Mockingbirds in response to stuffed owls. Two primary display elements are evident from their photographs: raised and spread tail, and opened wings. This display was termed "Wing-flashing" because of its resemblance to wing movements commonly observed in foraging Mockingbirds (Hailman, 1960*c*).

Possibly similar wing movements were also observed by Hicks (1955), who did not mention the tail position of a Mockingbird confronting a snake. In displays to the observer and the squirrel above, Mockingbirds flicked their wings in what may have represented incipient wing movements. However, because the wing movements and the Tail-up movements are separate elements of display in hand-reared birds (Hailman, MS), it seems desirable to avoid a unit description and name for the combined elements. An ontogenetic study of these two elements and their combinations in inter- and intraspecific agonistic displays is thus called for by the present evidence.

SUMMARY

Mockingbirds displayed to four mammalian species when the latter were near the nest: dog, cat, human, and squirrel. The Mockingbird faces the potential predator, cocks its tail vertically, utters a loud, sharp *klok* while suddenly fanning the tail, and usually concludes with a rasping vocalization. Sometimes the displaying bird also snaps its bill and gapes at the intruder, and occasionally it flicks its wings slightly.

Recently fledged young birds also displayed in this manner, but did not direct the response toward the predator. Calling and posturing of the adults present, rather than presence or movement of the predator, appear to elicit the response of the young birds.

The relation of this Tail-up display to the Wing-waving display given to avian and reptilian predators is discussed.

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REGULATION OF NESTING TIME AND DISTRIBUTION IN THE HOUSE WREN

S. Charles Kendeigh

At the Baldwin Bird Research Laboratory, near Cleveland, Ohio, where this study was carried on between 1921 and 1938, House Wrens (*Troglodytes aedon baldwini*) commonly begin their first clutches in the latter half of May, and individuals that nest a second time lay their second clutches in late June or early July. Considerable variation, however, occurs. The first clutch of the year was started on 7 May in 1921 but not until 4 June in 1926. What regulates the time of nesting in a species and why it varies from year to year are interesting questions and may give information on what controls the breeding distribution of the species. Doubtless a number of internal physiological and external environmental factors are involved (Wagner, 1960; Marshall, 1961). The present study, supported by a grant from the National Science Foundation, attempts to analyze some aspects of the problem.

That most birds in high latitudes nest in the spring or early summer, rather than in the autumn or winter, depends in large part on the stimulating effect of increasing photoperiods for the development of the gonads. The House Wren winters principally in the Gulf states and hence is subjected to increasing photoperiods after the winter solstice in late December. Although no study has been made of the gonad cycle in this species throughout the year, there is reason to believe that the gonads are in full functional condition at the time of the birds' arrival on their nesting territories in the northern states and southern Canada.

The median date for activity of the *first* males at nest boxes in northern Ohio is 1 May, of females, 11 May. The median date for *all* males to begin nesting activities is 11 May, for females, 20 May (Kendeigh, 1941*a*). Late arriving birds may, however, continue to establish nesting activities throughout June and the first half of July. Differences in beginning of nesting activities any year must obviously depend, in part, on the time of the birds' arrival.

For species in desert regions, the coming of rains may initiate nesting activities. In arctic regions, areas free from snow may be required by ground-nesting species. Differences between localities and from one year to another in time of nesting activities often agree with first availability of food. None of these factors appears to be critical for the House Wren.

Temperature, however, may be important. In her work with the Song Sparrow (*Melospiza melodia*), Nice (1937) indicated that first eggs in early April were laid five days after three days averaging 18.2 C, and general laying began five days after three days averaging 22.9 C. If egg laying was delayed,

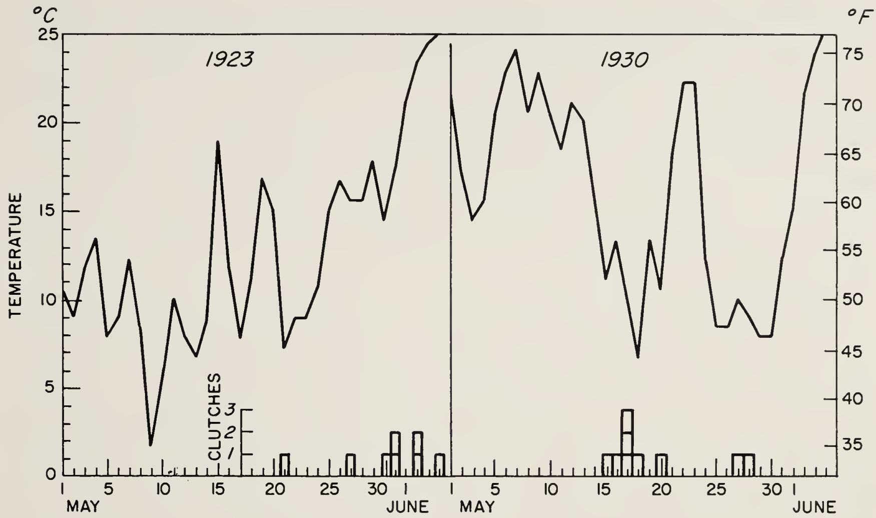

FIG. 1. Dates on which clutches were started and mean daily temperatures during May and early June 1923 and 1930.

the temperature threshold decreased 0.87 C per day thereafter for two weeks.

Pied Flycatchers (*Muscicapa hypoleuca*) do not begin laying until mean daily temperatures exceed 10 C, and a later drop in temperature to 6 C may interrupt the beginning of new clutches in the species (Curio, 1959). That temperature also affects the initiation of egg laying in the House Wren is evident in comparing the two years, 1923 and 1930 (Fig. 1).

It has been suggested that the onset of egg laying is induced by the accumulation of heat since the beginning of spring. Kluijver (1952) summed the daily mean temperatures above 0 C each year, 1912 to 1951, for the period from 16 March, when nest-building activities began in the Great Tit (*Parus major*), to 20 April, the mean "determinant" date for egg laying, and found a high inverse correlation with the onset of egg laying. Laying did not always start, however, as soon as a fixed "warmth–sum" was reached. Cold weather, prevalent at the time, would delay laying, and other factors, such as relative humidity, appeared to exert an influence. The accumulation of heat may have been more important in developing the birds' food of moth caterpillars, upon which they depend almost entirely for feeding their young, than because of any direct effect of the heat upon the gonads (Kluijver, personal communication; Lack, 1956). It is not practical to correlate the accumulation of heat during the spring which the House Wren experiences with the onset of laying, as the location of individual birds in their wintering range and at various times during their migration northward is unknown. The effect of temperature on the initiation of egg laying, however, may be more direct.

The egg is mostly formed a few days before it is laid. The yolk material is deposited around the oocyte while it is still in the ovary, then ovulation occurs as the oocyte bursts out of the ovarian follicle and enters the oviduct. Albumen, shell membranes, and the hard shell are added as the egg moves down the oviduct. The passage down the oviduct in the domestic fowl, and presumably also in other birds, involves approximately the last 24 hours before the egg is laid.

Riddle (1916) showed for the Domestic Fowl that the rate of growth of the oocyte in the ovary is very slow until five to eight days before ovulation, but then it increases nearly 26 times; the transition from one rate to the other occurring in a single day. Romanoff (1943) verified this sudden outburst of growth not only for the fowl but also for the pheasant, quail, and duck, with the change in rate beginning in all species five or six days before ovulation. These are all nidifugous species.

In the nidicolous Starling (*Sturnus vulgaris*), Bissonnette and Zujko (1936) showed that the increase in diameter of ovarian follicles was slow until late March, then increased 32 times in rate, being most rapid during the five days before ovulation. In the Jackdaw (*Corvus monedula*), rapid enlargement begins four days before ovulation (Stieve, 1919). During the four and one-half days before ovulation in the pigeon (Riddle, 1927), coincident with the onset of rapid growth of the oocyte, the oviduct increases in weight by 1,000 per cent, the suprarenals hypertrophy, blood sugar is raised 20 per cent, blood calcium by 100 per cent, blood fat by 35 per cent, and blood phosphorus by 50 per cent. Blood phosphorus reaches its peak three days before ovulation; blood fat, blood calcium, and sugar two days before; the suprarenal size at the time of ovulation; and the oviduct a day after ovulation as the egg passes through it and is laid. Any factor that affects the energy resources of a bird, such as temperature, would conceivably be of vital importance on the deposition of yolk and these other changes and, consequently, on the time of laying.

As far as I am aware, little or nothing is known as to what determines the time for the sudden increase in growth of the oocyte in the ovary four to five days before it is ovulated and five to six days before it is laid as an egg. Since the changes involved affect not only the oocyte but the accessory sex organs and the blood chemistry as well, they are probably under hormonal control. Copulation with the male appears not to be the releasing stimulus in the domestic fowl that continues to lay eggs almost daily without cocks present. However, it may be important in wild species. Copulation, in the House Wren, although seldom observed, was believed to occur immediately after the female chose her nest box and a male. Nest building by the female generally begins on the same day, and the first egg is laid three to five days later.

In his study of the Swift (*Apus apus*), Lack (1956) believed that the first egg of clutches was laid five days after an improvement in the weather, as did Nice (1937) for the Song Sparrow. In the Great Tit, Kluijver (1951) places the "determinant date" for the laying of the first egg four days previous (i.e., three days before ovulation). In an earlier study with the House Wren (Kendeigh, 1941*b*), a correlation was obtained between the average temperature during the three days before the egg was laid and its weight. Likewise, a correlation was found between the mean temperature 24 hours before time of ovulation (i.e., the second day before laying) and the size of the clutch.

Kluijver (1951) assumes that four days is the time required for the rapid deposition of yolk and other changes, since this was the usual interval observed between a significant temperature change and the laying of the first egg of a clutch. Once this yolk deposition was started, the first egg was invariably laid, and an additional egg was laid each day until the clutch was completed, regardless of intervening unfavorable weather. This is not the case in all species, however. Kluijver states that egg laying in the Blue Tit (*Parus caeruleus*) is often interrupted by a fall in temperature. In the Swift, the interval between eggs is longer in bad weather (Lack, 1956). Missed days in egg laying are not infrequent with the House Wren, and, as indicated above, the size of eggs and the number in a clutch appear to be influenced by temperature even after the clutch has been started. By using a special stain introduced with the food, Riddle (1911) was able to measure the daily deposition of yolk around the oocyte in the domestic fowl and found that it often fell to one-half the maximum, and occasionally was lacking for 24 hours. For these various reasons, therefore, we do not accept a "determinant" date four or five days before laying but believe that temperature may influence the egg laying up at least to the time of ovulation and possibly up to the actual deposition of the egg into the nest.

TEMPERATURE THRESHOLDS

The average air temperature was first determined for the fifth day before the laying of the first egg, following the practice of previous investigators, in each of 122 first clutches for the 18 years involved in this study. This was 15.1 C with a wide standard deviation of ± 5.1 C. The average temperature was then determined for the three days preceding the laying of the first egg, the same interval as used in our previous study (Kendeigh, 1941*b*). This temperature was 14.8 C ± 2.7 C. The two average temperatures are not significantly different, but the smaller standard deviation for the three-day period

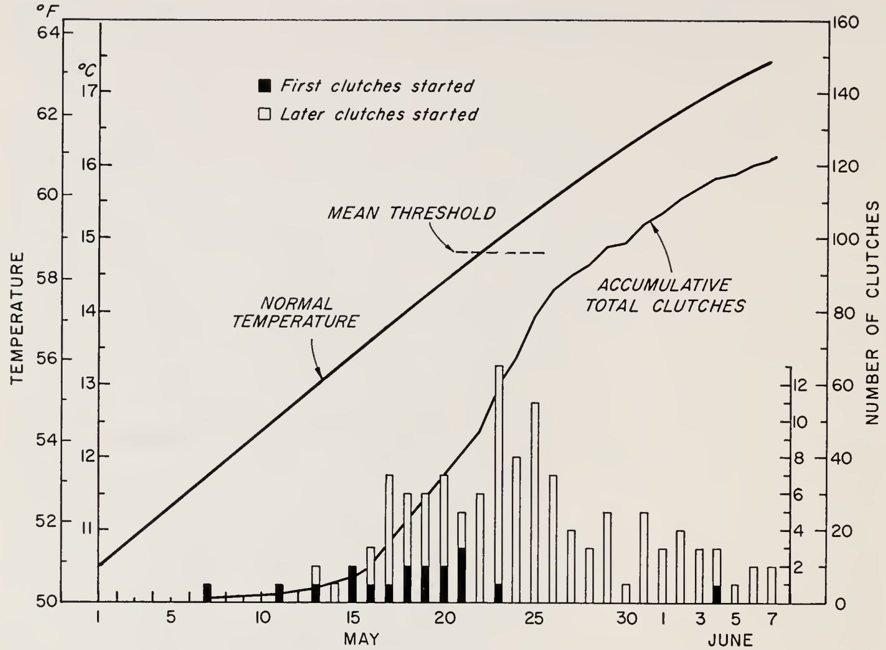

FIG. 2. Number of clutches started each day, accumulative number started, and normal air temperatures, during years 1921 to 1938, inclusive.

of about one-half of the standard deviation for the fifth day before laying may indicate that the three-day period is of greater significance.

Mean daily temperatures of 14.8 C and above, lasting one to several days, may occur repeatedly throughout May, being separated by periods when the temperature falls below this level. Such periods of high temperature, if they come before the middle of the month, are often not followed by egg laying; but after 15 May they are almost invariably followed by the deposition of eggs within the average of 2.8 days (1–5 days). The year 1926 is an exception. Heavy mortality of birds over the preceding winter so reduced the wren population that first eggs were not recorded until 4 June. There is no evidence at hand to determine whether this temperature threshold becomes lower with the progress of the season, as found by Nice (1937) for the Song Sparrow.

When the number of first clutches started each day during May and early June of the 18-year period is plotted (Fig. 2), the peak comes about 23 May. It is significant that the normal temperature at this time is very close to the mean threshold of 14.8 C. The decline in number of new clutches started at temperatures above 14.8 C is not because these temperatures are unfavorable

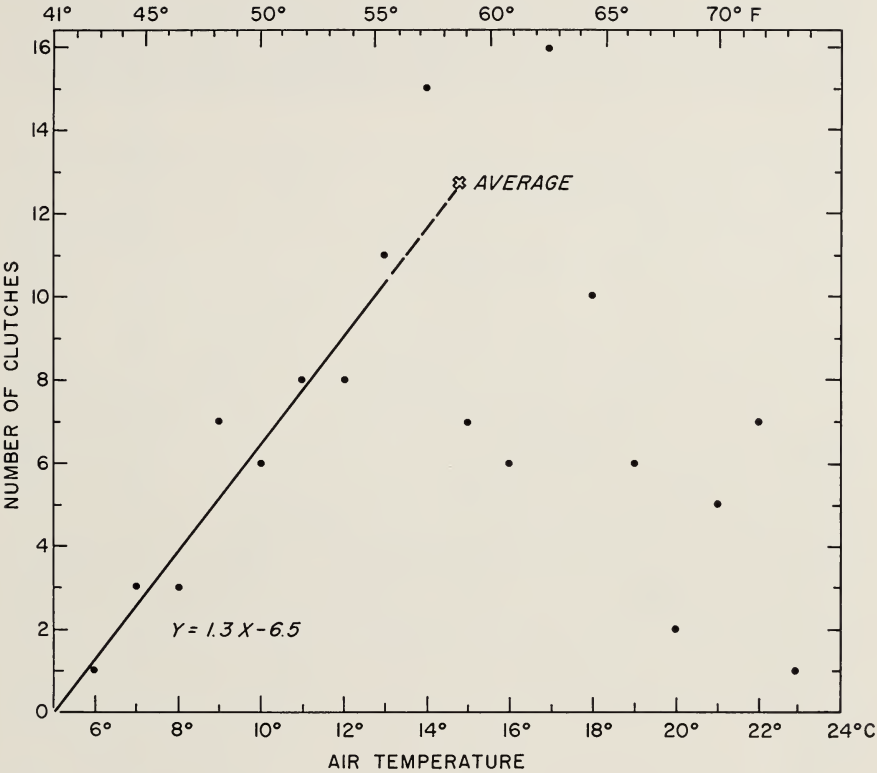

FIG. 3. Correlation between number of clutches started and mean air temperatures for the three preceding days.

but because of the decrease in arrival of new birds from the south and of the nesting area becoming saturated with territories.

When the number of clutches started is plotted against average air temperatures for the three days preceding the first egg (Fig. 3), it is evident that hardy birds can begin laying at temperatures well below the average threshold of 14.8 C. However, the number of such clutches started decreases linearly with drop in temperature, and an absolute threshold of 5 C is indicated. The seven clutches started at temperatures of 6 C, 7 C, and 8 C were scattered through the month, viz., 13, 14, 16, 22, and 24 May.

RELATION TO NORTHWARD DISTRIBUTION

Cleveland, Ohio, is near the center of the distributional range of *T. a. baldwini.* This subspecies is uncommon at Quebec, in Quebec Province, and absent at White River, Ontario (Kendeigh, 1934). The *A.O.U. Check-list of North American Birds* (1957) indicates, however, that *T. a. parkmanii* has spread from the west around the north side of Lake Superior, northward to a line extending from Minaki in western Ontario to Lake Abitibi on the eastern boundary of the province. This invasion may have been relatively recent.

If the temperature of 14.8 C is taken as the threshold for initiation of general egg laying, the later rise in temperature would delay general nesting until early June at Quebec and until middle June at White River (Fig. 4). This would agree roughly with the formula suggested by Baker (1938) that, with passerine species, the start of the egg season gets later and later northward at a rate of about 18 days per 10° of latitude, although between 32°N and 46°N there is a general tendency for breeding to start later than would be necessary to conform with this rule. Cleveland lies at about 41.5°N, Quebec close to 47°N, and White River at about 48.5°N. That no nesting of *T. a. baldwini* is reported at White River may be due to the very late date at which temperatures become favorable, fully a month or a month and a half after the bird's gonads have matured. This is not to gainsay that a few hardy birds might attempt nesting as soon as temperatures went above 5 C. It is possible that the population of *T. a. parkmanii* has more of these hardy individuals than does *T. a. baldwini*, since this subspecies occurs still farther to the north.

Egg laying and incubation are about equally energy-demanding processes (Kendeigh, 1962), and inability of the bird to mobilize sufficient energy at the prevailing temperatures may be the direct factor that limits northward dispersal. At 14.8 C, my calculations indicate that the heat energy the incubating bird would need to apply to the eggs in order to maintain them at the proper incubation temperature would amount to 44 to 68 per cent of the productive energy that the bird had available. Productive energy is the energy that a bird can produce for various activities over and above what it requires for existence. The lower value would be sufficient were the next box fully exposed to the sun throughout the day; the higher value would be required if the nest box were continuously in the shade. As air temperatures drop, the bird can spare less from the maintenance of its body temperature, yet the eggs require the application of more heat to keep them at the proper incubation temperature. At 5 C, the amount of heat that would need to be applied to the eggs in nest boxes in the sun and shade would require 1.5 to 2 times the amount that a bird of average capacity could accumulate at this temperature. Energy reserves in the body would need to be drawn upon and the situation would have to be very temporary. The amount required for egg laying at these temperatures would be within the same range. Since the bird must use productive energy for other activities as well as incubation, only individuals of unusual energy-mobilizing capacities would be able to carry on

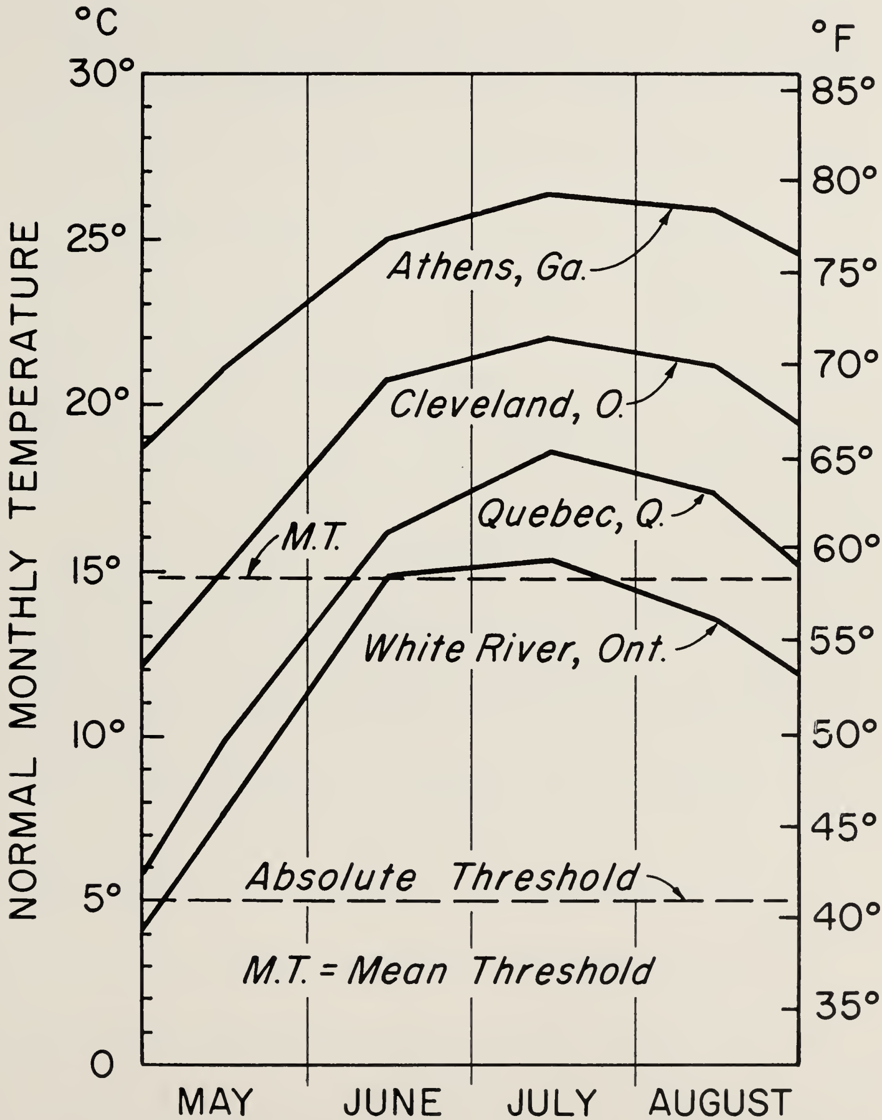

Fig. 4. Progress of normal air temperatures at four localities from May through August.

nesting activities at this temperature. At still lower temperatures it would become impossible.

RELATION TO SOUTHWARD DISTRIBUTION

The farthest south that the House Wren has penetrated, and this only in recent years, is in the vicinity of Athens, Georgia (34°N). Temperatures are suitable for egg laying at Athens in April (Fig. 4), but the birds are probably not then ready to do so because of the undeveloped gonads. At this time of year, photoperiods increase in length less rapidly in the south than in the north. Odum and Johnston (1951) found nesting at Athens beginning in late May and continuing into July. Of three known nests, one contained five nestlings, one had five eggs of which only three hatched, and one had only four eggs. In northern Ohio, seven eggs per clutch are common in May and early June, six eggs from early June to middle July, five eggs from early to late July, and four eggs from middle July to August. There is evidence that high temperatures tend to curtail the laying of large clutches of eggs (Kendeigh, 1941*b*). It is of interest that normal temperatures during May at Athens are similar to those during June and July at Cleveland (Fig. 4). The four-egg clutch at Athens was laid during and immediately following the highest temperatures during the entire summer (30.6 C). There is doubtless a limit southward where temperatures become so high during May as to discourage egg laying altogether.

SUMMARY

Onset of egg laying in the House Wren is regulated to the general time of year by the development of the gonads under the stimulus of changing photoperiods, to the time of month by their return to the breeding grounds from spring migration, and to the precise day by temperature. Low temperatures, particularly during May when the development of the gonads puts the birds in breeding condition, may limit the breeding range northward and high temperatures may limit the breeding range southward. Limitation of the breeding range appears thus to be determined by the lack of synchronization between the occurrence of favorable temperatures and photoperiods—northward because the onset of favorable temperatures is too slow, southward because it is too fast.

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COMPARISON OF FAT LEVELS IN MIGRATING BIRDS KILLED AT A CENTRAL MICHIGAN AND A FLORIDA GULF COAST TELEVISION TOWER[1]

Larry D. Caldwell, Eugene P. Odum, and Shirley G. Marshall

In this paper fat levels in migrating birds killed at a Michigan television tower located near Cadillac are compared with levels found in the same species killed at a Florida Gulf coast tower located near Tallahassee. Extensive studies of birds killed at the latter tower, which is located astride what is believed to be a major trans-Gulf migratory route, are in progress at the University of Georgia (Odum, Connell, and Stoddard, 1961) and at the Tall Timbers Research Station, Tallahassee, Florida (Stoddard, 1962).

Birds killed during nocturnal flights were collected by Caldwell at the Michigan tower (Station WWTV) and by Mr. Herbert Stoddard, Sr., at the Florida tower (Station WCTV). All specimens were stored in plastic bags in deep freeze until processed. Total body fat was determined by a simple, rapid method now in routine use at the University of Georgia laboratory. The procedure involves vacuum dehydration of the specimen followed by extraction with petroleum ether. Three weights were taken: total wet weight, total dry weight (after dehydration), and total nonfat dry weight (after extraction); the difference between the latter two weights is the estimate of total fat content (see Odum, 1960).

In this paper fat is expressed as a percentage of the nonfat dry weight, that is, grams fat/100 grams of nonfat dry weight. This ratio is more satisfactory for direct comparisons than the ratio of fat to wet weight (the usual "fat index"), since it is not affected by variations in water content or by slight dehydration that may have occurred before specimens were recovered at the towers or while stored in the freezers. Also, in contrast to the wet weight index, the fat–nonfat ratio is linearly related to total fat content since the nonfat dry weight remains virtually constant. That is, a doubling of the index indicates a doubling of the fat deposits. Nonmigrating birds generally have a fat–nonfat ratio of 10–50 per cent, moderately fat migrants (or sometimes winter specimens) 50–100 per cent, while very fat migrants run between 100 and 300 per cent.

RESULTS

As shown in Table 1 and Fig. 1, fall migrant warblers, vireos, thrushes, and tanagers from the Florida Gulf coast had possessed much greater fat reserves than birds of the same species from Michigan. All these species winter in

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TABLE 1

MEAN FAT LEVELS OF MIGRATING BIRDS KILLED AT A CENTRAL MICHIGAN AND A FLORIDA GULF COAST TV TOWER DURING AUTUMN MIGRATION

Species	Number of individuals	Grams fat/100 grams nonfat dry weight	
		Mean ± SE[1]	SD[2]
Gray-cheeked Thrush (*Hylocichla minima*)			
Michigan	10	64 ± 7.5	23.6
Florida	26	168 ± 13.6	69.5
Red-eyed Vireo (*Vireo olivaceus*)			
Michigan	14	74 ± 10.3	38.7
Florida	59	121 ± 6.1	47.1
Tennessee Warbler (*Vermivora peregrina*)			
Michigan	6	93 ± 21.9	53.6
Florida	16	205 ± 6.3	25.3
Magnolia Warbler (*Dendroica magnolia*)			
Michigan	15	55 ± 3.8	14.5
Florida	25	155 ± 11.1	55.5
Ovenbird (*Seiurus aurocapillus*)			
Michigan	12	86 ± 10.6	37.1
Florida	16	151 ± 6.9	27.1
American Redstart (*Setophaga ruticilla*)			
Michigan	5	73 ± 10.9	24.4
Florida	17	129 ± 12.4	50.9
Scarlet Tanager (*Piranga olivacea*)			
Michigan	2	117	
Florida	13	186 ± 11.7	42.1
White-throated Sparrow (*Zonotrichia albicollis*)			
Michigan	9	59 ± 5.4	16.2
Florida	17	20 ± 2.2	9.2

[1] Mean and standard error of mean. All differences between Florida and Michigan are significant at the 99 per cent level where five or more individuals in each sample are available.
[2] Standard deviation.

Central or South America. In contrast, White-throated Sparrows, which winter in southeastern United States, were significantly fatter in Michigan than in Florida, even though the mean fat level in Michigan was generally lower than in the other species.

Only a few specimens were available for comparison in the spring. As shown in Table 2, mean fat levels in Florida and Michigan were about the same in three species of spring migrants, insofar as the meager data show.

As would be expected, individuals of tropical-wintering species that strike the Florida Gulf coast tower have much greater fat reserves in fall than in

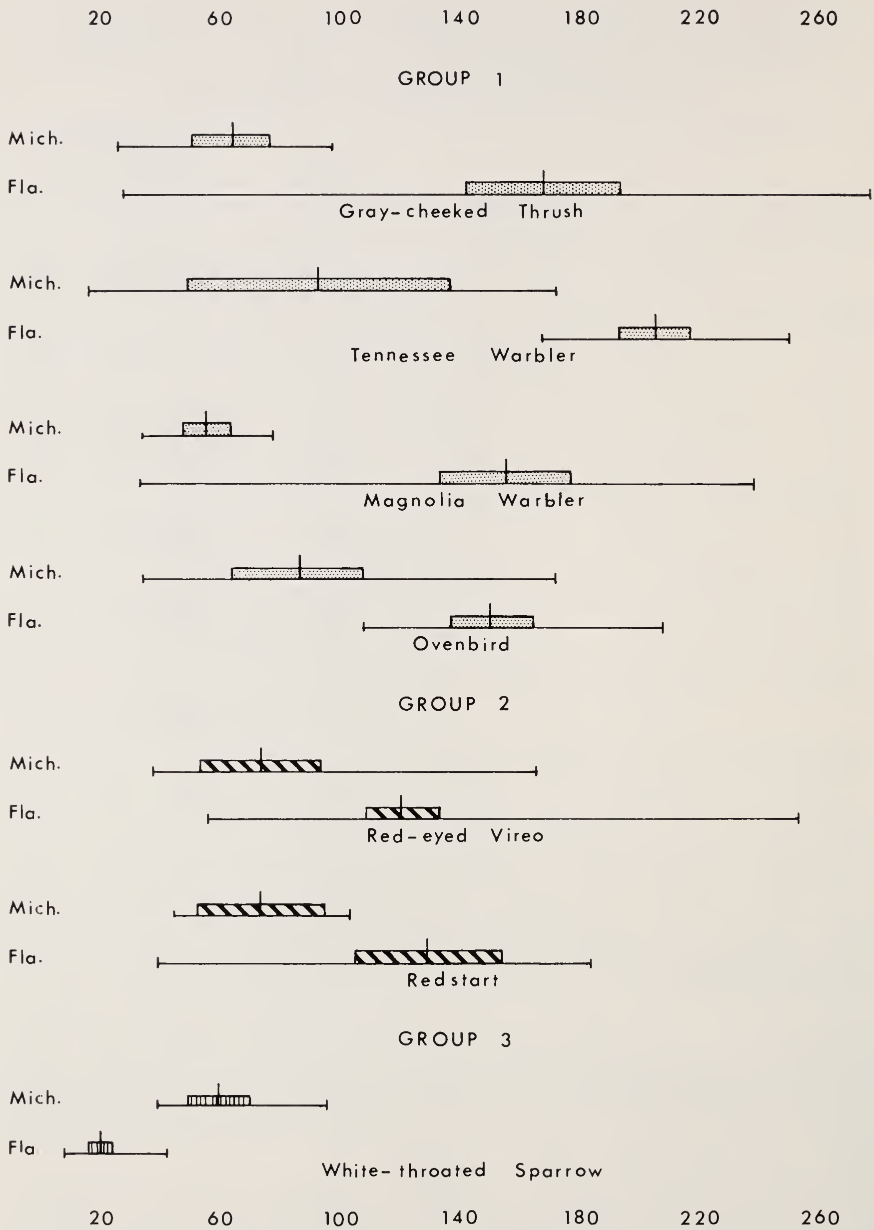

Fig. 1. Comparison of fat levels in migrating birds killed at a central Michigan and a Florida Gulf coast TV tower during the autumn migration. Fat is expressed as grams per 100 grams of nonfat dry weight. Vertical lines indicate means, horizontal lines extremes, and shaded boxes two standard errors on each side of the mean. The four species

TABLE 2
MEAN FAT LEVELS OF MIGRATING BIRDS KILLED AT A CENTRAL MICHIGAN AND A FLORIDA GULF COAST TV TOWER DURING SPRING MIGRATION

Species	Number of individuals	Grams fat/100 grams nonfat dry weight	
		Avg ± SE[1]	SD[2]
Red-eyed Vireo (*Vireo olivaceus*)			
Michigan	13	54 ± 6.5	23.4
Florida	26	67 ± 4.8	24.7
American Redstart (*Setophaga ruticilla*)			
Michigan	3	43 ± 11.8	20.1
Florida	3	34 ± 3.5	6.0
Bobolink (*Dolichonyx oryzivorus*)			
Michigan	2	87 —	—
Florida	9	97 ± 8.9	26.7

[1] Mean and standard error of the mean. Difference between Michigan and Florida not statistically significant for any of the species.
[2] Standard deviation.

spring (Odum, Connell, and Stoddard, 1961). As shown in Table 3, fall migrants in central Michigan were also fatter than spring migrants, but the difference is not nearly so great as is the usual case in Florida. The Michigan spring birds were surprisingly uniform in fat content, and not much above the level to be expected in nonmigratory birds at that season. For example, a series of nonmigratory Carolina Wrens (*Thryothorus ludovicianus*) which we have extracted during the spring and fall seasons averaged 35 grams/100 grams dry weight with a range of 20 to 55. Thus, the mean level of 51 for warblers (Table 3) and the mean of 54 for vireos (Table 2) in Michigan in spring are within the upper range of nonmigrating individuals.

DISCUSSION

Although birds from the two localities were not collected in the same year, the fall specimens from Michigan were picked up about two weeks earlier in the season than the Florida specimens with which the comparisons were made. Consequently, the samples may indicate trends in fat deposition which occur as migrants move from the northern border to the southern border of the United States. All the tropical-wintering species were fatter in Florida, indicating increasing fat reserves as these species move southward.

←
in Group 1 are thought to be habitual trans-Gulf migrants, the two species in Group 2 are thought not to be so strongly trans-Gulf in their southward flights, while the one species in Group 3 does not migrate south of the Gulf Coast.

TABLE 3
MEAN FAT LEVELS OF MIGRATING BIRDS KILLED AT A CENTRAL MICHIGAN TV TOWER IN FALL AND SPRING

Species	Number of individuals	Grams fat/100 grams nonfat dry weight	
		Avg ± SE[1]	SD[2]
Black-and-white Warbler (*Mniotilta varia*)			
Fall	10	70 ± 7.5	23.4
Spring	12	48 ± 3.5	12.7
Nashville Warbler (*Vermivora ruficapilla*)			
Fall	10	66 ± 4.8	15.1
Spring	14	69 ± 6.9	25.5
Ovenbird (*Seiurus aurocapillus*)			
Fall	12	86 ± 10.6	37.1
Spring	8	45 ± 7.1	20.0
American Redstart (*Setophaga ruticilla*)			
Fall	5	73 ± 10.9	24.4
Spring	3	43 ± 11.6	20.1

[1] Mean and standard error of mean.
[2] Standard deviation.

This would mean that these birds could make much longer flights by the time they reach the Gulf Coast than would be possible in Michigan. Notably, the Gray-cheeked Thrush and Tennessee and Magnolia Warblers, species believed to be habitual trans-Gulf migrants, were more than twice as fat in Florida. In contrast, the north–south difference in fall was not quite so great in the Red-eyed Vireo, and Redstart (see Fig. 1), species believed not to be strongly trans-Gulf in their migration (since many individuals are observed using the circum-Gulf routes: see Stevenson, 1957). The situation in the White-throated Sparrow is what would be expected since Michigan is near the beginning and Florida at the end of its migration route. White-throats apparently never become as fat as the long-range migrants (see also Odum, 1958). These preliminary data indicate that fat levels of birds killed at towers located at different geographical points along the migratory route do reflect the pattern of migration characteristic of the species.

Using the tentative model proposed in a previous paper (Odum et al., 1961), maximum flight ranges estimated from the mean fat levels of birds at the two localities are as follows (estimates in round numbers):

Table 1. Tropical-wintering species, fall migration: Florida—1,100 miles
Michigan— 500 miles
Table 1. White-throated Sparrow, fall migration: Florida—150 miles
Michigan—350 miles

Table 2. Tropical-wintering species, spring migration: Florida—350 miles
Michigan—350 miles

Table 3. Tropical-wintering species, Michigan:
spring migration—250 miles
fall migration—500 miles

Since the data in Table 2 are inadequate and involve three species of rather different migratory patterns, a better comparison in the spring is between the average flight range of about 350 miles in species of the northern warblers arriving in Florida, and the average of 250 miles for Michigan as shown in Table 3. Thus, it would seem that tropical-wintering species may be expected to be fatter on the average in Florida than in Michigan for both fall and spring, but much more so, of course, in the fall migration.

It should be emphasized that these estimates of flight range are the maximum range possible if all of the fat reserves are used (and assuming favorable weather). Actually, telescope and radar observations indicate that many migrants terminate nocturnal flights when flying over continental areas after a few hours, and before the fat reserves are exhausted. Hassler, Graber, and Bellrose (1963), for example, report that mass flights in September over Illinois occur mostly in the early hours of the night, the density of flying birds dropping off sharply after midnight. Trans-Gulf flights, of course, require a much longer time in the air. While we do find spring individuals in Florida that have largely depleted their fat reserves, the mean fat levels of spring arrivals are still substantial, indicating reserve fuel over that normally needed. The lowest fat levels, in fact, are found in birds that are near the end of their migratory routes, such as the White-throated Sparrow in Florida in fall, or the northern warblers in Michigan in spring. As discussed in more detail in a previous paper (Odum, 1960), it is now clear that many species begin migration with low or moderate fat reserves and with consequent short flights. In long-range migrants the fat reserves are apparently increased with each stop until the maximum level is reached at or near points where long nonstop flights are required, as, for example, on or near the Gulf Coast.

SUMMARY

Mean fat levels of six species of tropical-wintering thrushes, warblers, and vireos killed in the fall migration at a Florida Gulf coast television tower were significantly greater than in the same species killed at a central Michigan tower; levels in species believed to be habitual trans-Gulf migrants were more than twice as great in Florida.

In constrast, fat levels in White-throated Sparrows, a species wintering in the Gulf states, were significantly greater in Michigan in the fall.

In spring, fat levels of four species breeding in Michigan were low to moderate and not significantly different at the two tower locations.

The results provide indirect evidence for the hypothesis that long-range northern

migrants begin southward migration with low to moderate fat reserves and with consequent short flights, then increase their reserves with each stop until the maximum level is reached at or near points, as on or near the Gulf Coast, where long nonstop flights are undertaken.

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HEART WEIGHTS OF SOME ALASKAN BIRDS

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The collection and interpretation of quantitative data relating to internal organs of birds have been largely overlooked by ornithologists until recently. Emphasis was placed for many years (and still is to a certain extent) upon morphological features. According to some investigators, the wisdom of weighing or measuring organs is questionable, especially when these raw data seemingly have no immediate practical value and supposedly clutter up the literature. Some of these data, when systematically collected (see Norris, 1961) with a view toward the solution of certain problems, have special value. Examples are spleen, liver, and thyroid weights amassed and studied as they relate to problems of reproduction, migration, and the like. As far as heart weights are concerned, the researches of Norris and Williamson (1955), Williamson and Norris (1958), Hartman (1954, 1955, 1961), Johnston and Williamson (1960), and others have yielded some important and interesting facts. It is now known, for example, that the size of a bird's heart is related to features such as total body weight, altitude, and activity.

Admittedly, much of the basic work in heart weight analyses has been done, but in spite of the compilations and comparisons contributed by the authors cited above (and others), refinements and further analyses are desirable. Hartman, for example, presented (1955) 1,340 heart weights of birds, many of which were tropical or subtropical forms. His data, together with those from arctic forms gathered in the present investigation, make possible a comparison of heart weights of birds over a broad geographic area. The analyses to follow compare and contrast some of the data from tropical and arctic forms, and also present heart weights (previously unpublished) from unusual North American birds and some Asiatic forms rare in North America. Finally, attention will be drawn to possible sex and age differences in species where large samples are available, and to certain variations in heart weight associated with seasons and/or fat deposition and migration.

From the end of May until late August 1960, I was part of a team of ornithologists studying birdlife on the arctic coast of North America at Cape Thompson, Alaska (latitude 68°06′ N, longitude 165°46′ W), under the auspices of the United States Public Health Service. The investigations were supported by the Division of Biology and Medicine of the Atomic Energy Commission (Agreement No. SF-54-373, environmental studies of Project Chariot). Heart weights recorded here were taken incidental to our main studies of avian populations and distribution, but, at the same time, we felt that there were real values to be gained in saving hearts from specimens taken for taxonomic or other purposes. Assisting in collecting hearts were Wayne Hanson, John Hines, Brina Kessel, Dale McCullough, Jerry Tash, Max Thompson, Francis S. L. Williamson, and Ernest Willoughby.

Most of the heart weights were obtained from birds fresh from the field, but some weights were taken after the heart had been preserved in 10 per cent formalin. Each heart was dried by blotting on absorbent paper, the vessels clipped off close to the heart, and the cavities emptied before weighing. Essentially the same method of obtaining weights was used as that discussed by Norris and Williamson (1955).

Heart weights from 567 individuals are given here. Seventy-seven species are represented, from eight orders and 21 families. The majority of these birds were collected within 10 miles of Cape Thompson along the sea coast or on the tundra at elevations ranging from sea level to about 700 feet. Most of the species are known to breed in the Cape Thompson region (Williamson et al., MS); generally speaking in the accounts to follow, those taken only in early June were migrating northward, whereas the birds taken only in August were migrating southward. Pertinent details concerning breeding, migration, and fat conditions are discussed under each species account or in the tables. The few species associated with the coniferous forest (*Pinicola, Canachites, Parus, Ixoreus, Perisoreus, Bombycilla, Vermivora, Picoïdes, Seiurus, Spizella,* and *Dendroica*) came from the Noatak River, about 100 miles east–southeast of Cape Thompson.

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DISCUSSION

Comparisons with temperate forms.—Heart and body weights from the Alaskan birds (Table 1) can in a general way be compared with Hartman's data (1955:227–234), but comparisons are usually possible only at the generic level.

Gavia spp. Probably all the loons from Alaska were migrants, although all three species breed in the Cape Thompson area. Uniformly, these loons had small heart ratios (0.90–1.22), the mean for the three species (eight birds) being 1.05. Hartman's figures of 1.10 and 1.33 for *G. immer* are within the range of expected interspecific variation.

Phalacrocorax spp. The two specimens of *pelagicus* reported here represented a local breeding population. Their heart ratios (1.13–1.14) were somewhat larger than those reported by Hartman (1955) for *auritus* (0.89) and *olivaceus* (0.67, 0.72). In a later paper (1961) Hartman gives an average of 0.91 for both of these latter species.

Grus canadensis. Although more heart weights were taken in Alaska than those mentioned by Hartman, the heart ratios of about 0.80–0.98 compare rather favorably with his values of 0.70 and 0.86.

Charadrius spp. The heart ratios of 1.52–1.64 from *semipalmatus* in Alaska are considerably larger than the values given by Hartman for *vociferus* (1.35) and *wilsonia* (1.27), but *semipalmatus* is a much smaller bird.

Erolia spp. For *melanotos*, the data from Alaska (1.50–1.78) approximate closely Hartman's figure of 1.70 though in his later paper (1961) values of 1.13 and 1.25 are

TABLE 1
BODY WEIGHTS AND HEART WEIGHTS OF SOME ALASKAN BIRDS

Species	Migratory[1] status	Fat[2] condition	Body weight		Heart weight		Ht. wt/body wt	
			Mean	Extremes	Mean	Extremes	Mean	Extremes
Gavia adamsii 2 adF	PB	1	4,430	(4,303–4,557)	47.0	(46.3–47.7)	1.07	(1.02–1.11)
Gavia arctica 2 adM	MN	4	2,602.5	(2,185–3,020)	28.8	(26.7–30.9)	1.12	(1.02–1.22)
2 adF	MN	4	2,025.5	(1,870.6–2,180.3)	21.4	(19.1–23.8)	1.06	(1.02–1.09)
Gavia stellata 1 adM	MN	3	1,694		17.6		1.03	
1 adF	MN	3	1,472		13.3		0.90	
Phalacrocorax pelagicus 1 adM	B	1	2,030		23.2		1.14	
1 adF	B	1	1,509		17.1		1.13	
Branta nigricans 4 adM	MN		1,419.6	(1,398–1,440)	15.1	(13.3–16.7)	1.07	(0.93–1.19)
Histrionicus histrionicus 1 adM	MN	4	736.1		8.1		1.10	
2 adF	PB	4	536.2	(519.7–552.7)	7.3	(6.7–7.8)	1.35	(1.29–1.41)
Polysticta stelleri 1 adM	PB		823.3		8.5		1.03	
Somateria mollissima 1 adM	MN	4	2,750		25.8		0.94	
Lampronetta fischeri 3 adM	MN	1	1,367.6	(1,174–1,647)	13.0	(10.4–16.4)	0.95	(0.89–1.00)
Melanitta deglandi 1 adM	A	0	1,026.7		10.5		1.02	(emaciated)
Canachites canadensis 1 adM	PB		649.0		6.7		1.03	
Lagopus lagopus 5 adM	B, PB	0, 1	619.9	(586.5–634.1)	8.4	(7.1–9.1)	1.35	(1.21–1.44)
Lagopus mutus 3 adM	B, PB	1	508.1	(482.7–531.5)	9.4	(8.8–10.0)	1.85	(1.82–1.88)
Grus canadensis 3 adM	B, PB		3,434.0	(3,008–3,693.0)	30.3	(28.2–33.9)	0.87	(0.80–0.94)
2 adF	B, PB		2,799	(2,700–2,898)	25.9	(23.2–28.5)	0.92	(0.86–0.98)
Charadrius semipalmatus 3 adM	PB		42.5	(39.5–44.6)	0.68	(0.60–0.72)	1.59	(1.52–1.64)
1 adF	PB		45.6		0.72		1.58	
Pluvialis dominica 8 adM	B, PB, MS		146.7	(135.3–162.0)	2.31	(1.96–2.7)	1.57	(1.44–1.79)
4 adF	B, PB, MS		146.6	(134.5–158.6)	2.12	(1.90–2.27)	1.45	(1.39–1.55)
Arenaria interpres 4 adF	MS		94.9		1.54		1.62	
Arenaria melanocephala 1 adM		4	118.7		2.08		1.75	
1 adF		4	124.5		2.24		1.80	
Capella gallinago 1 adM	PB	4	113.5		1.18		1.04	

TABLE 1 (*Continued*)

Species	Migratory[1] status	Fat[2] condition	Body weight Mean	Body weight Extremes	Heart weight Mean	Heart weight Extremes	Ht. wt/body wt Mean	Ht. wt/body wt Extremes
Numenius phaeopus 2 imM	MS	1	320.8	(296.5–345.0)	4.3	(3.3–5.3)	1.41	(1.28–1.54)
1 imF	MS	1	377.3		4.3		1.14	
Heteroscelus incanum 1 adM	B		101		1.6		1.58	
Calidris canutus 9 adM	MS(?)	4	135.0	(106.2–147.8)	2.2	(1.79–2.40)	1.63	(1.42–1.75)
1 adF		4	142.5		2.2		1.54	
Erolia acuminata 2 imF	MS	2	51.2	(49.3–53.0)	0.86	(0.81–0.90)	1.68	(1.53–1.83)
Erolia melanotos 3 adM	PB		57.4	(40.8–69.5)	0.97	(0.61–1.24)	1.67	(1.50–1.78)
1 adF	PB		54.2		1.1		2.03	
Erolia bairdii 1 imM	MS		34.3		0.55		1.60	
1 imF	MS		42.1		0.66		1.57	
Erolia alpina 1 adM	PB	1	46.5		0.91		1.96	
1 imM		1	47.2		0.81		1.72	
Limnodromus scolopaceus 1 imM	MS		103.0		2.06		2.0	
2 imF	MS		103.2	(101.6–104.8)	1.77	(1.63–1.91)	1.71	(1.60–1.82)
Ereunetes pusillus 1 adM	PB		20.6		0.39		1.89	
1 imM	MS		19.3		0.32		1.66	
3 adF	PB		24.5	(21.1–29.8)	0.43	(0.39–0.49)	1.81	(1.38–2.32)
Ereunetes mauri 5 adM	B, PB	4	23.8	(21.5–27.0)	0.42	(0.39–0.45)	1.79	(1.56–1.95)
4 imM	MN, MS	4	23.0	(21.0–24.6)	0.39	(0.30–0.44)	1.67	(1.43–1.79)
2 adF	MN, MS	4	25.6	(25.5–25.6)	0.44	(0.39–0.48)	1.70	(1.52–1.88)
1 imF	MN, MS	4	24.2		0.43		1.78	
Tryngites subruficollis 1 imM	MS	4	69.5		0.86		1.24	
Limosa lapponica 2 adM	PB	4	243.3	(240.3–246.3)	3.85	(3.8–3.9)	1.58	(1.58–1.58)
5 imM			218.8	(195.5–240.7)	3.54	(3.0–3.86)	1.62	(1.37–1.74)
2 adF			308.5	(297.2–319.8)	4.35	(4.2–4.5)	1.41	(1.31–1.51)
5 imF			250.6	(206.8–268.2)	3.79	(3.2–4.17)	1.52	(1.23–1.69)
Crocethia alba 1 imM	MS	2	48.5		0.71		1.46	
3 imF	MS	2	48.7	(43.4–53.5)	0.76	(0.70–0.87)	1.57	(1.42–1.66)
Phalaropus fulicarius 2 adF	MS	1	44.6	(43.7–45.5)	0.80	(0.79–0.80)	1.79	(1.76–1.81)
10 imM	MS	1	33.3	(29.6–39.0)	0.55	(0.45–0.66)	1.64	(1.47–1.90)
1 ad F	MS	1	55		1.0		1.82	
6 imF	MS	1	36.6	(33.9–39.2)	0.56	(0.52–0.60)	1.54	(1.48–1.63)
Lobipes lobatus 2 imM	MS		25.9	(25.2–26.7)	0.48	(0.43–0.52)	1.83	(1.71–1.95)
2 adF	MS		43.1	(38.7–47.5)	0.70	(0.57–0.83)	1.61	(1.47–1.75)
1 imF	MS		28.6		0.56		1.96	

TABLE 1 (*Continued*)

Species	Migratory[1] status	Fat[2] condition	Body weight Mean	Body weight Extremes	Heart weight Mean	Heart weight Extremes	Ht. wt/body wt Mean	Ht. wt/body wt Extremes
Stercorarius pomarinus 1 adM	MN	4	710.2		7.3		1.03	
2 adF	MN	4	775.5	(741–810)	8.2	(8.1–8.3)	1.06	(1.00–1.12)
Stercorarius parasiticus 5 adM	MN		406.3	(371.8–440.2)	6.12	(5.1–7.5)	1.50	(1.35–1.70
2 adF	MN		456.7	(416.8–496.6)	6.35	(6.2–6.5)	1.41	(1.25–1.56)
Stercorarius longicaudus 5 adM	B, PB	2, 4	285.4	(272.3–301.4)	3.6	(3.3–4.3)	1.28	(1.19–1.46)
1 imM	B, PB		271		2.8		1.03	
2 adF	B, PB		332.7	(323.8–341.5)	3.6	(3.3–3.9)	1.09	(0.97–1.20)
Larus hyperboreus 6 adM	B, PB	2, 4	1,529.9	(1,466.4–1,624.4)	14.3	(13.1–16.2)	0.93	(0.85–1.10)
7 adF	B, PB	2, 4	1,284.6	(1,164.6–1,490.1)	11.6	(10.5–14.9)	0.91	(0.83–1.00)
1 subadM			1,225.1		9.9		0.81	
7 subadF			1,190.1	(747.3–1,470)	11.4	(6.6–14.1)	0.95	(0.88–1.02)
Larus canus 1 subadM	A		400.5		4.7		1.17	
Rissa tridactyla 4 adM	B		495.1	(466.4–545.0)	5.2	(5.0–5.7)	1.06	(1.03–1.09)
2 juvF			47.5	(41.5–53.4)	0.49	(0.44–0.54)	1.04	(1.01–1.06)
2 adF	B		434.0	(380.4–487.6)	4.1	(3.6–4.6)	0.95	(0.94–0.95)
Xema sabini 2 adM	MN		188.2	(174.8–201.5)	2.2	(2.0–2.4)	1.17	(1.14–1.19)
1 adF	MN		169.1		2.2		1.30	
Sterna paradisaea 3 adM	P, PB		102.3	(100.1–103.5)	1.40	(1.35–1.44)	1.36	(1.30–1.44)
3 adF	P, PB		104.8	(96.5–117.0)	1.54	(1.25–1.70)	1.47	(1.30–1.68)
1 imM			68.0		99.0		1.46	
Uria aalge 4 adM	B	1	929.8	(865.0–1,032.0)	8.6	(7.4–9.6)	0.92	(0.83–1.02)
4 adF	B	1	911	(855–970)	8.9	(8.2–9.4)	0.98	(0.90–1.04)
Uria lomvia 25 adF	B	1	887.1	(747.3–1,046.0)	8.8	(7.8–10.0)	0.99	(0.86–1.10)
18 adM	B	1	956.5	(837.0–1,060.0)	9.54	(7.9–11.6)	1.00	(0.87–1.23)
Cepphus columba 1 adM	B		490.0		7.5		1.53	
1 adF	B		502.2		6.8		1.35	
Brachyramphus brevirostre 1 adF	B		203.9		3.11		1.53	
1 juvM			35.7		0.50		1.40	
2 adM	B		251.1	(236.0–266.1)	2.94	(2.68–3.19)	1.18	(1.01–1.35)
Aethia cristatella 1 adM	A	0	216.6		2.3		1.06	

TABLE 1 (*Continued*)

Species	Migratory[1] status	Fat[2] condi-tion	Body weight		Heart weight		Ht. wt/body wt	
			Mean	Extremes	Mean	Extremes	Mean	Extremes
Fratercula corniculata 4 adF	B		602.2	(543.7–664.7)	6.1	(5.6–6.4)	1.02	(0.96–1.14)
Lunda cirrhata 1 adM	B	1	836.6		8.5		1.02	
1 adF	B	1	741.3		6.8		0.92	
Picoïdes tridactylus 2 adM	PB	1	55.0	(53.6–56.5)	0.68	(0.66–0.70)	1.24	(1.23–1.24)
Eremophila alpestris 1 adM	PB		43.0		0.50		1.16	
Perisoreus canadensis 3 adM	PB	0	75.8	(72.5–78.0)	0.73	(0.70–0.75)	0.96	(0.91–1.01)
2 imM		0	75.2	(74.6–75.8)	0.69	(0.67–0.71)	0.92	(0.88–0.95)
3 imF		0	69.6	(66.8–72.3)	0.64	(0.58–0.72)	0.93	(0.83–1.08)
Parus cinctus 1 adM	PB	1	12.8		0.22		1.72	
1 imM			13.0		0.19		1.46	
1 adF	PB	1	12.0		0.15		1.25	
1 imF			12.0		0.19		1.58	
Parus hudsonicus 1 imM			12.9		0.24		1.86	
1 adF	PB	1	10.8		0.19		1.76	
Ixoreus naevius 1 adM	PB		86.6		1.02		1.18	
1 imM			68.7		0.77		1.12	
Hylocichla minima 1 adF	PB		31.1		0.35		1.12	
1 imF			30.5		0.39		1.28	
Oenanthe oenanthe 1 adM	PB		23.2		0.35		1.51	
14 imM	MS	1, 4	25.4	(22.9–27.7)	0.36	(0.29–0.44)	1.42	(1.27–1.73)
8 imF	MS	1, 4	25.5	(23.3–28.1)	0.36	(0.31–0.41)	1.41	(1.12–1.61)
Luscinia svecica 2 imM	MS	4	19.9	(18.8–21.0)	0.31	(0.30–0.31)	1.52	(1.43–1.60)
8 imF	MS	4	19.3	(16.4–21.0)	0.27	(0.22–0.30)	1.40	(1.20–1.59)
Phylloscopus borealis 5 adM	B, PB, MS	4	11.0	(9.1–13.2)	0.18	(0.14–0.23)	1.59	(1.38–1.82)
6 imM	B, PB, MS	4	10.5	(10.0–11.3)	0.16	(0.15–0.17)	1.54	(1.42–1.62)
2 adF	B, PB, MS	4	9.6	(8.1–11.1)	0.15	(0.12–0.17)	1.50	(1.48–1.53)
6 imF	B, PB, MS	4	10.4	(9.3–11.4)	0.15	(0.13–0.17)	1.49	(1.14–1.72)
Motacilla flava 11 adM	B, PB, MS	3, 4	18.2	(16.1–20.4)	0.27	(0.22–0.33)	1.50	(1.36–1.84)
10 imM	B, PB, MS	3, 4	18.6	(17.4–20.2)	0.27	(0.24–0.29)	1.44	(1.22–1.61)
12 adF	B, PB, MS	3, 4	16.7	(15.3–18.3)	0.25	(0.21–0.28)	1.49	(1.28–1.73)
11 imF	B, PB, MS	3, 4	17.9	(16.1–20.9)	0.25	(0.31–0.29)	1.40	(1.24–1.68)
Anthus spinoletta 1 adM	B, PB	0, 1	21.8		0.35		1.61	
1 adF	B, PB	0, 1	19.2		0.27		1.41	
1 imF			17.5		0.26		1.49	
Anthus cervinus 2 adM	B, PB		21.8	(20.6–23.0)	0.33	(0.32–0.33)	1.49	(1.39–1.60)
1 adF	B, PB		25.0		0.32		1.28	

TABLE 1 (*Continued*)

Species	Migratory[1] status	Fat[2] condition	Body weight Mean	Body weight Extremes	Heart weight Mean	Heart weight Extremes	Ht. wt/body wt Mean	Ht. wt/body wt Extremes
Bombycilla garrula 1 adM	PB	2	50.0		0.70		1.40	
1 adF	PB	2	53.5		0.84		1.57	
Vermivora celata 1 imF	MS(?)		9.0		0.12		1.33	
Dendroica coronata 1 adF	PB	2	13.9		0.17		1.22	
2 imF			13.0	(11.5–14.4)	0.17	(0.16–0.18)	1.32	(1.25–1.39)
Dendroica striata 1 imM	MS(?)		13.5		0.17		1.26	
Seiurus noveboracensis 1 imM	MS(?)	1	16.6		0.22		1.33	
Wilsonia pusilla 1 imM	MS	0	8.0		0.12		1.50	
3 imF	MS	0	7.6	(7.2–8.2)	0.10	(0.10–0.11)	1.31	(1.22–1.39)
Pinicola enucleator 3 adM	PB	1, 2	60.2	(58.3–62.8)	0.83	(0.80–0.85)	1.38	(1.34–1.43)
3 adF	PB	1, 2	59.5	(58.8–60.1)	0.86	(0.77–0.91)	1.45	(1.28–1.55)
Acanthis sp. 18 adM	B, PB	0, 1	13.2	(11.7–14.5)	0.24	(0.21–0.28)	1.81	(1.47–2.12)
8 adF	B, PB	0, 1	14.3	(11.8–16.6)	0.24	(0.22–0.27)	1.67	(1.46–1.95)
Passerculus sandwichensis 16 adM	B, PB	0, 1	18.3	(15.4–21.1)	0.29	(0.23–0.31)	1.56	(1.32–2.01)
3 imM	B, PB	0, 1	19.0	(18.7–19.4)	0.25	(0.23–0.26)	1.30	(1.23–1.34)
9 adF	B, PB	0, 1	19.4	(15.9–25.6)	0.27	(0.25–0.29)	1.39	(1.09–1.76)
2 imF	B, PB	0, 1	16.9	(16.7–17.1)	0.22	(0.22–0.22)	1.30	(1.29–1.32)
Spizella arborea 2 adM	PB		19.4	(19.0–19.8)	0.24	(0.21–0.27)	1.24	(1.06–1.42)
1 imM			18.4		0.24		1.30	
Zonotrichia leucophrys 8 adM	B, PB	1, 2	27.3	(25.3–29.2)	0.33	(0.29–0.38)	1.19	(1.06–1.37)
1 juvM			28.0		0.28		1.00	
9 adF	B, PB	1, 2	24.8	(20.8–26.9)	0.29	(0.24–0.34)	1.19	(0.94–1.35)
Zonotrichia atricapilla 1 adM	A	1	35.2		0.49		1.39	
Passerella iliaca 1 adM	A		40.5		0.59		1.46	
Calcarius lapponicus 47 adM	B, PB	0, 1, 2, 3	27.3	(24.0–30.5)	0.43	(0.33–0.51)	1.59	(1.25–1.88)
21 adF	B, PB	0, 1, 2, 3	27.3	(23.5–32.5)	0.40	(0.30–0.53)	1.48	(1.14–2.11)
2 imM		0, 1, 2, 3	28.9	(28.3–29.4)	0.51	(0.44–0.57)	1.76	(1.50–2.01)
2 imF		0, 1, 2, 3	25.5	(24.7–26.3)	0.38	(0.37–0.38)	1.48	(1.41–1.54)
1 juvF			18.5		0.27		1.46	
Plectrophenax nivalis 2 adM	B, PB	2	34.3	(29.5–39.1)	0.56	(0.54–0.58)	1.66	(1.48–1.83)
1 adF	B, PB	2	32.0		0.45		1.41	

[1] Migratory status: B, breeding; PB, probably breeding; MN, migrating northward; A, accidental; MS, migrating southward.
[2] Fat condition: 0, no fat; 1, a little fat; 2, moderately fat; 3, fat; 4, very fat.

given. Other species of *Erolia* (*acuminata*, *bairdii*, and *alpina*) had moderately large hearts ranging from 1.53–1.96.

Larus spp. Hartman's figures for *atricilla* range from 0.73–0.98. In the present study, heart ratios of *hyperboreus* and *canus* ranged from 0.81 to 1.17, and for other gull genera (*Rissa* and *Xema*), similar values were obtained.

Sterna spp. Interestingly enough, *paradisaea* from Alaska had heart ratios of 1.30–1.68, but for three other species, Hartman reported much lower values (1.04–1.34).

Parus spp. For three species Hartman gave values of 1.30–1.58, whereas in Alaska, for two other species, heart ratios ranged from 1.25 to 1.72 and 1.76 to 1.86.

Hylocichla spp. *H. minima* in Alaska had heart ratios from 1.12 to 1.28, whereas *guttata* and *fuscescens* reported by Hartman had values of 1.21–1.61.

Dendroica coronata. The three heart ratios from Alaska ranged between 1.22 and 1.39. Hartman's average for 10 birds was 1.29.

Wilsonia pusilla. Hartman's figure of 1.05 for this species in Panama and a later value (1961) of 1.18 differ significantly from the values of 1.22–1.50 found in Alaska.

Passerculus sandwichensis. Hartman's average of 1.46 does not seem to differ greatly from Alaskan values (averages of different groups ranging from 1.30–1.56).

Spizella spp. The values of 1.06–1.46 of *arborea* from Alaska tend to be greater than those given by Hartman for *passerina* (1.03–1.32) and *pusilla* (1.29), but sample sizes were small.

Zonotrichia spp. The two species from Alaska had greater heart ratios (0.94–1.39) than did another two species (0.84–1.00) reported by Hartman.

Recognizing the many possible sources of error involved by comparing Hartman's data with mine (interspecific comparisons, different breeding conditions, seasonal variations, and the like), in a very general way arctic species tend to have larger hearts than do more southerly species in the same genus from temperate and tropical regions. Many years ago Parrot (1893), Rensch (1948), and others proposed this latitudinal difference, but there were few supporting figures because many authors failed to cite specific collecting localities. In addition to the comparisons made here with Hartman's figures, Norris and Williamson (1955) have provided some further comparable figures from California. Their heart ratios for lowland specimens of *Zonotrichia leucophrys* and *Passerella iliaca* are significantly less than the values obtained from Alaskan birds. Some of these differences might be due to body weight alone, but until more regional weights are available quantitatively (see, for example, Norris and Johnston, 1958), it seems that latitude, per se, does play a role in affecting heart weight in birds.

Sex and age differences.—For some species enough heart weights were available to warrant statistical comparisons of two sex or age groups. Thus, standard *t* tests (see Simpson, Roe, and Lewontin, 1960:176) were used to compare the heart ratios between adult males and adult females in the following species: *Pluvialis dominica*, *Uria lomvia*, *U. aalge*, *Motacilla flava*, *Acanthis* sp., *Zonotrichia leucophrys*, *Passerculus sandwichensis*, *Calcarius lapponicus*, and *Larus hyperboreus*. Similar comparisons were made between immature males and immature females in *Motacilla flava, Oenanthe oenanthe,* and *Phalaropus fulicarius.* In none of these statistical comparisons were the differences between sexes significant at either the 5 per cent or 1 per cent level. Thus, the data from these Alaskan species taken on their breeding grounds bear out the early contention of Hartman (1955:223–224) that between sexes in birds heart weights are generally similar.

More recently, however, Hartman (1961:17) has found significant sexual differences in heart weight in 19 species, most of which were tropical forms. In these, the male's heart was the larger. Nineteen species, nevertheless, represent only a small proportion of the 360 species surveyed in his paper. So, from all the data now available on bird heart weights, it appears that any differences attributable to sex are relatively unimportant.

Additional comparisons by *t* tests were made between the following: adult vs. immature males in *Phylloscopus borealis* and *Motacilla flava*; adult vs. subadult females of *Larus hyperboreus*; adult vs. immature females of *Motacilla flava*; and, for *Calcarius lapponicus*, adult males taken in June were compared with adult males taken in July, and a similar comparison using adult females taken in these two months. As before, no significant differences were found at the 5 or 1 per cent levels. At least in the few species used in these comparisons, it can be concluded that (1) adult and immature heart weights are similar and (2) in *Calcarius* heart weights are not significantly different between adults taken at the onset of the breeding season and those taken at or immediately after the completion of breeding.

Flight habits.—Although total body weight is probably the foremost factor influencing heart size in birds, it seems likely from the data presented by other authors and in Table 1 that heart size is related also to flight habits. Species which habitually fly only short distances have small hearts. Hartman (1955, 1961) has alluded to the fact that tinamous, known for their poor flying abilities or habits, have extremely small hearts (0.1–0.2), as do Turkeys (*Meleagris gallopavo*) (0.40), Bobwhite (*Colinus virginianus*) (0.39), Spruce Grouse (1.0), and Willow Ptarmigan (1.3). These are all species which typically walk or run more frequently than they fly. Many aquatic birds which generally dive for food also have small hearts: in Table 1, observe the heart values for loons (ca. 1.05), cormorants (1.1), eiders (ca. 1.0), murres (0.9), and puffins (1.0). Although the size of these birds certainly influences heart size, the data suggest that flying requires more energy and hence a larger heart than either walking or diving in birds.

Similarly, one can find a good case for soaring or gliding flight when compared with a more active, flapping flight. Among falconiform birds Hartman (1955:227) gave heart ratios of < 0.7 for most of the vultures and buteos, whereas two species of falcons had ratios of > 1.3. In the present work, the jaegers and gulls generally have small hearts. Although jaegers are capable of swift, flapping flight, they frequently soar and/or glide as do the gulls for which data are available here.

All these data relate to activity among birds, and it is of particular interest to call attention to Bowman's careful investigation (1961:80–86) of the Galápagos finches. The heart ratios of nine species of geospizines varied between 0.54 and 0.69, among the smallest such values known for passerines. The small hearts are correlated with foraging activities and flight: the smallest, most active species had the largest heart, and the species with the largest heart had the strongest and most rapid flight. Bowman's data point up a need for more information on bird activity as it is related to heart size in birds.

Heart weights of ptarmigan.—Ever since Strohl reported (1910) on ptarmigan heart weights from Europe, his work has been quoted widely as evidence that at least some birds residing at high altitudes have larger hearts than others residing at lower altitudes. Strohl's data were for *Lagopus alpinus* (= *L. mutus*) taken at 2,000–3,000 meters elevation in the Alps and *L. lagopus* taken at 600 meters over the north plains of the continent. Heart weights of *mutus* were 16.30 grams/1,000 grams body weight, and of *lagopus*, 11.08 grams/1,000 grams. These heart weight differences were therefore attributed to the altitudinal differences. Later, Stieve (1934 *fide* Hartman, 1961) compared heart sizes in these two species and found the differences to be interspecific.

At Cape Thompson these two species were sympatric in the years 1959–61. Heart ratios for birds taken in 1960 are given in Table 1. When these values for adult males are converted to weights comparable to those given by Strohl, *mutus* has a heart weight of 18.5 grams/1,000 grams body weight and *lagopus*, 13.5 grams/1,000 grams. Since both species were collected together at elevations ranging from near sea level up to about 500 feet, the data from Alaska strongly suggest that heart weight differences between these two ptarmigan are not due to altitudinal differences. Rather, heart weight differences seem more related to body weights. Especially is this relationship clear when additional body weights (all adults collected between 1959 and 1961) between the two species are compared. From Table 2 it is plain that *lagopus* in northern Alaska is considerably larger than *mutus*.

Interspecific heart weight differences in these ptarmigan—at least from the overwhelming data from Alaska—should be attributed to body weight differences and not altitude. This does not, of course, negate or minimize intraspecific differences due to altitude as clarified by Norris and Williamson (1955) for other species.

Fat condition.—The relationship between fat condition and migratory

TABLE 2
BODY WEIGHTS OF TWO SPECIES OF PTARMIGAN FROM NORTHERN ALASKA

	Number	Body weight in grams	
		Average	Extremes
Willow Ptarmigan (*Lagopus lagopus*)			
adult male	20	649.5	563.1–752.0
adult female	6	588.4	533.5–683.7
Rock Ptarmigan (*Lagopus mutus*)			
adult male	20	509.3	465.0–552.5
adult female	6	464.1	427.5–500.8

status shown in Table 1 is apparent because most migrating individuals fell into the higher fat classes and, conversely, individuals taken while breeding or probably breeding were, on the average, much less fat. Whereas great masses of abdominal and/or subcutaneous fat might affect the heart weight : body weight ratio, my own observations of such obese birds have also shown considerable fat deposits associated with the heart, but pericardial fat deposits are usually removed before weighing.

In addition to the specimens taken for heart weights, others were collected and frozen for quantitative lipid studies (Johnston, MS). These species were *Calcarius lapponicus, Ereunetes mauri, Acanthis* sp., *Pluvialis dominica,* and *Sterna paradisaea.* The average body lipid content of the first four of these species (ten specimens each) ranged between 5.8 and 7.4 per cent of the total body weight. Ten specimens of *Sterna* had an average body lipid content of only 11.3 per cent. From these and other unpublished data it does not seem likely that such low lipid values could significantly affect the heart weight : body weight ratio in these species.

SUMMARY

Five hundred sixty-three individuals of 77 species were taken near Cape Thompson, Alaska, in the summers of 1960 and 1961. For each of these birds, total body weight, heart weight, and the heart weight : body weight ratio are presented.

By comparing these data with those compiled by Hartman for tropical and subtropical birds, it is concluded that arctic species tend to have larger hearts.

No significant intraspecific sex or age differences were detected.

Heart size is related to body activities: species which spend much time foraging on the ground (regarded as "poor fliers"), those which generally dive for food in water, and soaring birds have smaller hearts than their counterparts which are more active fliers.

The sympatric Willow and Rock Ptarmigan have significantly different heart ratios, but, contrary to earlier beliefs, this difference is attributed to body size rather than altitude.

Body lipids of four breeding species (*Calcarius, Acanthis, Pluvialis,* and *Ereunetes*) amounted to < 10 per cent of the total weight; in another species (*Sterna*), this value was about 11 per cent. In at least these species, it is believed that the heart ratio is not significantly affected by lipid deposits.

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GENERAL NOTES

Chimney perching for warmth in Starlings.—Maintenance of a favorable energy balance by Starlings (*Sturnus vulgaris*) during winter in the northern part of their range is sometimes difficult. This conclusion is evident from observations of mass mortality in severe winter weather (Forbush, 1927:409; Odum and Pitelka, 1939). Like many other species, Starlings are known to roost in situations favoring nighttime heat conservation (see, e.g., Kalmbach, 1932), but heat-conserving actions of daylight periods have been less frequently reported. On cold days during the winter of 1962–63 in Kalamazoo County, Michigan, I noticed a tendency for Starlings to perch on chimneys for extended periods. The birds usually sat quietly, singly or in groups, on the inner edge of the chimney (or, if the chimney possessed a ledge within the aperture, on this ledge). More frequently than not, the lee side of the chimney was used. Little vocalization and few social interactions were noticed; occasionally a bird would bring food to a chimney and eat while it perched there.

To determine whether or not the use of chimneys was related to air temperature, the following procedure was employed: A predetermined route of nine city blocks in Kalamazoo was walked at the same time each morning (beginning between 9:09 and 9:15 AM and ending between 9:29 and 9:34), and the total number of Starlings seen and the number seen perched on chimneys were recorded. Immediately before and after the observation period, light intensity (at 4 feet, reflected from a north-facing gray stone surface) and wind velocity (at 4 feet) were recorded; air temperature was recorded continuously during the observation period. Dates of observation were 1–12 (except 3, 4, 10, 11) March 1963. A parallel series of observations (without wind and light determinations) was made 3–9 March (beginning 8:50–9:00 AM) in Grand Haven, Ottawa County, Michigan, by Jack W. Kammeraad.

The results of these observations indicate that the use of chimney perches increased directly with decreased air temperature (Fig. 1). No particular correlation with wind or light was discernible. From these results, it seems likely that the Starlings were using the chimneys as heat sources. Probably air temperature is not the sole factor involved in chimney perching; rather, the Starlings may tend to perch on chimneys if heat loss is slower there than elsewhere and to leave if high winds, rain, etc., make heat loss greater than in more sheltered sites. (The unusual observation of 100 per cent at + 2° C [see Fig. 1] was of six birds on the only rainy day of the observation period. The lowest count on any other day was 13 birds; presumably, most birds on this day were in sheltered situations where they were not readily seen.) No quantitative estimates of energy relations can be given, but it is patent that under some conditions of low temperature, chimney perching can conserve a substantial amount of energy that would otherwise be dissipated in maintenance of body temperature.

Instances of Starlings perching on chimneys in England have been considered examples of "smoke-bathing," a kind of behavior supposed to be related to anting (see Prideaux, 1947; White, 1948; and for a review of the subject of smoke-bathing, Whitaker, 1957: 246–248). That a "smoke-bathing" behavioral pattern, not connected with maintenance of body temperature, may exist is conceivable, but nothing in the observations presented here seems to require the postulation of such behavior.

I am indebted to Jack W. Kammeraad for the use of his observations, and to Charlotte Calhoun for the opportunity to examine some of her field notes.

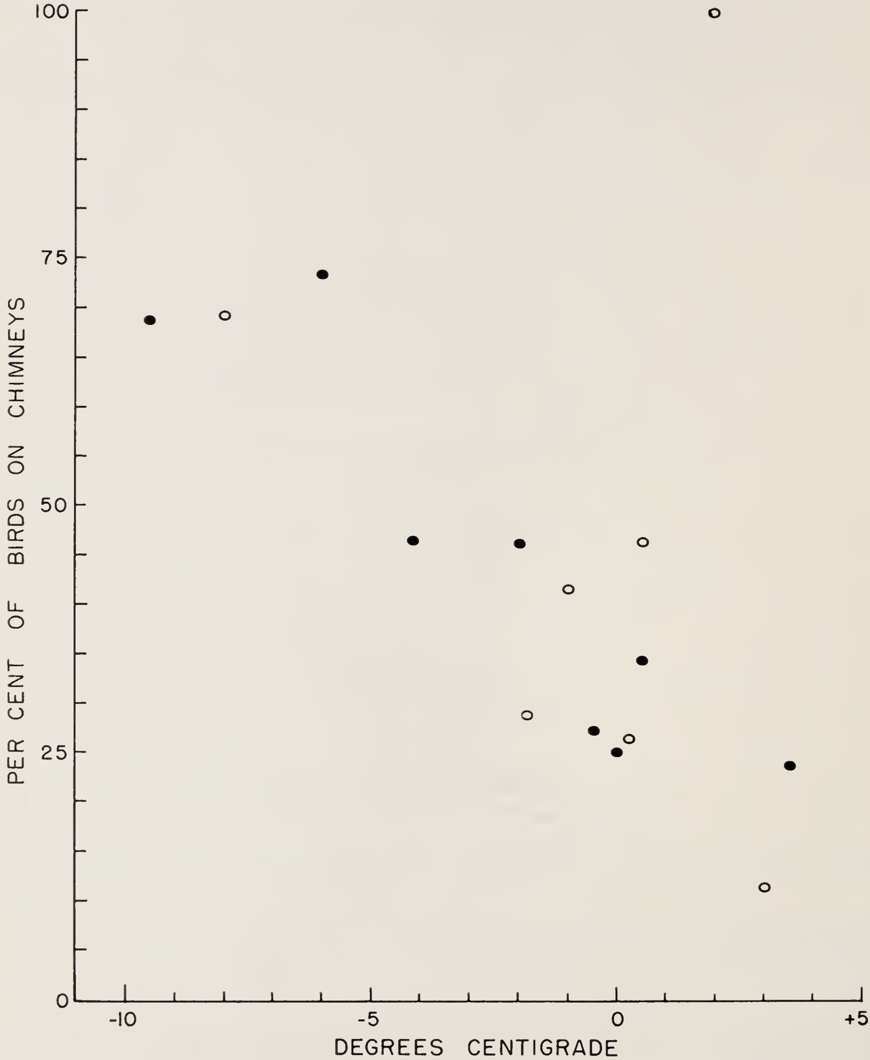

Fig. 1. Relationship between air temperature and the tendency of Starlings to perch on chimneys. Y axis is $\frac{\text{number of Starlings on chimneys}}{\text{total number of Starlings observed}} \times 100$. Solid points are for Kalamazoo, open symbols are for Grand Haven.

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Carolina Wren's ability to survive during severe winters.—In *Wilson Bull.*, 75: 140–158, Barbara G. Beddall describes the range expansion of several species, including the Carolina Wren (*Thryothorus ludovicianus*) in the northeastern states. The article referred to habitats and temperatures but no mention is made of the effect of snowfall upon the possible survival of these species. The following comments refer to the Carolina Wren. Bent's "Life Histories of North American Nuthatches, Wrens, Thrashers, and Their Allies," *U.S. Nat. Mus. Bull.*, 195, says that a 1916 study of 291 stomachs representing every month showed animal matter, nearly all insects, to account for 94.18 per cent of the contents, and when a deep fall of snow covers the ground for a long time, and is accompanied by severe cold, most of the wrens succumbed to cold and starvation. There is also a quotation by Dr. Alexander Wetmore citing two winters when the Carolina Wren population was greatly reduced, and concluding with the statement, "The supposition advanced in my former note that decrease in the species was due not to cold, but to the heavy blanket of snow seems substantiated."

This species, formerly an uncommon resident of Polk County, Iowa, became well established in 1954 and was seen regularly throughout 1961. The severity of the winters following their establishment is shown by the following data furnished by the U.S. Weather Bureau Station at the Des Moines Airport.

Winter Dec.–Feb.	Average temp. F	Minimum temp.	Snowfall 3 months	Average snow on ground
54–55	24.4	–13	22.9″	2.1″
55–56	22.3	–14	15.3	0.9
56–57	25.0	–18	19.5	1.1
57–58	24.8	–20	21.8	1.9
58–59	21.0	–14	19.1	1.2
59–60	25.0	– 8	32.9	4.2
60–61	25.9	–12	15.2	0.6
61–62	17.2	–19	49.4	7.2

There had been no noticeable decrease in the population after the winters of 1956–57 and 1957–58 when there were minimum temperatures similar to those for 1961–62, but there have been no Carolina Wrens reported during 1962 or 1963, from which it appears that there is a limit to the amount of snow cover which this terrestrial feeder can tolerate.—Woodward H. Brown, *4815 Ingersoll, Des Moines, Iowa 50312, 8 August 1963.*

Distributional data on uncommon birds in Utah and adjacent states.—During the summer of 1961, and to a limited extent in 1962, as part of a study on the birds of Utah supported by the National Science Foundation, field parties covered much of the state. While the primary objective was the obtaining of series of geographically variable birds, incidentally several specimens of rare birds were taken and some extensions of range ascertained. The noteworthy data of this nature are presented herewith. In addition, several rarities from the Dugway Proving Grounds taken by John B. Bushman are reported, as well as information on uncommon birds taken in Utah, Wyoming, Colorado, and New Mexico by Clayton White while a member of the University of Utah ecological research team studying the flora and fauna of the Flaming Gorge and Navajo reservoir sites of the Upper Colorado River Basin Project. Unless otherwise stated, all specimens are in the collection of the University of Utah Museum of Ornithology. Several of the specimens were taken by Gary Lloyd, Guy Musser, and Gary Worthen, the members, along with Clayton White, of the 1961 field parties.

Common Loon (*Gavia immer*).—An unusual record for a desert region far from water pertains to a female found alive in a parking lot at Dugway, 4,800 feet, Tooele County, on 18 May 1960. It was preserved as a study skin.

Horned Grebe (*Podiceps auritus cornutus*).—While there are several sight records of this species for Utah, the only specimen was secured in 1872 (1872. Allen, *Bull. Mus. Comp. Zool.*, 3:173) near Ogden. On 8 April 1962, two female specimens were obtained at the Farmington Bay Refuge, Davis County, by Gary Worthen and Hugh Hogle. This grebe is a rare migrant in the state in contrast to the abundant Eared Grebe (*P. nigricollis*).

Green Heron (*Butorides virescens anthonyi*).—Two additional examples of this heron, rare in Utah, have been obtained. Both are immature females. One was taken at Spring Run on the southern outskirts of Salt Lake City on 27 December 1960; the other, 4 miles west of the Salt Lake airport on 9 October 1961. The December example indicates that during mild winters, such as 1960 was, individuals either remain late in migration or winter over in the region.

Ross' Goose (*Chen rossii*).—A mounted specimen at the headquarters building of the State Department of Fish and Game was taken at Flowell, Millard County, on 3 April 1961, by Donald E. Neilson, Superintendent of the Clear Lake Waterfowl Refuge. It had been seen for two weeks associating with a flock of domestic ducks on a small irrigation pond and was so tame that it would flush only as a last resort to avoid capture. It would accompany the ducks on foot into the fields during feeding excursions. This is the second specimen taken in the state and preserved in a collection. There are about a dozen additional sight records.

Hybrid teal (*Anas discors* × *Anas cyanoptera*).—This hybrid specimen was obtained through Calvin Wilson, Superintendent of the Tracy Aviary in Salt Lake City, after it died on 14 February 1962. It had been picked up originally by Mr. Wilson at the Ogden Bay Refuge, Weber County, in September 1951, afflicted with botulism. The underparts are cinnamoneus, but lighter than in the Cinnamon Teal, and the black of the belly is lacking. The speckling of the Blue-winged Teal suffuses the underparts. There is a suggestion of lateral white patches at the base of the tail as in the Blue-winged Teal, but the patches are pinkish in the hybrid. Bill size is intermediate. The color of the scapular and interscapular regions is also intermediate. In general, the head markings are closest to the pattern of the Blue-winged Teal. The cheeks, however, are pinkish and although white is present at the base of the bill on the sides of the face, the crescent of the Blue-winged Teal is indistinct. Unlike either of the parental species, white borders the black of the chin and continues in dilute fashion posteriorly the length of the midline of the throat.

Fulvous Tree Duck (*Dendrocygna bicolor helva*).—A female was taken by Donald E. Neilson at the Clear Lake Waterfowl Management Area, 20 miles south of Delta, Millard County, on 20 May 1959. The largest ovum measured 3 mm in diameter. Only one other specimen has been reported from Utah.

Wood Duck (*Aix sponsa*).—This species is sufficiently rare in Utah that additional records of occurrence are noteworthy. A male bird of the year was taken by Raymond Behle at Farmington Bay Waterfowl Management Area, Davis County, Utah, on 10 October 1962. Donald E. Neilson contributes the following on Wood Ducks for the Clear Lake Waterfowl Management Area in Millard County. On about 1 October 1957, he observed one female feeding with a captive flock of Canada Geese (*Branta canadensis*) penned on the lake shore near the residence. Between feedings it rested on an old fallen fence post in the water a few feet offshore in the lake. The duck was observed almost daily for a month or more. It was fairly tame and could be approached within 100 feet. An immature male was banded on 30 September 1959. It was retrapped two or three times within a two-week period following its banding. Through March 1961, the species had been seen three more times at the refuge, a total of five records in four seasons.

Bald Eagle (*Haliaeetus leucocephalus*).—An adult Bald Eagle was seen on 21 July 1961, near the mouth of Negro Andy Canyon, San Juan County, New Mexico. Its behavior, when flushed, seemed to indicate that it was a nesting bird. Unfortunately, it was not possible to make a thorough search of the area, but there were numerous Douglas firs and cliffs that would provide suitable nesting locations for the species. Bailey (1929. "Birds of New Mexico," p. 108) states that the Bald Eagle occasionally breeds in the state, but most of her records are for fall and winter.

Pigeon Hawk (*Falco columbarius columbarius*).—In the last checklist of the birds of Utah, Woodbury et al. (1949. *Bull. Univ. Utah Biol. Ser.*, 11(2):11) give this race the status of sparse migrant or winter resident, but without substantiating data. The only Utah representative of the race that we know of is a male specimen in the University of Utah collection taken in the Salt Lake City Cemetery on 9 March 1937, and identified by John W. Aldrich in 1941. Incidentally, the A.O.U. Check-list (1957) does not indicate that this race is accidental or casual in western North America.

Pigeon Hawk (*Falco columbarius suckleyi*).—A female of this race was shot at the Tracy Aviary in Salt Lake City on 1 February 1954. It was identified by John W. Aldrich in 1960. Two examples of this race from Ogden, Utah have been reported previously by Porter and Knight (1952. *Auk*, 69:84).

Sora (*Porzana carolina*).—A specimen was taken in the housing area of the Dugway Proving Ground far from water at the south end of the Cedar Mountains, 4,800 feet, Tooele County, on 26 August 1957.

Semipalmated Plover (*Charadrius semipalmatus*).—Two specimens were taken at the sewer pond marsh, 4,700 feet elevation, near the main gate of the Dugway Proving Grounds at the south end of Skull Valley, Tooele County, on 29 April 1961. This species is a casual migrant in Utah and not known heretofore from the Dugway desert area.

Long-billed Dowitcher (*Limnodromus scolopaceus*).—Eleven specimens were taken at a pond just north of the Utah–Wyoming border, 5 miles southeast of Mountain View, 6,000 feet elevation, Uinta County, southwestern Wyoming, on 11 August 1962. They are all in breeding plumage save one which is in a transitional stage toward the winter dress. Knight (1902. *Univ. Wyo. Exp. Sta. Bull.*, 55:46) indicates that the species is rare in Wyoming, with all records confined to the southeastern portion. Twomey (1942. *Ann. Carnegie Mus.*, 28:393) reports three specimens taken in May 12 miles east of Vernal in northeastern Utah. His only fall records pertain to flocks seen 10 and 25 September.

Sanderling (*Crocethia alba*).—One was taken on 29 April 1961, at the sewer pond marsh near the main gate of the Dugway Proving Grounds at the south end of Skull Valley, Tooele County. This is an uncommon migrant not known previously from the west desert region of Utah.

Bonaparte's Gull (*Larus philadelphia*).—A specimen was secured 6 miles northwest of Camelback Mountain, 4,300 feet, Tooele County, on 25 April 1955. It was in a puddle in a roadside barrow pit. In addition to this being a new and unusual record for the desert, it is one of half-a-dozen records for the state.

White-winged Dove (*Zenaida asiatica mearnsi*).—Until 1961, the only published record of the species for the state was that by C. W. Lockerbie, reported *in* Woodbury et al. (op. cit.:16) in East Canyon, Morgan County, on 1 August 1939. According to Mr. Lockerbie, their observation was of a single bird among a flock of Mourning Doves (*Zenaidura macroura*) frequenting the sagebrush along the east side of the East Canyon reservoir. However, there is another hitherto unreported observation. Clifton Greenhalgh of the Utah State Fish and Game Department saw one in a flock of Mourning Doves at Park Valley, Box Elder County, during June 1949.

Indications are that the species may be extending its breeding range into Utah. In early June 1961, Clifton Greenhalgh reported a flock of about a dozen at the Terry Ranch, in the Beaver Dam Wash, Washington County, 2,500 feet elevation, 5 miles north of the Utah–Arizona border in extreme southwestern Utah. One of our field parties visited the site on 23 June 1961, seeking a specimen, and although unsuccessful in this regard, the species was nevertheless seen on 24 June at the Lytle Ranch to the north. Mr. Lytle stated that he had observed White-winged Doves for several years. Two specimens were taken by Darold Nish at Greenhalgh's request and later brought to the University by Mr. Greenhalgh. They were a male and female, obtained at the Terry Ranch on 24 June 1961. The testes of the male measured 16 mm long, and the largest ovum of the female was 6 mm in diameter.

On 25 May 1962, Dean Stock of the University of Utah obtained a female at the Terry Ranch. Its ova measured 5 mm. Several others were seen at the time. In early July 1962, Dennis L. Carter of the Naturalist staff of Zion National Park also found the species in the Beaver Dam Wash. It would thus seem that the species is now established in the Wash in small numbers and probably breeds there. Much field work by many ornithologists in southwestern Utah prior to 1961 had failed to reveal the presence of the species, thus leading to the inference that recently there has been an extension of breeding range. Furthermore, records are accumulating from elsewhere in the state.

Lynn Greenwalt, Refuge Manager at Fish Springs National Wildlife Refuge in Juab County, central western Utah, reports that a White-winged Dove was trapped and banded at the refuge on 24 May 1961. A second White-winged Dove was trapped at Fish Springs on 8 September 1962, but expired in the trap and was prepared as a specimen. Two were observed on 1 May 1962, in Liberty Park, Salt Lake City, by Dan Dickerson, a student at the University of Utah.

Spotted Owl (*Strix occidentalis lucida*).—A female Spotted Owl was collected on 15 July 1961, in Frances Canyon, Rio Arriba County, New Mexico. This bird, her mate, and three fledged young were roosting midway up an 18-foot mountain red cedar in an association with Douglas fir. Another nesting pair was observed the same day in LaJara

Canyon, the adjacent canyon north of Frances Canyon. Bailey (op. cit.:330) says that Woodhouse reported it as common in the state in 1851, but since then it has been seen only on rare occasions.

Lesser Nighthawk (*Chordeiles acutipennis texensis*).—Heretofore this nighthawk has been known in Utah only from the extreme southwestern corner (Virgin River Valley), where it is considered to be a sparse summer resident. In addition to specimens being taken at the Terry Ranch in the Beaver Dam Wash and at St. George in southwestern Utah, two male specimens were secured one mile north of Hanksville, 4,100 feet, Wayne County, 8 July 1961, in southeastern Utah. The testes in the two specimens measured 6 and 7 mm long.

Black Swift (*Cypseloides niger borealis*).—To add to the data presented by Knorr (1962. *Condor*, 64:79) pertaining to the Black Swift breeding in the Wasatch Mountains of northern Utah, there is a specimen in the University of Utah collection prepared from a bird found dead by Guy Musser on 2 August 1960. It was clinging to tules along the stream issuing from Weeping Rock, Zion Canyon, 4,500 feet, Zion National Park, Washington County, Utah. Other information bearing on the distribution of this species in Colorado and New Mexico is as follows. An adult female with enlarged ovary was taken near Allison, La Plata County, Colorado, at a location about 3 miles north of the New Mexico border, on 12 June 1960. It is in the University of New Mexico collection. The enlarged gonads would indicate a breeding bird and it may prove to be from a breeding colony in New Mexico since several Black Swifts were seen by Clayton White throughout the month of July along the San Juan River in New Mexico. One was in the company of several nesting White-throated Swifts (*Aëronautes saxatalis*) on 15 July 1960, at a location one mile above the prospective dam site, which is about 50 miles east of Farmington, New Mexico, and 30 miles south of the Colorado–New Mexico border. Bailey (op. cit.:349) states that in 1883 Mr. Anthony found them nesting in the highest mountains of southwestern Colorado, but the first verified breeding record for Colorado is as recent as 1950 (Knorr, 1950. *Auk*, 67:516) from a location only about 80 miles north of the Navajo reservoir area. More recently, Knorr (1961. *Wilson Bull.*, 73:155–170) reported sightings still closer to the reservoir site, from Archuleta County, Colorado. Bailey (loc. cit.) gives only fall records and states that there are no summer records for the state.

Rufous Hummingbird (*Selasphorus rufus*).—There has long been a question whether this species may breed in Utah in addition to being a transient. Bee and Hutchings (1942. *Great Basin Nat.*, 3(3–4):73) list three breeding records at Lehi, Utah County, on 20, 21 June and 30 July. In a footnote, C. Lynn Hayward comments, "The breeding records of the rufous hummingbird are of unusual interest. Bent (1940, U.S. Nat. Mus. Bull. 176, p. 396) states that the species breeds south as far as southwestern Montana and suggests that it may be found in the mountains further southward. A nesting specimen was collected and mounted by Mr. Hutchings and was later supposedly sent to Brigham Young University, but unfortunately it was lost. However, Mr. Hutchings carefully checked the specimen and there is no doubt as to its identity." Also suggesting breeding status is a specimen taken by Gary Worthen on 10 July 1961 on the Wasatch Plateau, 9,000 feet elevation, at the north end of Fairview Reservoir, Sanpete County. It was a male that weighed 0.8 gram, with testes 2 mm long. However, the specimen had a thin layer of fat, suggesting that it may have been a migrant. Bailey (1928. "Birds of New Mexico," p. 363) mentions migrant Rufous Hummingbirds in that state on 7 July. Clayton White observed an adult male defending two young that were perched on a wire fence at the Tracy farm at Naf, Idaho, 1 August 1961. This is about one mile north of Nafton, Utah.

Black Phoebe (*Sayornis nigricans semiatra*).—Eight additional examples were taken of this species, known in Utah only from the southwestern corner of the state. One was secured at the City Springs, St. George, on 30 December 1960, and another example from the same locality was taken on 19 June 1961. One was taken at the junction of the Virgin and Santa Clara rivers on 30 December 1960, and another there on 22 June 1961. Four were taken at Three Lakes, 5 miles north of Kanab, 26–27 June 1961. Two were also seen in the town of Newcastle, Iron County, on 26 May 1962. The two December examples indicate that the species is a permanent resident and the new data suggest that this phoebe is more common in southwestern Utah than heretofore supposed.

Verdin (*Auriparus flaviceps acaciarum*).—Although this species was known to occur in extreme southwestern Utah as a resident, there was only one specimen in the University of Utah collection. Seven more now have been added. Two were taken at the Terry Ranch in Beaver Dam Wash on 30 December 1960, and one at St. George the following day. The other four, including a juvenile, were taken at the Terry Ranch in the Beaver Dam Wash on 23–24 June 1961.

Brown Thrasher (*Toxostoma rufum longicauda*).—A specimen obtained by John B. Bushman at Fish Springs, 4,350 feet elevation, Juab County, on 9 June 1961, is the third record of this species for Utah. It was a male with testes measuring 13 by 7 mm.

Crissal Thrasher (*Toxostoma dorsale coloradense*).—Although reported from southwestern Utah as early as 1891, few specimens have been obtained since and the species was not represented in the collection at the University of Utah. We now have seven specimens as follows, all from the City Springs area, 2,800 feet, St. George, Washington County. Two females were taken on 31 December 1960, an adult male and a juvenile female on 20 June 1961, and three juveniles (two males and a female) on 25–26 May 1962.

Hermit Thrush (*Hylocichla guttata oromela*).—An immature female obtained at the mouth of Emigration Canyon, 5,500 feet, Salt Lake City, on 7 October 1961, has been identified by John W. Aldrich as of the race *oromela*. This migrant kind has been reported only five times previously from Utah.

Cedar Waxwing (*Bombycilla cedrorum*).—Suggesting nesting status, a pair with young was seen in an orchard 21 miles south of Hanksville, Wayne County, on 13 June 1961. A pair of adults was also seen in the town of Garrison, Juab County, on 24 May 1962. Although fairly common some winters in company with Bohemian Waxwings (*B. garrulus*), there is only one certain breeding record for the state.

Red-eyed Vireo (*Vireo olivaceus*).—Two records may be added to the few already available of this uncommon migrant in Utah. A specimen was obtained in Salt Lake City on 1 June 1962, and one at Dugway, Tooele County, taken on 6 September 1962, one and a half miles southeast of the main gate.

Northern Waterthrush (*Seiurus noveboracensis notabilis*).—A migrating female taken at a desert waterhole in southeastern Utah represents this race. It was taken at Green Water Spring, 5,400 feet elevation, Castle Creek, 18 miles southwest of the Natural Bridges National Monument, San Juan County, 13 May 1960. It was in a clump of willows beside a pond. Another Great Basin specimen was taken at the Dugway Housing area, 4,800 feet, Tooele County, on 21 May 1961. Waterthrushes are rare migrants in Utah and only about a dozen record specimens have been taken.

American Redstart (*Setophaga ruticilla*).—An adult male was taken 3½ miles east of Camelback Mountain, 4,335 feet elevation, Tooele County, on 30 August 1961. Not only is the species rare in northern Utah but its occurrence in a barren, desert region is unusual.

Hooded Oriole (*Icterus cucullatus nelsoni*).—A breeding male with testes measuring 9 mm long was taken on 25 June 1961, at the Lytle Ranch, 2,500 feet elevation, Beaver Dam Wash, Washington County. This is the third specimen, to our knowledge, from Utah.

Scott's Oriole (*Icterus parisorum*).—Five additional specimens of this rather rare oriole in Utah were taken at the Lytle Ranch, 2,500 feet elevation, Beaver Dam Wash, Washington County, on 25 June 1961.

Blue Grosbeak (*Guiraca caerulea interfusa*).—Heretofore the records of this species in Utah have been confined to the Colorado River drainage, but a female specimen was obtained 4 miles west of Lehi, 4,562 feet, Utah County, on 29 June 1961, in the Great Basin. In addition, on 22 August 1962, three were seen at the Farmington Bay Refuge by Roger Tory Peterson and several other ornithologists.

Indigo Bunting (*Passerina cyanea*).—A breeding male was taken at River Mile 372, Green River, 6,050 feet, Sweetwater County, Wyoming near the Utah border on 4 July 1959. Knight (loc. cit.) does not report the species for Wyoming and there are but two records for Utah.

On 16 July 1961, an adult male was seen by Clayton White on Los Pinos River, San Juan County, New Mexico. Bailey (op. cit.) does not record this species for the state.

Black Rosy Finch (*Leucosticte atrata*).—To add to the data presented by Miller (1955. *Condor*, 57:306) and French (1959. *Condor*, 61:18–29) on the distribution of the species, the Black Rosy Finch has been found breeding in two additional mountain ranges in Utah. Behle (1958. *Univ. Utah Biol. Ser.*, 11(6):33) reported a sight record of the species in the Raft River Mountains. On 27 July 1961, Clayton White, Gary Lloyd, and Guy Musser saw several, including family groups of adults and young, at some cliffs near the head of Clear Creek, 9,000 feet, in the Raft River Mountains, but specimens were not obtained. However, on 16 July 1962, White obtained one specimen, a breeding female, thus definitely establishing the occurrence of a colony in this mountain range of northwestern Utah.

French (op. cit.:27) commented that the LaSal Mountains of southeastern Utah were expected to harbor breeding rosy finches. However, neither he nor Behle (1960. *Univ. Utah Biol. Ser.*, 12 (1)) found them there. French further commented that although this range has peaks of 13,000 feet elevation, few have cliffs suitable for rosy finch nest sites, and he postulated that aridity may be influential in preventing a rosy finch population there. A continued quest met with partial success on 15 July 1961, when the female of a pair was taken at the head of Dark Canyon, 12,000 feet elevation, on the east crest of the LaSal Mountains. Since only a pair was seen after several days of field work, the inference is that the species is rare. The finding of the Black Rosy Finch in the LaSal Mountains would seem to rule out the possibility of the Brown-capped Rosy Finch (*Leucosticte australis*) breeding in Utah. Since the latter species apparently breeds in the San Juan Mountains in Colorado to the east (fide French, op. cit.:27), a narrow hiatus separates the breeding ranges of the two species. This gap is less than those separating many of the breeding sites of the Black Rosy Finch.

Lark Bunting (*Calamospiza melanocorys*).—Two more specimens to add to the records summarized by Porter and Egoscue (1954. *Wilson Bull.*, 66:221) were taken 3 miles east of the north end of Camelback Mountain, 4,350 feet, Tooele County, one on 23 May and the other on 6 June 1956.

Grasshopper Sparrow (*Ammodramus savannarum perpallidus*).—A specimen was taken 3 miles east of Camelback Mountain, 4,350 feet, on 19 September 1961. It was presumably a fall migrant, being very fat. This species seems to have disappeared as a breeding bird in Utah along with the removal of grassland through overgrazing.

Lapland Longspur (*Calcarius lapponicus alascensis*).—Evidence is mounting that the longspur, heretofore considered hypothetical or accidental in the state, is actually a regular, although uncommon, winter visitant, at least in the northern part of Utah. Porter (1954. *Condor*, 56:364) reported a specimen from the Dugway Proving Grounds, Tooele County, taken on 13 April 1953, representing the race *C. l. lapponicus*. However, the race *C. l. alascensis* seems to be more common, for Porter (loc. cit.) reports a specimen of this race also from Dugway taken on 3 November 1953, and Killpack (1953. *Condor*, 55:152) and Killpack and Hayward (1958. *Great Basin Nat.*, p. 25) give several records from the Uinta Basin around Roosevelt and Myton. A hitherto unreported specimen of *C. l. alascensis* was taken by William H. Behle at the Farmington Bay Waterfowl Management Area on 5 November 1955. Another representative of *alascensis* from Dugway is a male found dead on 9 October 1957, beside a building 3 miles east of Camelback Mountain, Tooele County.—William H. Behle, John B. Bushman, and Clayton M. White, *Department of Zoology, and Ecology and Epizoology Research, University of Utah, Salt Lake City and Dugway, Utah, 15 March 1963.*

Production of sterile eggs in the Dickcissel.—Because female Dickcissels (*Spiza americana*) are secretive, their nests are difficult to find, and little is known about incubation in this species. Gross (1921. *Auk*, 38:169) reported that of eleven nests that were studied in 1918 in the state of Illinois, sterile eggs were contained in six. Some "sterile" eggs were broken open by Gross and were found to show no embryonic development. Of five eggs contained in one nest, four were sterile.

In late May to early July 1963, nine nests containing eggs of the Dickcissel were found within 4 miles of Lawrence, Kansas. Observation of these nests until their eggs hatched or were destroyed by predators (four nests were robbed) revealed that of five nests, four contained sterile eggs. In one nest containing five eggs, two were sterile. Sterile eggs were found, one in each nest, in two nests containing three eggs and in one nest containing five. The one nest lacking a sterile egg contained only three eggs. Therefore, in northeastern Kansas as well as in Illinois the production of sterile eggs in the Dickcissel is seemingly not uncommon.

It is difficult to show adaptiveness in the production of sterile eggs because their production requires an expenditure of energy. Laying of sterile eggs entails making unnecessary trips to the nest, increasing the chance that predators find it.

Skutch (1957. *Ibis*, 99:69–93) suggested that incubation by both male and female is primitive behavior. In the Dickcissel all of the duties of nest building, incubation, and care of young are now performed by the female (Gross, op. cit.). The male is brightly colored, resembling in color and pattern the meadowlark; whereas the female is obscure in color and pattern. Selection may have been, therefore, in favor of a small brood so that the female, in assuming all responsibility for it, could find and bring sufficient food for the young. Obviously, a decrease in clutch size would decrease the brood size; but it is suggested that in the Dickcissel the brood size has been decreased by the production of sterile eggs. If so, the physiological mechanisms governing clutch size in this species seem to be relatively more immutable than those governing fertilization.

I thank J. Knops, of the University of Kansas, and my wife, C. F. Long, for helping with the field studies.—Charles A. Long, *Department of Zoology, University of Illinois, Urbana, Illinois, 8 October 1963.*

An unusual Mallard nest.—On 12 June 1963, a painter found a duck nest on top of one of the campus dormitories. This did not seem peculiar since we have several records of Wood Ducks (*Aix sponsa*) nesting on campus buildings on the south shore of Lake Mendota, Madison, Wisconsin. The building on which the nest was found was about 100 yards from the lake. A university photographer (Gerry Schultz), the painter (William Tortorici) who found the nest, and I visited the site and photographed the duck and nest. The duck was a Mallard (*Anas platyrhynchos*) and was sitting on seven eggs. An eighth egg had rolled out of the flimsy nest and was never retrieved by the hen. The nest

was built in a rain gutter on the roof of a four-story dormitory. The incubating hen was shaded in the afternoon by the overhanging boughs of a large ash tree (*Fraxinus pennsylvanica*), and the slope of the roof gave partial shade in the morning. The nest was built of debris found in rain gutters, e.g., twigs, leaf fragments, many ash seeds, flakes of gutter paint, and unidentifiable material. The entire nest weighed 48 grams. There was surprisingly little down in the nest, but even the small amount of down held the other components together. The bird was very docile, indicating that it had been sitting for some time. Eight days later, all but three eggs remained, and the hen had deserted. Common Crows (*Corvus brachyrhynchos*) frequent the campus area and could have removed the eggs. I examined the remaining eggs and found them to be infertile or addled very early in incubation. It seems likely that a shower during early incubation would undoubtedly have chilled the eggs since the nest was in the base of the water trough.—ROBERT A. MCCABE, *Department of Wildlife Management, University of Wisconsin, Madison, Wisconsin 53706, 5 August 1963.*

Chimney Swifts gathering insects off the surface of a pond.—On 6 July 1960, while filming near Margaretville in the Catskill Mountains of New York, I observed two Chminey Swifts (*Chaetura pelagica*) in what I believe was the act of scooping insects off the surface of an ice pond on a farm about two miles northwest of town. Roberts ("Birds of Minnesota," Vol. 1, p. 650) notes that "Swifts, like Swallows, drink by dipping lightly to the surface of the water." However, the manner in which these birds dipped to the water, and especially their erratic flight, led me to believe that they were collecting insects from the surface rather than obtaining a drink. Both swifts carried on this erratic searching, darting flight just above the surface of the water, periodically dipping their bills to the water. This they did for a few minutes at a time and then they flew directly toward a group of farm buildings about a quarter of a mile away. A few minutes later they returned to repeat the performance. Speculation was that the pair had a nest somewhere in these farm buildings and were feeding their young with the material they gathered. However, time did not permit me to locate the nest and I did not observe Chimney Swifts repeating this method of food gathering even though I revisited the pond many times subsequently when swifts were flying overhead. The maneuverings of the two Chimney Swifts occurred at 9:35 AM and were observed for about 15 minutes. During this time they made three trips to the farm buildings, so apparently this was not a casual occurrence but a definite pattern for this particular time. This procedure probably continued longer, but I had to leave the scene.

Although I have not made an exhaustive search of the literature in trying to find references to this mode of feeding by Chimney Swifts, all references in *The Auk, Bird-Banding, The Condor, The Wilson Bulletin* and many state and regional publications were checked. There are several references in the literature of swifts "drinking" (Roberts, "Birds of Minnesota," Vol. 1, p. 650; Forbush, "Birds of Massachusetts," Vol. 2, p. 313; Witherby et al., "Handbook of British Birds," Vol. 2, p. 245) and "feeding" (MacDonald, "The Birds of Brewery Creek," pp. 108, 255–256; Bent, "Life Histories of North American Cuckoos, Goatsuckers, Hummingbirds and their Allies," *U.S. Nat. Mus. Bull.*, 176:271–272; Witherby, op. cit., 2:249) over and around water but they are vague about whether any of the swifts were actually engaged in collecting insects from the water surface.—WALLACE N. MACBRIAR, JR., *Milwaukee Public Museum, Milwaukee 33, Wisconsin, 24 March 1962.*

Blue Jay attacks cowbird nestling.—At approximately 2:00 PM, 15 July 1963, my family and I were suddenly attracted to the sound of quarreling birds at the asphalt parking lot of the Audubon Nature Center, Greenwich, Connecticut. I turned in time to see an adult Blue Jay (*Cyanocitta cristata*), at a height of about 3 feet, drop a nestling from its bill to the ground, apparently as the result of an attack upon the Blue Jay by an adult Catbird (*Dumetella carolinensis*). After dashing at the Blue Jay, which dropped its prey, the Catbird flew to the hedge bordering the parking lot, remained hidden, but constantly called. The Blue Jay attempted three or four times to pick up the struggling nestling in its bill as we approached, but gave up and flew away.

Upon examination, I found two of the secondaries of the left wing badly torn and projecting up oddly. I easily broke them off. The nestling was a Brown-headed Cowbird (*Molothrus ater*) of the size and activity which I had some years ago found capable of limited flight and able to leave Scarlet Tanager (*Piranga olivacea*) nests. After holding it in my hand so that it could be viewed by my daughters and others interested, where it remained completely calm and with eyes closed, I took it to the hedge bordering the parking lot. By tapping its legs against a small branch, I caused it to perch, but within ten seconds it flew toward the calling Catbird in a descending flight, disappearing into the dense cover about a foot above the ground.

It would seem that the cowbird nestling was, in some way, attractive to the Catbird and may have been from its nest. While Young (1963. *Wilson Bull.*, 75:117) includes the Catbird as a species infrequently parasitized by the cowbird, Friedmann (1929. "The Cowbirds," pp. 193, 194, 253) indicates that the Catbird is a very uncommon victim and is absolutely intolerant of cowbird eggs. It is entirely possible, of course, that the Catbird was merely attracted by the distress calls of the nestling, and that its disquieted continuing calls after the incident were in reaction to the entire situation complicated by human interference. Moreover, the direction of flight of the cowbird young was not only toward the calling Catbird but directly away from me. Whether or not the cowbird nestling was from a Catbird nest, actual accounts of interspecific predatory relationships are sufficiently infrequent to warrant mentioning of this interesting occurrence.—KENNETH W. PRESCOTT, *Academy of Natural Sciences of Philadelphia, 19th and Parkway, Philadelphia, Pennsylvania, 7 August 1963.*

Unusual behavior of a Northern Shrike.—On 1 December 1962, at Ester Dome, 7 miles west of College, Alaska, I observed an adult Northern Shrike (*Lanius excubitor*) abandoning a freshly killed Pine Grosbeak (*Pinicola enucleator*) to attack a Sharp-tailed Grouse (*Pedioecetes phasianellus*). The shrike, when first seen, was pursuing a flying grosbeak, which took refuge in a clump of high-bush cranberry shrubs where other grosbeaks were sitting. After several minutes, one of the grosbeaks flew out and hovered in front of the bush, picking at berries. The shrike immediately left its perch in a nearby tree and attacked the hovering grosbeak, apparently hitting it with the bill or biting it in the head region, knocking the grosbeak to the ground. The shrike picked up the grosbeak in its feet and flew to a birch tree about 75 feet from me and alighted. A group of three Sharp-tailed Grouse, seemingly frightened when I moved, suddenly flushed from the ground about 35 feet from the base of the tree in which the shrike had just alighted. Almost simultaneously with the flight of the grouse, the shrike dropped the dead grosbeak and left its perch in pursuit of the grouse. The shrike flew low to the ground and overtook the grouse. Upon reaching them, it rose above the last one and struck down at its back with feet and bill. I could not observe whether the grouse was actually hit. Two such strikes were made before the birds were lost to view around a clump of trees.

In view of the size difference, the grouse weighing between 600 and 750 grams and the shrike about 62 to 68 grams, it seems unlikely that the shrike was actually attacking so large a bird as a prey item. Cade (1962. *Wilson Bull.*, 74:394) gives 80 to 100 grams as near the maximum-size prey a shrike can handle. Thus, this behavior approaches in character and nature what Moynihan (1955. *Auk*, 72:242) terms "redirection" (a reaction directed toward an object or animal other than the one releasing or directing the reaction). Although Ficken and Dilger (1960. *Animal Behaviour*, 8:240–259) would reserve the term redirection for a reaction to a "subnormal" stimulus initiated by a "normal" stimulus, the actions of the shrike fit the general pattern of the Prairie Falcon (*Falco mexicanus*) cited by Moynihan (loc. cit.).

It is believed that when the shrike was disturbed by my presence, and possibly startled by the unexpected noisy flight of the grouse, it became frustrated and unable to accomplish the usual "innate" sequence of killing, impaling and eating its prey as is, according to Cade (personal communication), characteristic. The shrike seems to have found an outlet for its thwarted feeding behavior by attacking the grouse.

Although this behavior may be somewhat obscure, in precise interpretation, and not categorically fit any existing, applied definition, it seems noteworthy that the shrike, under the observed circumstances, should attack a bird outweighing it by nearly tenfold. Such attacks by shrikes appear to be heretofore unrecorded in the literature.

I wish to thank Dr. Tom Cade for several pertinent comments concerning this note.—Clayton M. White, *Biological Sciences Department, University of Alaska, College, Alaska, 26 July 1963.*

Migrant Cape May Warbler apparently carrying nest material.—The gathering and carrying of twigs by a female Cape May Warbler (*Dendroica tigrina*) at Bloomington, Indiana, on 16 May 1961, is of interest because the bird may safely be assumed to have been a migrant. Bloomington is about 400 miles south of the southern edge of the known breeding range of the species (A.O.U., 1957. "Check-list of North American birds"). Although there are numerous records of the performance of acts that are components of nest building by birds unprepared to complete a nest in which eggs will be laid (Armstrong, 1947. "Bird display and behaviour"), such behavior has apparently rarely if ever been recorded of individuals not yet arrived on the nesting ground. Nothing suggested that the acts were in the nature of display or of displacement activity.

The episode occurred at 8:45 AM on a clear day; the temperature was 60 F. Two female Cape May Warblers were moving through two ornamental Norway spruces (*Picea abies*) about 35 feet high. These spruces stood with interlaced branches beside a house located in a sunny clearing at the edge of a mature deciduous woods. Suddenly, one bird, 15 feet above the ground, seized with her bill a loose twig about 6 inches long. She manipulated this twig so that she held it near the middle and then began hopping upward around the periphery of the tree, dropping the object after 20 seconds and at a height of 20 feet. Four minutes later the performance was repeated at a height of 22 feet, apparently by the same bird. She then disappeared from view, and no more Cape May Warblers were seen at the spot.

It is interesting that this species has "rather strict requirements for nesting habitat . . . fairly open coniferous forest with a good percentage of mature spruces or . . . dense spruce forest with a scattering of taller spires above the canopy level" (W. W. H. Gunn, *in* Griscom and Sprunt, 1957. "The Warblers of America," p. 117). Twigs are among the usual nesting materials, but Bent (1953. *U.S. Natl. Mus. Bull.*, 203:215–216) suggests that they are sparingly used. The return to the breeding grounds is in late May or early June. The earliest nest-building date I have found is 2 June, reported by Bond (1937. *Auk,* 54:306–308), from Maine.

For at least two other migrant species of wood warblers there is evidence that some females reach the breeding range ready to perform behavior patterns involved in nest building. The female Prothonotary Warbler (*Protonotaria citrea*) returns to Michigan from the south often to find a nest site selected by the male and a nest already under construction. This structure the female "shortly" completes (Walkinshaw, 1953. *Wilson Bull.,* 65:154). I regularly see female Prairie Warblers (*Dendroica discolor*) picking up and dropping nest material soon after their arrival on the males' territories in spring. Occasionally this has occurred on the day of a bird's appearance on the territory, which may also have been the day on which her migration had been completed.—VAL NOLAN, JR., *Indiana University, Bloomington, Indiana, 10 July 1963.*

Prey of a Sparrow Hawk family when raising young.—This is a summary of food habits observations on a family of Sparrow Hawks (*Falco sparverius*), showing that another lizard, the Six-lined Racerunner (*Cnemidophorus sexlineatus*), and another bird, the Horned Lark (*Eremophila alpestris*), should be added to the list of known prey of this hawk.

Between 14 June and 1 July 1959, I observed a family of Sparrow Hawks several times. During this time, the family included the two parents and four male fledglings. Until old enough to leave the area, the young hawks lived mainly in the top of an old American elm (*Ulmus americana*) in the residential area of Nevada, Missouri.

Prey remains found under the tree during daily inspections as well as observations on the hawks with prey are my sources of information.

Insect remains under the tree indicate that the hawks ate many grasshoppers.

A parent bird arrived with a lizard on two separate occasions, on 21 and 23 June. Also, on 21 and 22 June, a young hawk had a lizard in its possession. On 21 June, in another instance, a young hawk flew from the top of a telephone pole directly across the street and captured a wounded Six-lined Racerunner I had found under the tree and had placed on the lawn within view of this hawk. It struck the lizard twice with its beak and then flew up with the prey to the elm. Reptilian remains collected on 14 June include one complete specimen and two separate tails of the Six-lined Racerunner.

A young hawk was eating a greyish-brown bird on a jutting limb at 1 PM, 16 June. The young had received food on two separate earlier occasions that day. Bird remains are as follows: House Sparrow (*Passer domesticus*), representing three individuals at least, collected 14 June; Horned Lark, one headless mutilated body, 16 June; Robin (*Turdus migratorius*), one headless partially eaten body, 16 June.

Although I never saw these hawks capture a bird, they clashed frequently in the area with potential prey species such as the Purple Martin (*Progne subis*), Eastern Kingbird (*Tyrannus tyrannus*), Starling (*Sturnus vulgaris*), and Robin.

Although the large role of the insect in the diet of this hawk is rather well known, I have found only one suspected use of the Six-lined Racerunner by the Sparrow Hawk. Fitch (1958. *Univ. of Kansas Publ. Mus. of Nat. Hist.,* Vol. 11, No. 2) found no evidence that the Sparrow Hawk preys on the Six-lined Racerunner, but he suspected that since Sparrow Hawks prey commonly on lizards that live in open situations, they might also use the Six-lined Racerunner.

I want to thank Mr. H. G. Deignan, Division of Birds, U.S. National Museum, for identifying the bird prey, and Mr. Loren D. Moehn, Biology Department, Cottey College, for identifying the lizards and for suggesting a pertinent reference on the Six-lined Racerunner.—DONALD H. LAMORE, *Cottey College, Nevada, Missouri, 7 January 1963.*

Brown Thrashers nesting in a cavity of a tree.—Unusual nesting sites of various species of birds have been observed and recorded by many workers in ornithology. Bent (1948 and 1949. *U.S. Nat. Mus. Bull.* 195 and 196, respectively) lists several examples of unusual nesting sites for the House Wren (*Troglodytes aedon*), the Mockingbird (*Mimus polyglottos*), and the Robin (*Turdus migratorius*). However, I have not read or heard of the Brown Thrasher (*Toxostoma rufum*) nesting in a natural cavity of a tree.

While conducting research on the nesting heights of birds around Ruston, Louisiana, I found a pair of Brown Thrashers on 12 April 1963, nesting at the "Tech Farm" in an open-type cavity of a willow (*Salix* sp.). Of the 108 nests of this species found thus far, 107 have been of the typical open-statant type. The term open-type cavity is used to imply that it was not of the typical woodpecker type, but a cavity that was due to decay in the tree. The willow is one of two in a pasture. The height from the bottom of the cavity to the ground measured 147.5 inches. The cavity measured 4 inches across and the highest portion of the surrounding wood measured 19.5 inches. The nest was typical of the species, except that the majority of the sticks in the structure were lacking. The depth of the nest was 1.5 inches and the inside diameter of the structure was 4 inches. All four eggs hatched in this nest.

It is interesting to note that in the same tree, 22 inches higher, there was a nest of House Sparrows (*Passer domesticus*) in another cavity.—WALTER K. TAYLOR, *Department of Zoology, Louisiana Polytechnic Institute, Ruston, Louisiana, 24 October 1963.*

NEW LIFE MEMBER

Sally F. Hoyt, of Etna, New York, an active member of the Wilson Ornithological Society since 1952, is now a Life Member of the Society. She received her A.B. degree from Wilson College, her M.S. degree from the University of Pennsylvania, and her Ph.D. degree from Cornell University. At present, Dr. Hoyt is Administrative Assistant to Dr. Olin Sewall Pettingill, Jr., Director of the Laboratory of Ornithology at Cornell University.

Her avian interests include feeding behavior, attracting birds, bird-study methods, bird-banding, and the Pileated Woodpecker; she has written on the ecology of this species, she has published many short notes and book reviews in a dozen journals, and she co-authored "Enjoying Birds in Upstate New York."

Dr. Hoyt, the widow of Southgate Hoyt—a former WOS member—is a member of Phi Beta Kappa, the A.O.U., Federation of New York State Bird Clubs, NEBB, EBBA, and others. She was Corresponding Secretary of the Federation of New York State Bird Clubs, Inc., and is Bibliography Committee Chairman of the Federation, and also is regional editor of *The Kingbird.*

ORNITHOLOGICAL NEWS

The WOS Treasurer indicates that about 500 members require second dues notices and 150 require third notices each year. Postage alone costs the Society over $32 for these reminders, and the time, stationery, etc., involved are to be considered also. Please pay your dues promptly—mail to Chandler C. Ross, Academy of Natural Sciences, 19th and Parkway, Philadelphia 3, Pennsylvania.

Dr. Thomas G. Scott, past Chairman of the WOS Conservation Committee, current Editor of *The Journal of Wildlife Management,* and former Head, Section of Wildlife Research of the Illinois Natural History Survey, has recently become Head, Department of Fish and Game Management at Oregon State University, Corvallis, Oregon.

Dr. Fred G. Evenden, long-time member of the WOS, is now the full-time Executive Secretary for The Wildlife Society, Suite 615, 2000 P St. N.W., Washington 36, D. C. 20036.

The National Science Foundation announces the next series of closing dates for receipt of proposals for:

Basic Research
- Life Sciences—15 January 1964
- Social Sciences—1 February 1964

Renovation and Construction of Graduate-level
- Research Facilities—1 December 1963

Proposals received prior to these dates will be reviewed and notification of the Foundation's action will be made within four months. Proposals received after these dates will be reviewed following the spring closing dates (Life and Social Sciences, 1 May; Graduate-level Research Facilities, 1 April).

Inquiries or proposals requesting support should be addressed to the National Science Foundation, Washington, D. C. 20550.

All manuscripts submitted for publication in *The Wilson Bulletin* should be sent directly to the new editor, Dr. George A. Hall, Department of Chemistry, West Virginia University, Morgantown, West Virginia.

EDITORIAL—IN APPRECIATION

In this twentieth and final number of *The Wilson Bulletin* published during my editorship I wish to state sincerely, gratefully, and enthusiastically my appreciation to those who have made the editing of this journal not only possible but enjoyable so far as I am concerned.

The invaluable knowledge, counsel, and time of the members of the Editorial Advisory Board were given generously and promptly to this end. They are: Drs. George A. Bartholomew, Andrew J. Berger, William C. Dilger, William W. H. Gunn, William A. Lunk, Robert A. Norris, Kenneth C. Parkes, and Raymond A. Paynter, Jr.

New ornithological literature has been reviewed carefully and diligently by volunteers secured by the editor of this section in the *Bulletin* or by himself, Dr. Olin Sewall Pettingill, Jr.

The Conservation Committee Chairmen, Drs. Thomas G. Scott and Laurence R. Jahn, have written or arranged for the writing of knowledgeable, extensive summaries of current conservation problems. These articles have elicited more favorable comment from readers than any other item in the *Bulletin.*

The W.O.S. Secretaries, Aaron M. Bagg and Dr. P. B. Hofslund consistently have been most cooperative in compiling and forwarding on time the Proceedings of Annual Meetings; and the Treasurer, Dr. Merrill Wood, has conscientiously prepared his annual reports and the long list of members, which appeared every other year. Norman Ford, Library Assistant, has prepared timely reports of new additions to the Josselyn Van Tyne Memorial Library.

Miss Monica Evans has labored well for long hours, annually, to prepare an index to the volume (including the issue containing the index).

Authors, almost without exception, have understood the intent of editorial suggestions and requests and have cooperated accordingly.

Artists Don Eckelberry and Dr. George M. Sutton have generously contributed the use of their original paintings on several occasions, and others have kindly subsidized the reproduction in color of some other paintings. Mrs. Carll B. Tucker's generosity made possible the plate of Robert Clem's painting of the Spotted Rail in the December 1962 *Bulletin.*

The printer of the *Bulletin* (The Allen Press of Lawrence, Kansas) has concerned himself beyond the normally expected scope of service dictated by the nature of his business, to the point of being substantially helpful.

To at least all of these, and to my wife Jean, whose considerable tolerance must not go unmentioned, a publicly recorded acknowledgment and thank you for your various kinds of assistance over the past five years!—H.L.B.

ORNITHOLOGICAL LITERATURE

THE BIRDS OF NOVA SCOTIA. By Robie W. Tufts. Nova Scotia Museum, Halifax, 1961: $6\frac{3}{4} \times 9\frac{1}{4}$ in., xviii + 481 pp., 40 col. pls., 30 line drawings, end-papers map. $7.50.

This book is the culmination of the author's lifetime spent in the outdoors and in promoting conservation in his native province.

While in large part a very fully annotated checklist, the book is actually much more. The 18-page introduction presents Nova Scotia itself, its topography (highlands, shoreline, and islands), geological history (briefly treated), vegetation, and climate. Also included are a historical summary of the ornithological work done previously and notes on bird distribution, protection, and conservation in the province. The contributions of a host of collaborators are acknowledged.

The format is very similar to "Birds of Newfoundland" (1951) by H. S. Peters and T. D. Burleigh. When anyone familiar with it opens "The Birds of Nova Scotia," he will have a feeling that he has seen it all before, as indeed he has insofar as most of the colored plates are concerned. Prepared by Roger Tory Peterson especially for the "Birds of Newfoundland," the plates were loaned by the Government of Newfoundland for use in this work and have been reproduced here in toto even though in several cases, such as the Robin, the Newfoundland subspecies illustrated are noticeably different from the common subspecies found in Nova Scotia. Eight color plates prepared by John A. Crosby of the National Museum of Canada illustrate additional birds found in Nova Scotia. Through no fault of the artist these plates suffer by comparison with Peterson's. The color reproduction is not only poor but the artist had to crowd on them illustrations of species which needed 12 to 14 plates. The species are consequently presented on a much smaller scale than in the Peterson illustrations. In addition to the color plates there are 30 fine drawings by John Henry Dick.

The information under each species is organized under (1) Status of Occurrence, (2) Description, (3) Range of Species, and (4) Remarks. The inclusion of data on description and range, which are available in all standard field guides and occupy so much space here, might be considered superfluous in this type of work. Of greatest importance is the up-to-date information on the occurrence of the various species of birds found in Nova Scotia. This has never before been available in summary. The author's own observations over many years comprise a large part of the data and are very valuable.

The author is to be congratulated on this addition to the regional books on North American birds, and the Nova Scotia Museum and the Government of Nova Scotia on making its publication possible.—W. AUSTIN SQUIRES.

TWO IN THE FAR NORTH. By Margaret E. Murie. Alfred A. Knopf, New York, 1962: $6\frac{1}{4} \times 8\frac{1}{4}$ in., xii + 438 pp., line drawings by Olaus J. Murie, map. $5.95.

Probably no two people have been more concerned over the destruction of our wilderness areas than Olaus and Margaret Murie. This is their story—not of their struggles against the ax and the bulldozer, but of the pleasures and satisfactions derived from their experiences in the wilderness.

There are four parts: Part I, Fairbanks, 1911–1919, deals with Mrs. Murie's girlhood in Fairbanks, Alaska, which she describes as "a flat platter of hodgepodge buildings and low log cabins, a fanshape on the lonely land, fog over the river, smoke plumes rising up from impudent little iron stoves defying the cold and the loneliness and all the powers of the unbeatable North."

Part II, the Upper Koyukuk, begins in June 1921, when, after an absence of two years, Mrs. Murie returned to Fairbanks to finish her education and become the first woman to graduate from the University of Alaska. It includes her meeting with Olaus Murie, from the U.S. Bureau of Biological Survey, who was in Alaska to study the caribou, their August wedding at Anvik on the Yukon, and a honeymoon trip by boat and dog team far up the Koyukuk River. This was Mrs. Murie's introduction to life with a naturalist–scientist–artist who was eager to study, sketch, or collect every bit of wildlife they encountered—mosses, meadow voles, chickadees, grizzly bears—in addition to caribou. The dogs "traveled so slowly that Olaus could point out all the birds. Redpolls and chickadees sang greetings from every side; ravens made patterns across the blue sky, wheeling back and forth over the river below us; pine grosbeaks flitted across the trail; a willow grouse cuddled serenely under some low branches; and flitting through the trees, keeping us company and questioning in liquid rippling notes, were the gray jays. . . ." She passed her initial test well.

In Part III, The Old Crow River, 1926, she returned North with her nine-month-old son and her husband whose assignment was to band young geese and molting adult geese on the nesting ground. This expedition, by boat up the Old Crow River, was without doubt the most difficult—the care of the baby, the wretched mosquitoes, a motor damaged beyond repair before the goal was reached. The Muries took it in stride, finding time to examine fossil bones, listen to White-throated Sparrows, and look over the tundra—"Wavering, hummocky, softly green, it stretched to the sky, here and there a stunted spruce, a small feathery birch, tussocks of white Labrador tea in bloom."

Part IV, Sheenjek, 1956, is a "fur piece" from the Old Crow River. This expedition into the Sheenjek Valley of the Brooks Range was completely modern with planes and two-way radios, nylon tents and movie cameras, and the company of three young scientists who made ecological studies of the animals and plants. Yet with all the new developments the spirit of the book never falters. With the same zest the Muries shoulder their packs and set off on foot toward the mountains and the head of the river. They lunched "beside a talkative stream of the most delicious ice-cold water," they followed century-old caribou trails, and they camped on a gravel bar edged with willows and spruce. Olaus drew arctic poppies and made a cast of a wolf track, while Margaret cooked dinner over the open fire. And on the day that they were farthest north, they looked northwest at "the snow-covered peaks, with glaciers on their sides" and at the canyons. "Canyons, folding in and shouldering into one another, sharply knife-edged and rugged, and all of a dark-reddish and purple tone, cut their way into the heart of the mountain range under the crest."

Hardships and frustration never burden this book which grows better with every page. Anyone who has camped will admire the Muries' organization; anyone with an appetite will rush out and buy Jersey Creams, and anyone with an ounce of adventure and love of the wilderness will catch the spirit and enthusiasm and realize long before he reads the last page that these two people have had a wonderful time.

The illustrations are charming—enchanting. The reviewer has only one complaint: The inadequate map is worse than none at all. What can be done to make editors and publishers realize that the reader wants to know *where* he is *all* of the time?—Eleanor Rice Pettingill.

BIRDS OF TIKAL, GUATEMALA. By Frank B. Smithe and Raymond A. Paynter, Jr. Bulletin of the Museum of Comparative Zoology at Harvard College, 1963, Vol. 128, No. 5, pp. 245–324, 1 col. pl. $1.50.

Petén, the largest and most inaccessible of the departments of Guatemala, had been largely ignored by ornithologists until the advent of airplanes and archeologists. The extensive Central American activities of Salvin and Godman in the last half of the nineteenth century barely touched on the area. Prior to the present work only two important studies had been made there: Van Tyne collected at Uaxactun in the spring of 1931 (1935, "The Birds of Northern Petén, Guatemala," *Univ. Mich. Mus. Zool., Misc. Pubs.*, No. 27, 46 pp.) and Taibel at Lake Petén Itzá in the autumn of 1932 (1955, "Uccelli del Guatemala con speciale riguardo alla region del Petén raccolti dal Maggio al Settembre 1932," *Atti Soc. Italiana Sci. Nat.*, 94:15–84).

The "Birds of Tikal, Guatemala" is based largely upon the field work of Smithe in the Petén during parts of the years 1956 through 1960. Paynter, Jorge Ibarra of the Guatemalan National Museum, and others participated in the field study. The time periods covered nearly exclude the autumn and early winter so, as the authors point out, little is known of the fall migration at Tikal.

In 1959, Smithe published a check-list of the birds recorded in the preliminary years of this study. However, Paynter appears to have done the major work on the present manuscript. Following the introductory paragraphs in which the section on vegetation seems especially well done is an annotated list including 231 species (28 based upon sight records). Spanish common names, included in Smithe's original list, are omitted. Weights of specimens are given as they are in Van Tyne's 1935 paper. In a few species weight variations are discussed in relation to distribution. This type of analysis will be increasingly important as data accumulate but must be used with caution until daily and seasonal weight variations are better understood. It is regrettable that few of the early collectors made any effort to weigh fresh specimens.

The habitat of each form is mentioned and a few taxonomic simplifications are suggested, such as merging *Platypsaris* into *Pachyramphus*, which seems to be a good move. A color plate is included of the *Myiarchus* flycatchers of the Petén. No attempt is made to standardize or define the terms of relative abundance but a variety of words is used, seemingly chosen to avoid repetition. One could wonder, however, whether a form listed as "ubiquitous" is more likely to be seen than another described as "numerous" or "very abundant." Also, upon reading under *Trogon violaceus* that "*T. collaris* and this species are about equally abundant," I was surprised to turn back and find *T. collaris* to be "rather uncommon." The use of dual expressions such as "fairly common but seldom seen" or "abundant and conspicuous" is good in indicating not only the number present but the chance of encountering the species, two facets of relative abundance which are not necessarily correlated.

The annotated list is followed by a slightly prolonged discussion which lists species recorded elsewhere in the Petén but not yet at Tikal and compares the avifauna of the northern Petén with the remainder of the Yucatán Peninsula. Emphasis is placed upon the changes in habitat which are taking place as the human population increases, and on the value of future work at Tikal to determine the effect of these changes on the birdlife.

The importance of this study is evident in that it adds over 40 species to the check-list of Petén birds. It is also good to know that the Tikal area has been set aside as a national park, the first in Central America.—HUGH C. LAND.

DEVELOPMENT OF BEHAVIOR IN PRECOCIAL BIRDS. By Margaret Morse Nice. Transactions of the Linnaean Society of New York, New York, Vol. 8, 1962: 6 × 9 in., xii + 211 pp., 19 figs., 18 tables. $4.00.

If not already in debt to Margaret Morse Nice for her oustanding contributions to their science, ornithologists will be so now for this summary of the literature and known facts on the development of precocial behavior in birds. The title is actually too restrictive—altricial birds, as well as other forms of animal life, receive treatment in this work.

It is difficult to prepare an adequate review. It seems best merely to indicate the main subjects covered. There is little attempt in this paper to interpret or evaluate behavior, or to discuss, except very superficially, the inheritance of patterns of behavior. Mrs. Nice summarizes, analyzes, and compares the stages of development of behavior, drawing upon a wealth of published references as well as her own intensive and extensive studies and observations. Her own preface is an excellent outline of the organization of the subject matter.

The first chapter takes up parental care in invertebrates and in five classes of vertebrates. The second compares, in text and tabular form, some of the outstanding aspects of development in seven species of five classes of vertebrates, including a precocial and an altricial bird, and a precocial and an altricial mammal. In the third chapter Mrs. Nice breaks down the usually accepted, too-broad classification of precocial and altricial into eight finer subdivisions—describes them and, in tabular form, gives the stage of development at hatching for all the orders of living birds recognized by Wetmore. In eight of these orders, where differences occur, stages of maturity for the families are also given.

In the fourth chapter Mrs. Nice discusses and modifies Kuhlmann's stages of development of young while in the nest (post-embryonic, preliminary, and transition) and those of the period immediately following leaving the nest (locomotory and socialization). Much of the material presented in the rest of the paper is considered in respect to these five stages. In the next seven chapters Mrs. Nice describes the development of various forms of behavior in the eight types of young she has listed (four groups of precocial chicks, one semi-precocial, two semi-altricial, and one altricial) with minutely detailed examples from her own observations at Delta, Manitoba, and elsewhere, and with tables which show the age at first appearance for various coordinations associated with the five stages.

In the twelfth chapter Mrs. Nice gives the stage of appearance of various basic motor coordinations in precocial and semi-precocial birds compared with the appearance in the Song Sparrow (altricial), and found that 15 appeared in the same stages in all the birds.

The two concluding chapters summarize the present knowledge of embryological development of precocials and altricials. It is shown that a newly hatched altricial is markedly like a precocial embryo aged 12 to 13 days. Temperature control develops rapidly in altricials, slowly in precocials. The benefits and possible reasons for this difference are brought out.

There is a well-organized general summary of the paper as well as detailed summaries of each chapter. The bibliography contains over 400 titles. There are two indexes, one of subjects, the other of species and taxa. Both are workable and complete, and this will assist in making this paper an essential reference tool for every ornithological library.—SALLY F. HOYT.

Host Relations of the Parasitic Cowbirds. By Herbert Friedmann. Smithsonian Institution, United States National Museum Bulletin No. 233, 1963: 276 pp. $1.25.

Dr. Friedmann's classic work, "The Cowbirds. A Study in the Biology of Social Parasitism" (Charles C Thomas, 1929), has long been out of print. The present excellent monograph up-dates the earlier work and summarizes the accumulated information about cowbird parasitism since 1929.

The book contains complete annotated catalogs of the hosts of the Brown-headed and Bronzed Cowbirds. Tabular accounts of the hosts of the South American cowbirds are included, and specific data are presented on new hosts found since 1929. The Bronzed Cowbird is known to parasitize 52 species (in 12 families) of birds. Most of the hosts are members of the blackbird and finch families.

The three races of the Brown-headed Cowbird are now known to parasitize the nests of 206 species (333 species and subspecies) of birds. According to the information available to Dr. Friedmann, the 17 most frequently parasitized species are: Yellow Warbler, Song Sparrow, Red-eyed Vireo, Chipping Sparrow, Eastern Phoebe, Rufous-sided Towhee, Ovenbird, Yellowthroat, American Redstart, Indigo Bunting, Yellow-breasted Chat, Red-winged Blackbird, Kentucky Warbler, Traill's Flycatcher, Bell's Vireo, Yellow-throated Vireo, and Field Sparrow. Dr. Friedmann points out, however, that "at times, and in some localities, still other species may be found to be as important, if not more so, to the parasite" (page 7). He notes that 50 hosts "account for approximately 7,800 records out of a total of about 9,000 instances of cowbird parasitism. It would seem that the proportionate role they play in nature is, if anything, even greater than these figures would suggest, since many instances of parasitism upon common hosts are left unrecorded because of their repetitive nature, while most cases involving uncommon victims are published as records of particular interest."

Important as the annotated lists of hosts of the cowbirds are in themselves, the greater value of Dr. Friedmann's monograph lies in his analysis of the data on brood parasitism and of its significance in the life of the cowbird and its hosts. Of interest to all life-history students are the discussions of egg size and egg color among the cowbirds, the frequency of host selection, changes in host selection, intensity of parasitism of frequent hosts, breeding success of host and parasite, hatching potential of host species, mutual effect of parasite and host on egg production, duration of parasite's interest in host nests, foster parent-offspring relationship, reactions of host to parasitism, and hosts known to have reared young cowbirds.

Two selected quotations point up the need for caution in interpreting limited data on cowbird parasitism of a species and in drawing broad conclusions from those data.

In speaking of those hosts which respond "adversely to the intrusions of the parasite," Dr. Friedmann remarks: "Even here, the adverse responses (which constitute desertion of the nest, covering over the parasitic egg with a new nest floor, or actually throwing out the intruder) are not behavior patterns that appear to have been developed as defenses against parasitism. These responses are not specifically 'anti-cowbird' in their organization but rather are generalized types of reaction to something foreign entering the nest. As far as I know, no bird has actually developed a special defense against parasitism. In fact, it is difficult to imagine a clearly defined defense against an unspecialized parasite. In most cases, the normal fecundity of the host species enables it to survive the inroads of the parasite" (page 3). The Kirtland's Warbler may be an exception to the last sentence, as Dr. Friedmann notes.

"It must be kept in mind that, in the case of many of the single-brooded species of hosts, these birds may succeed in raising young of their own by renesting after the desertion or the destruction of the first parasitized nests. Parasitism may thus cause an extension of the hosts' breeding season. It follows that a mere calculation of the percentage of parasitized nests of these species gives only a partial picture of the situation. The critical point, namely the effect of parasitism on the total fledging success of the host species, is not accurately described by such percentage figures" (page 24).

Dr. Friedmann has done a typically outstanding job in writing about our current knowledge of cowbird parasitism, and he has pointed the way for more thorough studies of the subject.—ANDREW J. BERGER.

Dr. Friedmann has called our attention to an unfortunate error on page 85 of his paper. The printer, subsequent to corrected galley proofs, dropped out the first line of the account of the Gray Vireo, reading "This vireo has been recorded only once in print as a host of the . . ." In its place he repeated the first line of the following species, the Yellow-throated Vireo, reading "This is a frequently imposed upon victim, for which I have noted. . . ."—ED.

A STUDY OF BIRD SONG. By Edward A. Armstrong. Oxford University Press, New York, 1963: 5½ × 8¾ in., XV + 328 pp., 16 pls., 43 figs., 14 tables. $10.50.

Mr. Armstrong tells us that his "viewpoint is that song should be regarded as one aspect of a delicately integrated complex of behaviour" (p. xiv); consequently he covers a wide field in subjects with examples cited of birds from all over the world. The 50 pages of bibliography contain some 1,800 references. Thirty-five of these belong to the author, whose field studies have been largely carried out on six races of the European Wren (*Troglodytes troglodytes*).

In Chapter I, Bird Utterances as Language, it is stated that "Next to man, birds have developed auditory means of communication to greatest perfection" (p. 2). Highly socialized birds possess rather large repertoires of call notes, in contrast to typically solitary species. "To some extent birds can interpret the language of other species than their own and even quadrupeds can respond to the language of birds" (p. 27).

The second chapter, The Structure and Components of Song, discusses pitch, intensity, quality, etc. Table IV shows "Approximate frequency in cycles per second of European birdnotes" for eight species, while Table V does the same for six North American species. Spectrographs are given of several species showing the simultaneous rendition of two and even three songs at the same time.

Chapter III, The Development and Learning of Song, was of special interest to me. Details of studies on four European and two North American species are summarized. Whitethroats (*Sylvia communis*) raised in isolation developed the full repertoire of 24 call notes and three types of song (Sauer, 1954, 1955). Blackbirds (*Turdus merula*), with their much more elaborate songs, "can sing normally only when they have had the opportunity to hear other Blackbirds sing" (p. 47). Chaffinches (*Fringilla coelebs*) have received a great deal of attention; it has been concluded that "some characteristics of pitch, quality, intensity, and time relations are inborn, but all else is learned" (p. 52). As with many other species the birds learned their songs before they could sing. The Bullfinch (*Pyrrhula pyrrhula*) normally learns his father's song (Nicolai, 1956, 1959). Hand-raised Oregon Juncos (*Junco oreganus*) were found to "inherit their songs," yet are also "able to copy songs of their own or other species" (Marler, 1959).

A page is devoted to my studies of song development in Song Sparrows (*Melospiza melodia*) (1943). This is a good summary but it is somewhat confusing since Mr.

Armstrong does not distinguish between observations on wild and hand-raised birds. For instance, the bird that "concentrated his learning into a week in December and in so doing acquired all six versions of his rival's repertoire" was alone in our house with his 18-month-old "tutor," the only Song Sparrow he had heard since the age of six days. Mr. Armstrong says further: "Nice concluded that the pattern (form, length and timing) of the Song Sparrow song was inborn but that the quality was learned. This latter is probably too great a generalization" (p. 49). My conclusion was based on the history of the hand-raised birds of 1938; the two males heard no Song Sparrow singing except three or four examples at the ages of 25 and 26 days, when they were too young for song-learning, but in the fall they were exposed to occasional phonograph playings of the songs of British birds—Nightingale, Chaffinch, Song Thrush, etc. When their singing became adult at the end of December it was loud and whistled and resembled "foreign birds" more than that of wild Song Sparrows. Yet the form, length, timing, and even the number of songs in their repertoires were typical of the species.

The development and forms of "Sub-song" are discussed in Chapter IV. Six characteristics are quoted as differentiating it from "true song," but the author finds much to criticize in these categories. He decides that "Sub-song is a useful general term to denote forms of quiet song," (p. 61).

The next two chapters treat of "Vocal Mimicry" and "Song Dialects and the Relationship of Vocalization to Speciation." The Chaffinch is the classical example of different populations exhibiting different dialects of call notes.

In Chapter VII, Territorial Song and Related Forms of Song, Mr. Armstrong writes "A Song Sparrow which sung an exceptional amount was also exceptionally long-lived (Nice, 1943)." 4M was a domineering, intelligent, vigorous bird and he lived for eight or nine years. Yet the next longest-lived Song Sparrow I knew—57M—who died by accident when five years nine months old, was an exceptionally retiring individual who almost never sang! During two breeding seasons I failed to locate him but in three other seasons I found four of his nests on North Interpont.

The last six chapters are titled: Song-flight and Nonvocal Song; Song and the Annual Cycle; Female Song, Duetting, and Corporate Song; The Influence of Light, Weather, and Temperature on Song; Song and Adaptations to Habitat; and Bird Song as Art and Play.

All thirteen chapters are provided with subheadings, which help in the organization of the vast array of information presented. To this reviewer, who may be somewhat of a devotee of summaries, the book suffers from its marked lack of these important aids to comprehension.

A valuable Appendix is devoted to "Acoustic communication in the animal kingdom and the organs involved." There are four useful Indexes which give page references to "Birds," "Other Organisms," "Authorities," and "General," i.e., subjects treated.

The bibliography has been anglicized; in all titles from American journals involving *behavior* this word has been changed to *behaviour*, while Sutton's and Parmelee's paper on "Summer activities of the Lapland Longspur on Baffin Island," appears as "Summer activities of the Lapland Bunting in Baffin Island."

This comprehensive book that deals with such a multitude of topics and examples will serve as an important reference book to workers engaged in the study of bird vocalizations. With the author we can hope "that the reader may here find encouragement to explore further a realm of inexhaustible interest and delight."—MARGARET M. NICE.

Growing Wings. By Sarita Van Vleck. Doubleday & Company, Inc., Garden City, New York, 1963. 6¼ × 9½ in., xiv + 128 pp., 35 line drawings. $3.95.

Rarely does one find accuracy of scientific detail combined so well with ease and enjoyment of reading. Miss Van Vleck shows unusual skill in portraying, both in her sketches and in her prose, a complete picture with a minimum of unnecessary detail. There is much information contained in each chapter, as she leads us through the various phases of "the perennial cycle of birds." One hesitates to mention the few errors (not all ducks start their "second molt" in September; not all precocial young hatch on the ground; etc.). The errors primarily are the result of too-broad generalizations or over-simplifications and do not detract appreciably from the value of the rest of the text. The author has observed well and read widely and the reader profits from her ability to condense and interpret what she has seen and read. While one may at times wish for reference to sources, such annotating would detract from the story-like method of presentation. This is a book to be savored, not studied. It is filled with such appealing bits of descriptive prose as "The Ruby-throat's nest is an exquisite one-ounce bump" and, in speaking of fall flocking of warblers, "No noise accompanies their sociability, only a gauze of wispy squeaks." Anyone who has seen a recently hatched altricial bird will appreciate her description of a Redwing hatching. The book deserves success. May it encourage the author to give us more.—Sally F. Hoyt.

The Mourning Dove in Illinois. By Harold C. Hanson and Charles W. Kossack. Illinois Department of Conservation Technical Bulletin No. 2, 1963: xvi + 133 pp., front. (col.), 75 figs., 39 tables.

Two subspecies seem to comprise the Illinois Mourning Dove population. *Zenaidura macroura carolinensis* made up 44.8 per cent of the sampled population; *Z. m. marginella*, 7.6 per cent; and intermediates, 47.6 per cent. A north-to-south gradient exists in the density of doves. Banding returns, resulting from the concentrated program by banders during recent years and the efforts of Natural History Survey personnel, indicated that doves return to their birthplace to breed. Nesting usually commenced about 1 April and continued for perhaps 24 weeks. All but 2 per cent of the doves were produced before 5 August. Overall nesting success averaged 64 per cent. Doves in nothern Illinois averaged two nesting attempts per season. An average of 2.38 young were produced per pair. The ability of doves to renest repeatedly enables them to compensate for production disadvantages, such as the frailty of nests or the limitations of a two-egg clutch. From 50 to 70 per cent of the dove population produced annually dies within a year as a result of mortality factors.

Of particular interest to the ornithologist will be the guides developed for estimating the daily stages of incubated eggs and nestling growth.

In addition, numerous other aspects of the species' biology are discussed—sex ratios, migration periods and patterns, diseases and parasites, effects of climatic extremes, and the effects of hunting pressures.

This is an outstanding work and a valuable source of information for conservationists, biologists, or laymen interested in the Mourning Dove and its management.—William E. Southern.

INDEX TO VOLUME 75, 1963

This index includes, in addition to names of genera, species, and authors, references to the following topics: anatomy, behavior, distribution, food habits, measurements, migration, molts and plumages, nesting, parasitism, physiology, populations, predation, taxonomy, voice, and weights. Also included are references of biological significance to reptiles and mammals.

This issue of *The Wilson Bulletin* was published on 3 February 1964.

Suggestions to Authors

Manuscripts intended for publication in *The Wilson Bulletin* should be neatly typewritten, double-spaced, and on one side only of good quality white paper. Tables should be typed on separate sheets. Before preparing these, carefully consider whether the material is best presented in tabular form. Where the value of quantitative data can be enhanced by use of appropriate statistical methods, these should be used. Follow the AOU Check-list (Fifth Edition, 1957) insofar as scientific names of United States and Canadian birds are concerned unless a satisfactory explanation is offered for doing otherwise. Use species names (binomials) unless specimens have actually been handled and subsequently identified. Summaries of major papers should be brief but quotable. Where fewer than five papers are cited, the citations may be included in the text. All citations in "General Notes" should be included in the text. Follow carefully the style used in this issue in listing the literature cited; otherwise, follow the "Style Manual for Biological Journals" (1960. AIBS). Photographs for illustrations should be sharp, have good contrast, and be on gloss paper. Submit prints unmounted and attach to each a brief but adequate legend. Do not write heavily on the backs of photographs. Diagrams and line drawings should be in black ink and their lettering large enough to permit reduction. Authors are requested to return proof promptly. Extensive alterations in copy after the type has been set must be charged to the author.

A Word to Members

The Wilson Bulletin is not as large as we want it to be. It will become larger as funds for publication increase. The Society loses money, and the size of the *Bulletin* is cut down accordingly, each time a member fails to pay dues and is put on the "suspended list." Postage is used in notifying the printer of this suspension. More postage is used in notifying the member and urging him to pay his dues. When he does finally pay he must be reinstated in the mailing list and there is a printer's charge for this service. The *Bulletin* will become larger if members will make a point of paying their dues promptly.

Notice of Change of Address

If your address changes, notify the Society immediately. Send your complete new address to the Treasurer, C. Chandler Ross, Academy of Natural Sciences, 19th and Parkway, Philadelphia 3, Pennsylvania. He will notify the printer.

Louis Agassiz Fuertes Research Grant

This grant, established in 1947, is devoted to the encouragement and stimulation of young ornithologists. One particular desire is the development of research interests among amateur ornithologists. Any kind of ornithological research may be aided. Recipients of grants need not be associated with academic organizations. Each proposal is considered primarily on the basis of possible contribution to ornithological knowledge.

An anonymous donor gave $500 to found the fund; later, donors have provided some $600. The Council of the Wilson Ornithological Society has added funds as necessary to provide at least one $100 grant annually.

Although grantees are not required to publish their studies in *The Wilson Bulletin*, it is hoped that they will submit their manuscripts to the Editor of the *Bulletin* for consideration.

Since its inception, the Fuertes Research Grant has been awarded to 19 persons, many of whom have continued their research work.

Application forms may be obtained from Harvey I. Fisher, Southern Illinois University, Carbondale, Illinois. Completed applications must be received by 1 March 1964.