

THE WILSON BULLETIN

A Quarterly Magazine
of
Ornithology

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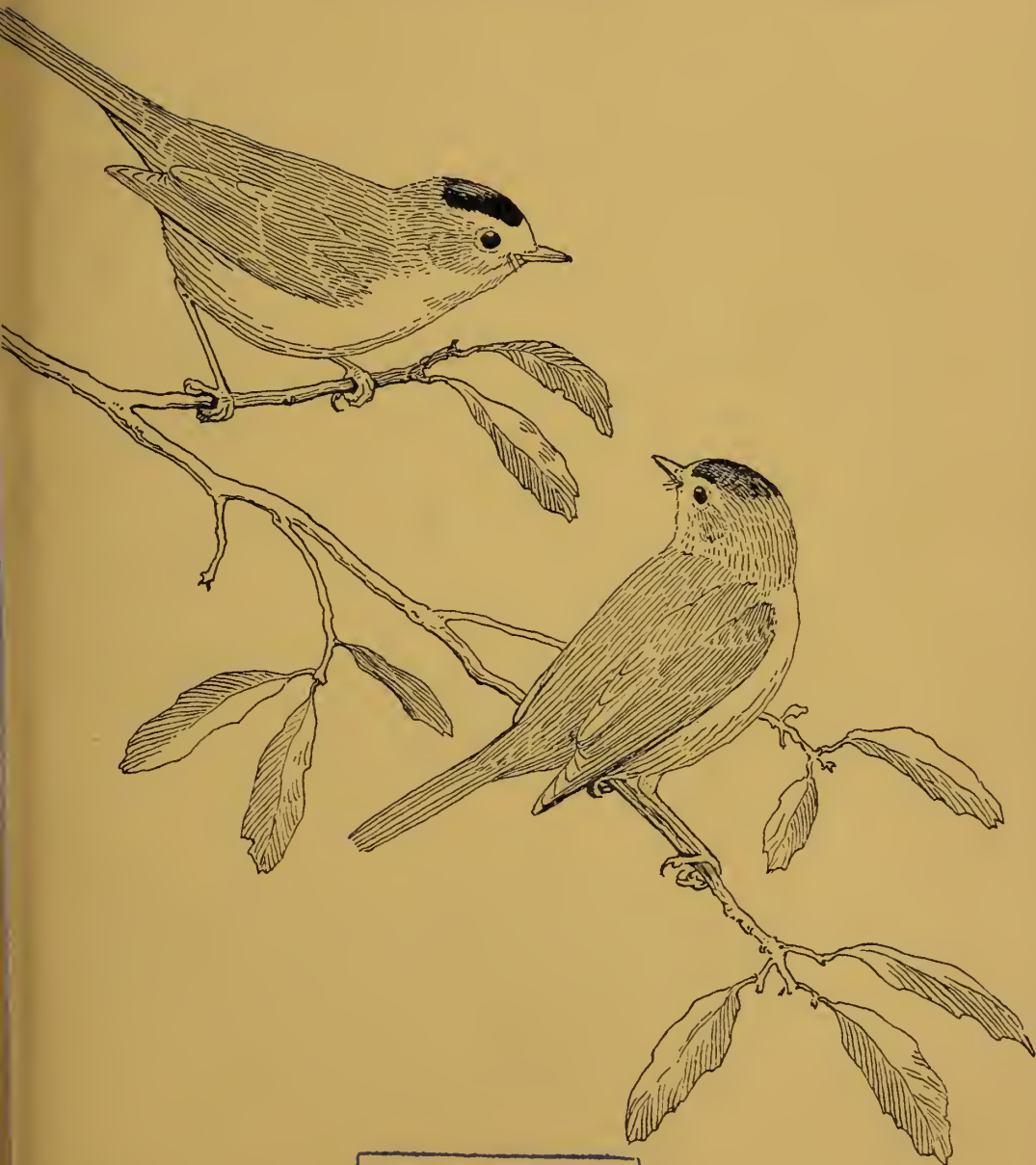


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CONTENTS

SAFFRON TOUCANET, Painting by <i>Don R. Eckelberry</i>	Facing page	5
A NOTE ON THE TOUCANS OF NORTHERN ARGENTINA <i>Don R. Eckelberry</i>		5
SPRING MIGRATION OF BLUE JAYS AT MADISON, WISCONSIN <i>A. W. Schorger</i>		6
THE 1961 IRRUPTION OF CLARK'S NUTCRACKER IN CALIFORNIA	<i>John Davis and Laidlaw Williams</i>	10
THE ALLEGED TRANSPORTATION OF ITS EGGS OR YOUNG BY CHUCK-WILL'S-WIDOW	<i>Albert F. Ganier</i>	19
NOTES ON INCUBATION AND NESTLING TEMPERATURES AND BEHAVIOR OF CAPTIVE OWLS	<i>Thomas R. Howell</i>	23
CONSTANCY OF INCUBATION FOR THE SCARLET TANAGER	<i>Kenneth W. Prescott</i>	37
FOSSIL IBISES FROM THE REXROAD FAUNA OF THE UPPER PLIOCENE OF KANSAS	<i>Charles T. Collins</i>	43
BILL SHAPE AS A GENERIC CHARACTER IN THE CARDINALS <i>Walter J. Bock</i>		50
NESTING OF PURPLE MARTINS ABOARD A SHIP	<i>Herbert W. Kale II</i>	62
HISTORY OF THE CAROLINA PARAKEET IN ITS SOUTHWESTERN RANGE	<i>Daniel McKinley</i>	63
GENERAL NOTES		
BROWN-HEADED COWBIRD FLEDGED IN BARN SWALLOW NEST	<i>Walter P. Nickell</i>	94
THE EFFECTS OF PROBABLE FROSTBITE ON THE FEET OF MOURNING DOVES WINTERING IN SOUTHERN MICHIGAN	<i>Walter P. Nickell</i>	94
NESTING ASSOCIATION OF PILEATED WOODPECKER AND YELLOW-SIAFTED FLICKER IN A UTILITY POLE	<i>Sanford D. Schemnitz</i>	95
BROWN-HEADED COWBIRD FLEDGED IN NEST OF BLACK-THROATED BLUE WARBLER	<i>Walter P. Nickell</i>	96

<i>TANAGRA TRINITATIS</i> ON TOBAGO, WEST	
INDIES	Norman B. Pilling and Robert W. Trowern 96
RENESTING OF A WILD PHEASANT HEN	John E. Warnock and G. Blair Joselyn 97
ALBINISM IN THE SCISSOR-TAILED FLYCATCHER	J. David Ligon 98
SIGHT RECORD OF THE GLOSSY IBIS FOR THE BASS ISLANDS, LAKE ERIE, OHIO	
	Loren Putnam, George Maxwell, and Stephen Tilley 98
WHIMBREL: FIRST SPECIMENS FOR KANSAS	David F. Parmalee 99
ORNITHOLOGICAL NEWS	100
ORNITHOLOGICAL LITERATURE	101

George J. Wallace, *An Introduction to Ornithology*, reviewed by Ormsby Annan; Roger Tory Peterson and the Editors of *Life*, *The Birds*, reviewed by Walter J. Breckenridge; Arthur Stupka, *Notes on the Birds of Great Smoky Mountains National Park*, reviewed by Henry M. Stevenson; E. W. Jameson, Jr., *The Hawking of Japan: The History and Development of Japanese Falconry*, reviewed by Olin Sewall Pettingill, Jr.; François Levaillant (translated by Eric Mosbacher), *Exotic Birds: Parrots, Birds of Paradise, and Toucans*, reviewed by Olin Sewall Pettingill, Jr.; Guy Mountfort, *The Wild Danube: Portrait of a River*, reviewed by Olin Sewall Pettingill, Jr.; Jack Couffer, *The Song of Wild Laughter*, reviewed by Olin Sewall Pettingill, Jr.; Helen Hoover, *The Long-shadowed Forest*, reviewed by Florence Page Jaques; Franz A. Roedelberger and Vera I. Groschoff, compilers, *The Wonders of Wildlife*, reviewed by Olin Sewall Pettingill, Jr.



SAFFRON TOUCANET

Baillonius bailloni

Painting by Don R. Eckelberry

A NOTE ON THE TOUCANS OF NORTHERN ARGENTINA

DON R. ECKELBERRY

THE Saffron Toucanet (*Baillonius bailloni*) pictured opposite is also known as the Saffron-colored Araçari, Banana Araçari, and Yellow Toucanet. Peters, in his "Check-List of Birds of the World" (1948. VI:31), reduced monotypic *Baillonius* to a subgenus of *Andigena*. The species is confined to southeastern Brazil, Paraguay, and the province of Misiones in Argentina.

On 15 September 1959, less than a mile from our camp near Tobunas, Misiones, William H. Partridge and I saw this single bird feeding with a small group of Red-breasted Toucans (*Ramphastos discolorus*). They were in the crown of a tree laden with perfectly round purple-black fruit the size of a large grape, called *Yvaporú* in the local Guaraní tongue and *Yaboticaba* in Portuguese. The Saffron Toucanet was less active than its associates and spent a good deal of time sitting upright as I have painted it—a pose that does not, however, show off its red upper tail coverts. As soon as it had been collected and we got back to camp, I set to work drawing and painting in the bill colors which in toucans may change very rapidly. The picture was completed the following day.

The two common toucans of Argentina belong to the genus *Ramphastos*. The huge-billed Toco Toucan (*R. t. albigularis*) ranges west and south until stopped by arid and open country, but reappears in the form of the nominate race in northwestern Argentina where a wet tropical spur reaches Tucumán. I found this species more common around Iguazú Falls than at our Tobunas camp where *R. discolorus* was the one seen daily.

I once watched a Red-breasted Toucan attempt to get at the eggs or young in a nest of the Great Kiskadee (*Pitangus sulphuratus*). The flycatchers soon drove it off, one attacking the frantic toucan first from one side and then from the other while its mate grasped the big bird in the middle of its back, fanned its tail for better support, and rode that toucan right into the woods.

The Red-breasted Toucan, like the Saffron Toucanet, is relatively small billed, though I noted that there was tremendous variation in bill size and considerable in the width of the alizarin center stripe in Partridge's specimens, a variability which did not seem to be at all related to sex. The range of the species in Argentina is approximately that of *R. t. albigularis*.

The fourth Argentine species is a particularly handsome araçari (*Pteroglossus castanotis*) found only in Misiones, though it has a broad range to the north. A hunter brought two of them into camp one day too late to paint and they proved to be the only ones seen during the month I was there.

180 WOODSOME ROAD, BABYLON, NEW YORK, 15 NOVEMBER 1963

SPRING MIGRATION OF BLUE JAYS AT MADISON, WISCONSIN

A. W. SCHORGER

FOLLOWING the publication (Schorger, 1961) of a note on the migration of a flock of Blue Jays (*Cyanocitta cristata*) on 24 April 1960, from Second Point, the thought occurred that this might not have been an isolated incident. Sufficient data have since been accumulated to show that Second Point is a traditional flyway. The jays cross University Bay to Picnic Point (Fig. 1.), then for the most part follow the shore of Second Bay to Second Point where usually there is hesitation in crossing Lake Mendota. My observations were made at an opening 200 feet west of Second Point. Picnic Point and the southern shore of Lake Mendota are well wooded. The vegetation in the spring of 1963 was so advanced during the migration as to limit decidedly the field of vision. In the spring of 1962 some flocks were seen to go northward from Picnic Point and bypass Second Point. It would be necessary to have observers stationed at several places from the tip of Picnic Point to Eagle Heights in order to obtain a complete picture of the migration. What takes place at Madison may not be true elsewhere as the migration is undoubtedly controlled by the local topography. I am not aware of any prior detailed description of a migration of jays.

I was unable in the spring of 1961 to spend adequate time on the migration, but on the morning of 7 May several flocks were observed to leave the point and proceed northward. H. A. Fletcher, Custodian of Picnic Point, informed me that 10 days previously the jays were moving past his cottage in flocks numbering up to 75 individuals. I arranged with Mr. Fletcher to be called when the birds began moving in the spring of 1962. On 1 May he called at 1:45 PM, stating that a few jays were around. At 3:35 I noted a flock of 16 rise from the point and proceed northwestward. On my return a few jays were noted drifting toward the point. The migration was then followed daily from 2 May to 9 May inclusive. On the morning of 27 April 1963, on my way to Second Point, I talked with Mr. Fletcher who stated that he saw two or three flocks numbering five to six on 24 April. On arriving at the point, I saw several flocks leave between 10:25 and 10:47. With the exception of 9 May, I was at the point at 6:00 AM or shortly thereafter from 28 April through 11 May. The migration in 1963 extended from 24 April through 15 May.

A log of the behavior of the jays on the forenoon of 3 May 1962, is given below. The morning was cool and cloudy, and with a light NW wind which became strong at 9:30. The sun appeared at 8:05. (The time as given in this paper is Daylight Saving.)

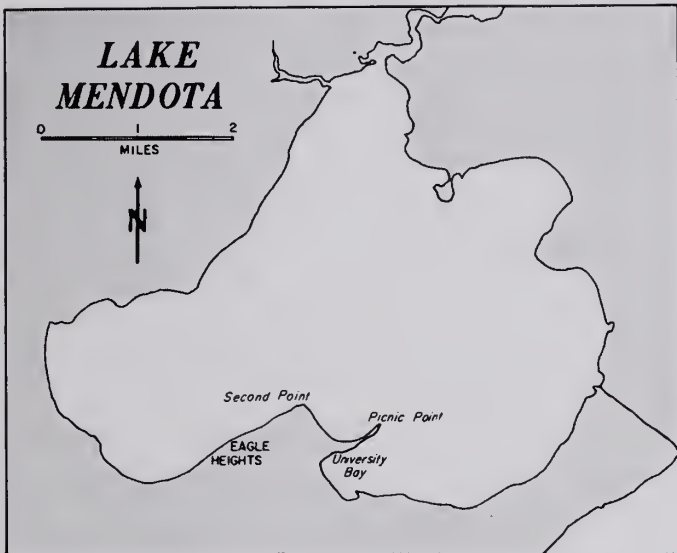


FIG. 1

Time

- 6:12. 40 circled and returned S.
- 6:15. 4 went NW.
- 6:20. 75 made a half turn then flew N.
- 6:22. 60 turned W on reaching the point and dropped in the trees out of sight.
- 6:30. 60 came in, gained height at an angle, and went NW.
- 6:32. 12 circled once and went N.
- 6:34. 30 circled and went N.
- 6:36. 24 made a half turn and went N.
- 6:40. 50 did the same.
- 6:42. 38 circled high and flew NE. Two minutes were taken in gaining elevation.
- 6:46. 31 went NW.
- 6:48. 30 came W turned and flew towards Picnic Point.
- 6:53. 38 circled and went N.
- 6:58. 50 circled, went N, and returned.
- 7:00. 30 joined the above and went N.
- 7:02. 7 arrived and returned S.
- 7:03. 33 arrived and alighted in the conifers.
- 7:07. 50 went N, returned, then went N for good. A flock of 18 followed them.
- 7:17. 100 went N.
- 7:22. 75 came in, circled, went S.
- 7:34. 5 went N, returned, and flew NE.
- 7:46. 50 went N.
- 7:50. 5 went N.
- 7:51. 40 flew NE.
- 7:55. 4 went NW.
- 7:56. 8 arrived and went W.
- 8:05. large flock circled high southward. Lost it.

- 8:14. 24 went NW, then N.
8:17. 100 circled and went N. A few left the flock and, at a slight angle from the perpendicular, volplaned with terrific speed to the trees on the point.
8:26. 37 circled to great height, then volplaned to trees W.
8:27. 25 flew NW over end of point.
8:43. 19 flew N.
9:07. 75 flew N.
9:08. 25 came in and dropped into trees W.
9:15. 21 came over high and went N.
9:21. 30 alighted on point then flew W.
10:15. 50 flying high went NE.
10:19. 12 rose from trees on point, rose, dropped again, then sifted W. I think the wind is too strong for them.
10:35. above number from W alighted on the tip of the point, then returned W.
11:00. left as no birds were moving.

The behavior of a flock arriving from the south is totally unpredictable. The lake is a temporary psychological barrier, and on arriving at the point there is usually hesitation. The usual procedure is to circle, sometimes accompanied by towering if the flock arrives at a low elevation. Occasionally a small flock will proceed directly northward. A flock frequently turns and returns directly southward or it may go in any direction except northward. It was common for flocks to turn and fly westward following the shore of the lake. A flock might tower to a great height, giving every assurance of proceeding northward, then suddenly dive with high speed and with a roar into the trees on the point. Here the birds might remain for a minute, rise, gain their former elevation, and proceed northward. Again after a flock has attained altitude, part will descend to the trees while the remainder will cross the lake.

A flock is usually fairly compact, but may form a long line. The crossing is made occasionally by individuals. On one occasion two jays, equally advanced, proceeded northward 300 feet apart. The largest flocks were estimated to contain 200 birds, but the average was about 25. The migration began shortly after daylight and usually declined rather abruptly by 10:00 AM. Up to this hour a flock would appear about every five minutes; however, on 11 May 1963, there was a gap between 7:27 and 8:26 AM when not a bird was to be seen. Stragglers would arrive and alight in the trees. When one or more ascended, it was an almost invariable indication that a flock, still invisible, was arriving from the south and would be joined. Individuals and small flocks that sifted in were usually noisy, but no calls came from the flocks in the air. Occasionally flocks of four and five would alight close together, and lilt and teeter for a minute or two before drifting away.

Several times one jay was seen to feed another, suggesting pairing. On one occasion three birds alighted in a tree. One was attacked and driven

away. I am unable to express an opinion on the extent of pairing during the migration. Many single individuals as well as flocks with odd numbers were seen. It would seem from the extremely chaotic mixing of the birds in a flock preparatory to leaving the point that the extent of pairing was not great.

Only individuals and small groups were seen to feed. For this purpose they usually alighted on the ground. Occasionally, however, jays would take what appeared to be insects from the limbs of the trees. I do not believe that the birds usually feed in the morning prior to migrating. Food is probably obtained at some time in the afternoon following completion of the flight for the day.

Migration is controlled by the velocity and direction of the wind. The morning of 30 April 1963, there was a north wind of 23 mph with gusts up to 35 miles. I felt certain that this condition would result in an accumulation of jays in the conifers on the point but not one bird appeared. In 1962 the migration was mainly north whereas in 1963 it was northwest. Even a following wind of 15 to 20 mph caused hesitation at the point. The jay is a weak flier and with a favorable wind does not exert itself. On the morning of 28 April 1963, there was a strong SE wind. On leaving the point the birds turned their heads to the SW and allowed themselves to be carried sidewise to the NW. The wind on 2 May 1963 was from the south at a velocity of 15 to 18 mph. In this case the birds turned their heads westward and were carried sidewise northward.

It was impossible to arrive at a reasonably accurate count of the number of birds that went northward, for on every day some flocks returned south and probably reappeared. Jays in migration will not do what is reasonably expected of them. On 7 May 1963, with a south wind of 10 to 15 mph, 1,206 birds were counted. Though conditions seemed very favorable for migrating, so many of the birds returned south that it is doubtful if more than one-third of them was counted but once. The same may be said for the count of 1,562 made the following forenoon.

In September 1952, Robbins (1952) observed a migration of jays at Adams, Adams County, near the Wisconsin River. A count of 750 was made on the 24th of this month. The Wisconsin River Valley would be in the direct line of flight northward for jays leaving Picnic Point. So far I have not detected any fall migration on a large scale in this area.

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THE 1961 IRRUPTION OF THE CLARK'S NUTCRACKER IN CALIFORNIA

JOHN DAVIS AND LAIDLAW WILLIAMS

IN a previous paper (Davis and Williams, 1957), we described five irruptions of the Clark's Nutcracker (*Nucifraga columbiana*) which had occurred in California between 1898 and 1955. In these irruptions, numbers of nutcrackers left the usual montane winter range and spent the winter in the coastal and desert regions, some remaining well into the following spring or even summer. Clark's Nutcrackers apparently depend primarily on stores of conifer seeds made in the fall to get them through the winter. The irruptions of 1935, 1950, and 1955, the only ones for which cone crop data were available, coincided with severe shortages of seed in the Sierra Nevada, whence we assumed most of the irrupting birds came. However, each of these poor seed years had been preceded by two or more years of relative seed abundance, and we hypothesized that irruptions of nutcrackers in California resulted from population increase during periods of two or more years of abundant winter food, followed by a severe decline in conifer seed crops. This pattern would result in an expanded population faced with a shortage of food to be stored for winter use, with numbers of individuals leaving the montane winter range to seek winter quarters elsewhere. In the fall and winter of 1961-62, another large-scale irruption of nutcrackers occurred in California, affording an opportunity to test our hypothesis.

TIME OF IRRUPTION

The first report of a nutcracker outside the normal range of the species in California in 1961 was of a single bird seen by Marianne Shepard at Glen Ellen, Sonoma County, on 29 September. Records continued to come throughout October and November, ranging from Glen Ellen south to San Diego. The irruption was obviously on a large scale, with reports from many coastal and desert areas. This information has been summarized by Cutler and Pugh (1962) for the northern half of the state and by Small (1962) for the southern half. The important point, however, is that the first records came in September and October. In this respect the irruption of 1961 agreed with those previously described, which supports the suggestion made in our paper of 1957, that irruptions of nutcrackers in California start when these birds begin to make their winter stores in the early fall. At this time the cones of most Sierra Nevada conifers open and shed their seed, which is then readily available to the birds. Presumably, in years of short supply, birds seeking seeds for winter stores fail to find adequate supplies locally and

TABLE 1
CONE CROPS ON THE WEST SLOPE OF THE SIERRA NEVADA
RATED ON A SCALE OF 1 (= NO CROP) TO 5 (= HEAVY CROP)

	1959 ¹	1960 ²	1961 ³
<i>Pinus ponderosa</i>	2.11 (62) ⁴	3.97 (111)	1.61 (86)
<i>Pinus lambertiana</i>	2.90 (50)	3.59 (88)	2.34 (84)
<i>Pinus jeffreyi</i>	3.19 (32)	3.51 (55)	1.51 (47)
<i>Abies concolor</i>	1.52 (44)	3.60 (67)	1.69 (77)
Combined mean	2.37 (188)	3.71 (321)	1.82 (294)

¹ From Forest Service records for 1959.

² From Schubert and Baron (1960).

³ From Baron and Schubert (1961).

⁴ Numbers in parentheses refer to numbers of reports.

wander to lower elevations in search of more. In years of widespread cone shortage, such as 1935, 1950, 1955, and 1961, such wandering may well lead a number of birds out of the normal winter range. Thus far, all of the irruptions recorded in California have started only after the seed shortages would have been evident to the birds. Lack (1954:234) noted that very large irruptions of some European species "sometimes start before the fruit crop on which the bird depends is ripe. . . ." Such a situation has not been recorded in nutcracker irruptions in California.

Nutcrackers irrupting in the fall and winter of 1961 remained at a number of coastal localities until the spring of 1962. For the first time, there were reports of nutcrackers breeding in coastal localities. However, the two reports of breeding were both of adults feeding begging young. Since feeding of full-grown begging birds, presumably females, was observed in nutcrackers on the Monterey Peninsula in 1956 (Davis and Williams, 1957:300), no report of extra-limital breeding of this species can be accepted unless confirmed by adequate photographs or, better, specimens of eggs or young.

THE 1961 IRRUPTION AND FOOD SUPPLY

Table 1 presents information on cone crops on the west slope of the Sierra Nevada for 1959, 1960, and 1961, for the ponderosa, sugar, and Jeffrey pines (*Pinus ponderosa*, *P. lambertiana*, and *P. jeffreyi*) and the white fir (*Abies concolor*). These are the four species considered in our 1957 paper; because of their relative abundance and wide distribution in the winter range of the Clark's Nutcracker in the Sierra Nevada, they must be of primary importance in providing seed for winter stores. The cone crops were rated by the foresters on a scale of 1 to 5, with 1 indicating no crop and 5 a heavy crop. For 1959, we averaged the reports of individual foresters throughout the west slope of the Sierra Nevada (U.S. Forest Service seed collection zones II, III, IV, and V) provided by Frank J. Baron from Forest Service files to

TABLE 2
CONE CROP RATINGS FOR THE SOUTHWESTERN
UNITED STATES AND FORT VALLEY, ARIZONA

Year	Southwest	Fort Valley	Seeds per Acre at Fort Valley
1959	Poor	Very poor	1,040
1960	Excellent	Excellent	263,440
1961	Generally poor	Poor	4,240

bring the data into line with those furnished for 1960 and 1961 by Schubert and Baron (1960) and Baron and Schubert (1961), respectively. None of the four species did well in 1961, and the mean rating of 1.82 for all species indicates a cone crop somewhat less than "very light." Baron and Schubert (1961:1) stated: "Poor cone crops are prevalent on nearly all species of forest trees this year [1961] over most of the state." As regards southern California (U.S. Forest Service seed collection zone IX), the ratings are based on far fewer individual reports than are those for the Sierra Nevada, but they parallel the annual ratings for the latter region for 1959, 1960, and 1961. Thus, as was true of the irruptions of 1935, 1950, and 1955, the irruption of 1961 coincided with low seed production on the winter range. So far, every Californian irruption for which cone crop data are available has coincided with poor cone crops and thus with low supplies of winter food on the normal winter range.

THE 1961 IRRUPTION AND POPULATION LEVEL

The irruption (and poor cone crop) years of 1935, 1950, and 1955 were preceded by two or more years in which there were heavy cone crops in at least one of the four conifers considered (Davis and Williams, 1957:302, Tables 1 and 2). We suggested that populations of nutcrackers built up in the Sierra Nevada during these years of abundant winter food supply. Further, since single years of heavy cone production followed by poor cone crop years (1936-37, 1941-42) did not result in irruptions, we suggested that it would take at least two years of good seed crops to build nutcracker populations up appreciably, since individuals of this species do not breed until they are two years old (Mewaldt, 1952: 361). Presumably, it would take two years of abundant winter food to build the breeding population up to a level at which the entire population, including breeding adults, nonbreeding first-year birds, and young-of-the-year, would be high in the fall, coincident with a shortage of cones. This pattern, however, did not occur in the two years prior to the irruption of 1961. As can be seen from Table 1, 1959 was a poor cone year, 1960 was a good cone year, and 1961 was again a poor

year. Schubert and Baron (1959:1) stated of the 1959 cone crop, "Only a few localities in California can expect a good crop of forest tree seed in 1959." These same authors (1960:1) stated of the 1960 crop, "Prospects are favorable for a good crop of forest tree seed in 1960." Thus, the irruption of 1961 was preceded by only one year of relative seed abundance. As noted previously, there were no irruptions following the poor cone years of 1937 and 1942, although 1936 and 1941 were years of cone abundance. Since there was an irruption in the poor year of 1961 following the good year of 1960, one may wonder why no irruptions occurred in 1937 and 1942. As regards 1937, it must be remembered that an irruption had occurred in 1935, a year of very poor cone crops. Since a number of birds that irrupted in 1935 undoubtedly never found their way back to the Sierra Nevada, and since the overwintering of nonirrupting birds might have been poor in the winter of 1935-36 because of the cone shortage, it seems likely that the population was at a low level in the fall of 1936. The good cone crop of that year might have raised the level of the population somewhat, but the population faced with a cone shortage in the fall of 1937 may well have been below normal, and perhaps for this reason, despite the cone shortage, there may have been enough food for most birds and hence no irruption occurred. However, no such explanation can be adduced for the absence of an irruption in 1942. Since an irruption did occur in 1961 after a similar sequence of years, the role of population buildup and consequent overcrowding in the Californian irruptions is not clear.

IRRUPTIONS IN OTHER STATES

As we pointed out in 1957, irruptions occurred in 1935, 1950, and 1955 not only in California, but in other states as well. The same was true of the 1961 irruption. Coincident with the Californian irruption of 1961, there were reports of Clark's Nutcrackers outside their normal range in Arizona and New Mexico. In addition, nutcrackers were recorded in states lying wholly outside the normal range of the species; extralimital records were reported from Texas, Oklahoma, Kansas, and Missouri. If food is the proximate factor in irruptions in other states, as it seems to be in California, then it must be assumed that the cone crops in many parts of the total range of the species fluctuate synchronously and in the same direction. Unfortunately, no other western state keeps records of cone crops comparable to those kept in California. However, Mr. Gilbert H. Schubert of the Rocky Mountain Forest and Range Experiment Station, Flagstaff, Arizona, kindly forwarded ratings of cone crops in the Southwest for 1959, 1960, and 1961 (Table 2). It can be seen that the ratings for the Southwest in these three years agree closely with those for the same years in California. Here, then, is the first evidence,

scanty though it may be, that fluctuations in the fall supply of seeds to be stored for winter use may be the proximate cause of coincident irruptions in many parts of the range of the Clark's Nutcracker. The synchronous and similar fluctuations in cone crops in such diverse montane areas as the west slope of the Sierra Nevada and the southern Rocky Mountains are obviously dependent on some widespread environmental factor or factors. Tirén (1935; reference not seen by us, but cited extensively by Svårdson, 1957) has shown that certain climatic factors are responsible for heavy cone crops in the Norway spruce (*Picea abies*), and that rhythmic fluctuations in the cone crops of that tree are the result of interaction between these climatic correlates and the physiological state of the individual tree after coning. Something of the same sort is undoubtedly involved here.

IRRUPTION OR INVASION TYPE OF MIGRATION?

Svårdson (1957) has advanced the idea that the presumed irruptions or invasions of certain European species are, in reality, migrations, the proximate factors for which are identical to those for ordinary migration. According to this hypothesis, irrupting species such as Red Crossbills (*Loxia curvirostra*), Nutcrackers (*Nucifraga caryocatactes*), Fieldfares (*Turdus pilaris*), and others, are normally migratory in response to "hormonal change, acting through metabolism, anchored by photoperiodism" (op. cit.:330) in exactly the same fashion as ordinary migrants. The primary distinction between "invasion migrants" and ordinary migrants is that abundant food supplies have a very strong retarding effect on the migrations of the former, and a very slight effect on migrations of the latter. Thus, invasion migrants will migrate only as far as they have to in order to find adequate supplies of winter food. If winter food is abundant on the breeding grounds, the migration will be scarcely evident; if the nearest adequate supplies of winter food are far from the normal range of the species, a long migration occurs, with numbers of birds reported from extralimital localities. Such a long migration results in what observers term an irruption or invasion. The question as regards the Californian irruptions of the Clark's Nutcracker is whether this species is normally migratory, setting out on a migration each year in response to the same physiological factors controlling onset of migration in ordinary migrants, but modifying the extent of the migration according to the location of adequate supplies of winter food, or whether the species should be thought of as nonmigratory, irrupting in some years because of poor supplies of food on the normal winter range, with food thus the proximate factor behind such population dislocations.

Svårdson lists the characteristics of invasion migrations (loc. cit.), so that it is possible, where we have the information, to see how many of these

characteristics the Californian irruptions of the Clark's Nutcracker possess. The *ultimate factor* behind invasion migrations is "escape from food shortage during a certain year" (as opposed to escape from food shortage during a certain *season* for ordinary migrants). This is certainly true of irruptions of the Clark's Nutcracker. The *participants* include "the whole population or only part, particularly the young or females." Since Svärdsön states (loc. cit.) that *all* the invaders in Nutcracker invasions in Europe are young birds, there is an obvious difference here. As we pointed out previously (Davis and Williams, 1957:298), of 21 specimens of Clark's Nutcracker collected in extralimital localities during North American irruptions, 11 were adults and 10 were first-year birds. Although the sample is small, it is sufficient to indicate that by no means all of the participating nutcrackers were young birds. As regards the *retarding stimulus of abundant food*, the effect is "very strong." Not enough is known about irruptions of Clark's Nutcrackers to come to any conclusion on this point. The *tendency to return to the home or winter range of last year* is "very weak." Again, not enough is known about nutcracker irruptions in this country. In the invasion of 1955, we noted (op. cit.:298) that there were many records of nutcrackers on the Monterey Peninsula throughout the fall and winter, but that the birds were seen at only two localities on the peninsula after March. It is intriguing to speculate that this abrupt dropoff in numbers at about the time of the onset of the breeding season may have resulted from numbers of irrupting birds trying to find their way back to the breeding range in the Sierra Nevada. The *performance of movement* in invasion migrations is "irregular in time and space." As we have seen, the onset of irruptions has been irregular as regards year of irruption, but the actual onset of the different irruptions has been remarkably constant in that all irruptions have started in California in late September and October. The Californian irruptions have been regular in space in that nearly all records during irruptions come from coastal and desert regions, especially from localities in the Coast Ranges or on the coast proper. However, this would be expected, because the next great concentrations of conifers west of the Sierra Nevada are found in the Coast Ranges and on the coast. Beyond the coastal coniferous forests lies the Pacific Ocean. There are records of irrupting nutcrackers on Santa Cruz Island and on shipboard off Los Angeles, but if any great numbers of nutcrackers flew out to sea during past irruptions in California, they would be lost as far as ornithologists are concerned. The apparent regularity of Californian irruptions in space may thus be imposed in part by the nature of the terrain over which the birds would be passing, and in part by the distribution of observers in the state. However, we must conclude that the Californian irruptions are regular in time as regards actual onset of irruption, and that they are probably regular in space as well. The

breeding range of invasion migrant species is "fluctuating." At present, there is no reliable record of nutcrackers breeding extralimittally anywhere in North America, and we must regard the breeding range of the Clark's Nutcracker as stable at this time. The remaining characteristics of invasion migrations listed by Svårdson either are not germane to a discussion of this particular species or represent points on which we have no information.

One possible source of evidence supporting Svårdson's hypothesis lies in the fact that wandering movements, either locally, or to great distances by small numbers of birds, occur frequently in nutcrackers in the Pacific states even in noninvasion years. Thus, Farner (1952) noted that at Crater Lake National Park, Oregon, there was an influx of nutcrackers into the higher parts of the park throughout the summer, and a gradual decline in numbers from September to December in these higher parts of the area. However, the same is also true, for example, of the Rufous-sided Towhee (*Pipilo erythrophthalmus*), definitely a nonirruptive species, in the montane parts of its range in California. As stated by Grinnell and Miller (1944:470), *Pipilo erythrophthalmus falcinellus* is "in general, resident; there is some altitudinal movement up mountain slopes after nesting and descent from higher parts of breeding range in winter, but no migration is known that carries birds outside of limits of breeding range." Such local movements may be common in montane birds, and the time of year at which they occur does not suggest that they are triggered by the same factors that are responsible for the onset of migration in ordinary migrants. Again, Grinnell and Miller (op. cit.:298) state of the Clark's Nutcracker in California that "there are frequent though irregular wanderings which carry individual birds or small companies in late summer and autumn far and wide, to lowest altitudes and farthest confines of state." It seems possible that these minor population movements, involving few birds, may be explained solely in terms of food supply: that is, that they result from restricted, local shortages of food, and that it is such local shortages that constitute the proximate factor involved.

It seems to us, then, that because of the particular characteristics of the irruptions of the Clark's Nutcracker, and because of the obvious correlation between these irruptions and food supply, it is best to think of food as the proximate factor behind them. There seems at present no reason to think of them as constituting migrations of any sort, in the absence of physiological evidence indicating that nutcracker populations achieve a premigratory state of some sort. Indeed, the extremely protracted molt period demonstrated by Mewaldt (1958) for the Clark's Nutcracker in Montana suggests that the physiology of this species differs rather considerably from that of "ordinary" migrants and that the hormonal picture in ordinary migrants and Clark's Nutcrackers may be quite different in the fall and winter.

The role of population levels in these irruptions is not clear. Nor can we explain why irruptions do not occur in some years of cone shortage. Clearly, the picture of these movements is largely incomplete. This is primarily because few ornithologists are active in the montane range of this species in the critical times of year, namely, the fall and winter periods. Thus, we have virtually no information on population levels prior to irruption, and we have no idea of movements within the montane winter range. At the present time, we can say only that these irruptions occur in relation to winter food supply, and that winter food supply seems to be affected in the same way over large areas within the range of the Clark's Nutcracker.

SUMMARY

The irruption of the Clark's Nutcracker in California in the fall and winter of 1961 is discussed. The irruption coincided with low cone crops in the montane regions of California.

An irruption of the species in Arizona also coincided with low cone crops in that state. It appears as if cone crops may vary synchronously over much of the range of the nutcracker.

It is concluded that food is the proximate factor underlying irruptions of the Clark's Nutcracker and that these irruptions are not invasion migrations triggered by the same proximate factors which trigger ordinary migrations.

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THE ALLEGED TRANSPORTATION OF ITS EGGS OR YOUNG BY THE CHUCK-WILL'S-WIDOW

ALBERT F. GANIER

MY experiences with the Chuck-will's-widow (*Caprimulgus carolinensis*) go back to the time when as a teen-age boy I roamed the woods about Vicksburg, Mississippi, and succeeded in finding three of their nests. Since I was subscribing to the little bird magazines of that day, I wrote an article on their habits which was published in *The Bittern* of January 1901. At Vicksburg the bird was a common species, judging from its calls at night, but to actually see one in life involved miles of tramping and searching through the woods.

After my college days I became a resident of Nashville, Tennessee, and there, too, found the "Chuck" present in goodly numbers. Its most favored haunt is the rolling or hilly country near the rivers where the elevation is from 450 to 650 feet. In the tableland, a few miles westward where the elevation is around 800 feet, it is replaced to a great extent by its smaller cousin, the Whip-poor-will.

Spring arrivals announce their coming about 15 April, although we have earlier arrival dates in April. Presumably the males return to their former territories where they vocally announce their presence with great persistence from an open space on the ground, such as a road. They are visited there by the female and mating begins. The birds continue to rendezvous at these places until the eggs are laid.

Thirty-five years ago I purchased a 25-acre tract of wooded land on a bluff along Stone's River, 9 miles from Nashville, and there built a summer cottage. I fenced the tract to keep out dogs, for three pairs of Chuck-will's-widows were nesting in this enclosed area. They continued to nest there for many years and I still have two pairs. I have often found their nests and have had good opportunity to study their habits there as well as elsewhere.

The two, glossy, handsomely marked eggs are laid usually about 15 May, on a level spot, so they will not roll downhill, and upon the dead leaves just as the bird finds them. Their protective coloration is good and they are not readily seen. They are not laid close to a tree, bush, or log since this would prevent the bird from arising quickly on flight. The female returns to nearly the same spot, year after year, if the surroundings have not changed. This has been observed also by others. Before the eggs are laid, she will be found roosting close by as though to observe the possibilities of predation. I have found and observed more than a score of nests but never found one the day the first egg was laid. Competent observers have done so, however, and have

found that a day intervenes between laying the first and second egg. Incubation (Wilson, 1959) requires approximately 20 days and the newly hatched young, covered with buffy down, at first lie flat on the ground. They soon become precocious youngsters, leave the nest site, and develop so rapidly that they are able to rise and fly 50 feet or more when only 17 days old. At this time they are completely feathered. Because of continued growth, the young molt during the latter part of July. During their development, they are attended only by the female. The males continue to occupy the same general area but are not seen at the nest site or near the young.

The preferred roosting spot is upon a fallen branch on the forest floor and here they may be found daily unless unduly disturbed. At such roosting spots a small pile of black and white excrement may be found. The birds sit crossways to their perch more often than not. They may less often be found roosting on the low branch of a tree in the woodland. The story recorded by Audubon that the birds roost in the daytime in hollow trees with bats is highly improbable. The physical characteristics of the bird would rule out such a habit.

We also read that the bird is highly conscious of its protective coloration and that it will not flush from the ground until nearly stepped on. This has not been my experience. I never approached a bird closer than 12 feet without its flushing and usually they leave their eggs on being approached within 15 to 20 feet. When roosting, the flushing distance is greater. When flushed from its eggs or small young, the parent makes a short, low flight, usually drops to the ground, and with flapping, outstretched wings, endeavors to lure the intruder away.

During the summer the Chuck-will's-widow breeds from the southern parts of Ohio, Indiana, and Illinois, south to the Gulf coast. They winter in Central America, the West Indies, and northern Colombia. Departure dates in the fall are hard to obtain because the birds rarely call after mid-August and late dates can be secured only by flushing one or seeing it flying in the dusk. My latest dates for Nashville are around 5 September, though I have one record of 23 September.

With this brief introduction, we will now take up the chief purpose of this paper which has to do with the reliability of the oft-repeated story about Chuck-will's-widows transporting their eggs or young to another site if they find that they have been touched by human hands. This story first appeared in Volume I of Audubon's "Ornithological Biographies," 1831, and the account, as printed, reads as follows:

"The bird forms no nest. A little space is carelessly scratched among the dead leaves and in it the eggs, which are elliptical, dull olive and speckled with brown, are dropped. These are not found without great difficulty, unless by accident a person passes within

a few feet of the bird while sitting, and it chanced to fly off. Should you touch . . . (the eggs) . . . and, returning to the place, search for them again, you would search in vain, for the bird perceives at once that they have been meddled with, and both parents remove them to some other part of the woods where chance only could enable you to find them again. In the same manner they also remove the young when very small. . . . The Negroes, some of whom pay a good deal of attention to the habits of birds and quadrupeds, assured me that these birds push the eggs or young with their bill along the ground. . . . I made up my mind to institute a strict investigation of the matter. The following is the result. When the Chuck-wills-widow, either male or female, (for each sits alternately) has discovered that the eggs have been touched, it ruffles its feathers and appears extremely dejected for a minute or two, after which it emits a low murmuring cry, scarcely audible to me as I lay concealed at a distance of 18 or 20 yards. At this time I have watched the other parent reach the spot, flying so low over the ground that I thought its little feet must have touched it as it skimmed along, and after a few notes and some gesticulations, all indicative of great distress, take an egg in its large mouth, the other bird doing the same, when they would fly off together, skimming closely over the ground, until they disappeared among the branches and trees. But to what distance they remove their eggs, I have never been able to ascertain nor have I ever had an opportunity of witnessing the removal of the young. Should a person, come upon a nest when the bird is sitting, refrain from touching the eggs, the bird returns to them and sits as before. This fact I have also ascertained by observation."

Briefly, it is my belief that Audubon had no such personal experience on which to base this story. It does not fit in with my own long experience with these birds, nor have I been able to find in the literature any ornithologist since Audubon's time who claims to have witnessed such an episode. I would not question the bird's capability of taking an egg in its large mouth and flying with it to another place, but the two, thus acting in concert, would be putting on an act far beyond the limits of avian intelligence.

Furthermore, I have never found two adult birds together, at or close to the nest during the daytime. When the sitting or brooding bird is flushed and makes the usual vocal protest. I have never seen a mate come to her aid as might be expected. This is true likewise during the weeks she is guarding the fledglings. Other observers, whom I shall quote further on, have also found this to be the case. During May, the males have regular locations from which to begin their evening calls and they can be heard calling at the same locations each evening. The nest site is never, in my experience, close to the initial calling point of the male.

The parental bond and home tie is usually developed in male birds through the process of nest building. In some species this activity may last for as long as two weeks and the final result is the production a a very helpful male parent to the young. Because of the utter lack of a nest in the case of the Chuck-will's-widow, the male is not exposed to this cooperative stimulus and apparently such a bond is not well developed.

Before presenting an array of evidence to nullify the Audubon story, let



FIG. 1. Chuck-will's-widow, between 5 and 6 weeks old. The light-colored (ochraceous-buff) scapulars and wing coverts will be replaced by darker feathers before fall.

us consider the circumstances surrounding the preparation of the first volume, of which this story is a part. Audubon had come to London in 1830 to see what could be done about beginning a descriptive treatise to follow along with his portfolios of plates. Late that year he found that three publishers were at work getting out editions of Wilson's book, with the same objective. At that time, Audubon was an unpracticed writer of English prose, and prospective publishers turned down his efforts. On advice from a fellow naturalist, he made a bargain with a young writer named William MacGillivray to act as a ghostwriter. This young man knew nothing about American birds except what he found in Audubon's journals and what Audubon wrote out from recollections in his flowery and sometimes indefinite style. This material MacGillivray rewrote, chiefly in his own words, to meet the exacting style of the day. Meanwhile, Audubon was painting pictures for sale in order to raise money for living expenses and for the printer, ever fearful that his first volume might be a financial failure. He wrote in his diary that his prospective English subscribers would not be satisfied with plain descriptive matter but that they required "novelty" in return for their patronage. Under the stress of competition and the fear of failure, it is fair to assume that Audubon and

MacGillivray dressed up the Chuck-will's-widow story to meet this demand for "novelty."

Audubon's opportunities to have observed the Chuck-will's-widow came only in the summers of 1821, 1822, and 1823. According to his 1820-21 Journal (Corning, 1929), he was at Bayou Sarah, Louisiana, north of New Orleans, from 17 June to 20 October 1821, and during that time found no birds of this species other than two specimens given to him by hunters. In 1822, he was at Natchez and during the nesting season spent his time in the swamp country across the river where the Chuck-will's-widow does not breed. During the summer, however, he apparently secured a male, from the hill country eastward, which he painted alongside a female secured in 1821. The spring of 1823 was spent traveling as an itinerant portrait painter until about 10 May, after which time he taught music and dancing at Bayou Sarah. In the following years, the nesting seasons were spent in northern localities.

With reference to its nesting, he set down in his 1821 Journal: "Many of the planters think that this bird has the power and judgment of removing its eggs when discovered, sometimes several hundred yards—these are usually laid on the bare earth, under a small bush or by the side of a log." This is the only reference to its nesting in this Journal. Stanley C. Arthur (1937), in his fine biography of Audubon, reproduces the above quotation and then states, "... which proves that this observation which appeared in the *Ornithological Biographies* was not founded on personal observations but upon mere hearsay." He then condemns those who have repeated the story in later years.

If Audubon had set down any notes on the Chuck-will's-widow during the summers of 1822 and 1823, we would expect to find them in the 1822-23 Journal. This small volume, described by his granddaughter Marie Audubon (1897), was burned by her after she had extracted from it what she chose to reveal. Dr. Eliot Coues had read through this Journal and after some sheets were removed for preservation, he is said not to have opposed its destruction. The sheets preserved do not include any notes on birds.

In Constance Rourke's biography (1936) of the famous bird painter, she gives a different version of the egg-transportation story; but this seems to have been only an unfounded dramatization of the account in the "*Biographies*" and the brief entry in his 1821 Journal, quoted above.

Through the years this strange story has intrigued many ornithologists and led to many attempts to verify or disprove it. Because of their nocturnal habits, the birds are different subjects for study. Not a great many people have found their eggs, because the only means of finding them is to flush the female from the forest floor.

On a number of the occasions that I have found the eggs, I have later brought others to view them or the incubating bird on the same day or on

subsequent days. When first found, I pick up and hold the eggs to the light to determine the stage of incubation. There have been times when the eggs disappeared or were found broken but I have always attributed this to my trail having been followed by a dog, a habit common to the canine family. Other predators, such as foxes, skunks, opossums, rats, snakes, will take the eggs. One nest, which I found with two fresh eggs, when visited the next day was found to have each egg broken on one side and the contents licked clean—probably the work of a skunk. After locating a nest with eggs, I do not approach again closer than 20 feet for fear of leaving a trail. I have observed the young within a day after hatching and have noted that the returning parent will alight a foot or more away from them. Her purpose is to cause them to slowly scramble toward her warmth and protection, thus getting them away from the spot that has been scented with the odor of incubation. This trick is continued daily and within a few days the young may be yards from the original site. I feel sure that the failure to find the eggs or young at the nest site has caused many to believe that they had been transported away by the parent. Having given you the gist of my own experiences, let me now quote you the observations of others.

Major Charles Bendire (1895) quotes the veteran ornithologist Dr. William C. Avery of Greensboro, Alabama, as follows:

“It is said that if either their eggs or young are disturbed, they are carried off in the capacious mouths of the birds. . . . I must say that I do not believe this assertion. I purposely flushed the bird off the eggs that I sent you, three times on May 3, 1890, when I first found the nest, and once on the 4th . . . and yet the old bird returned each time and continued to sit as long as the eggs remained there.”

W. J. Erickson, an experienced Georgia ornithologist (1919), says:

“To test the truth of the report that these birds remove their eggs a short distance when touched, I purposely handled every one of four sets found, being careful to mark the exact spot where they lay, but on returning to the eggs, I found every one in the spot where I had left them, none having been moved as much as an inch. I have made this test repeatedly in several other localities on the coast of Georgia but always with the same result.”

Herbert Stoddard of Thomasville, Georgia, is quoted by Bent (1940) as watching the young which had hatched on 30 April and 1 May. He records that they moved from day to day. The female flew in close; he never observed a male at the site. On 6 May (5 days after hatching), she was brooding her chicks 30 feet from the nest.

Captain Charles L. Steele (1930) made a study of a nest found at Ft. Benning, Georgia on 12 May, containing two eggs which hatched on 31 May. The old bird was very loathe to leave the nest and permitted seven persons to approach to within four feet before taking wing. When the invaders left the

vicinity, she returned at once to the eggs and permitted her picture to be taken at a yard distant. At 17 days of age one of the well-feathered young, found some distance away, was able to fly about 60 feet. The trustful deportment of this bird was unusual.

Some very fine observations on the nesting habits of this species have been furnished me by Dr. Lawrence P. Wilson of Walls, Mississippi, made at his country place south of Memphis. During 1962, he found a nest with 2 fresh eggs, on 24 May. The male bird was found 100 feet away on a fallen dead limb. He was there again the next day but was not to be found after that. Dr. Wilson built a blind and moved it to a point 25 feet from the nest for future observations. On 1 June, 8 days later, he visited the nest, held the eggs in his hands for several minutes to impart a possible human scent, and replaced them. With his wife he walked to the blind and entered, after which she walked away. After a 13-minute wait, the bird flew down to the ground and sat there facing the eggs but a few inches away. She remained there 8 minutes before moving forward to cover them. On 6 June, 5 days later, he repeated the experiment. This time the bird returned and alighted 3 feet from the eggs, later arising and dropping down to cover them. The following day, Dr. Wilson moved the eggs 6 inches. The bird, on returning, sat upon them there but the next day he found she had rolled them back to the original spot.

On 11 June, at 2 PM, his visit showed that one of the eggs had hatched. This was the 20th day after finding the eggs. The next day the second egg was found to have hatched. The following day, 13 June, the young were 18 inches from the "nest." On 14 June, the young were 12 feet away, although they were only 3 or 4 days old. Four days later they were 50 feet away from the last-mentioned spot. On 28 June, the young, now fully feathered and 16 or 17 days old, flew 100 and 150 feet, respectively.

During 1963, Dr. Wilson continued his observations and made some important findings by watching an incubating female from a blind through two entire nights. This nest, found on 27 May, held two fresh eggs which, on account of the late date, were presumably a replacement laying. He erected a small tent blind 25 feet from the nest and provided an electric light suspended in the tree above the blind, adjusted so that its rays would illuminate only within a few feet of the incubating bird. At dusk on 3 June he entered the tent with his wife, after which she walked away at 7:25 PM.

The bird returned at 8:10, after he turned the light off temporarily. As early as 7:40, three males had been heard some distance away and they continued calling for about 20 minutes. With the overhead light off, it was still easy to spot the bird on the nest with the small hand flashlight, since her eyes reflected the light "like a new penny." "Chucks" had been heard calling almost continuously from woods far off, but at 9:30 one came closer and

started calling. The incubating female raised up and gave 3 "quawks" but did not leave. The male left but returned at 11:20 and, in response to his "quawks," the female flew up into the trees, then returned to the eggs within 2 minutes, presumably having been fed by the male. At 1:40 and again at 3:55, the procedure was reenacted, both birds "quawking" while in the trees above. At 4:20, it had become fairly light and the female left the nest without an invitation from the male. She remained away for 15 minutes and this was presumed to be her regular morning feeding time.

On 7 June, Dr. Wilson again spent the night in the blind, entering at 7:40 PM, and the female, which had flown off, returned at 8:00. The male did not arrive in the trees above until 10:32, when he "quawked" several times and called "chuck-wills-widow" 3 or 4 times. After several further invitations on his part the female flew up into the trees, returning in less than 2 minutes. Again at 11:25 and 2:50 AM, the procedure was repeated. At one time, 11:45, 2 or 3 males were calling "chuck-wills-widow" nearby but the female showed no interest whatsoever. At 4:10, she flew off and remained away for 24 minutes; this again was presumably her morning feeding time.

On 9 June, Dr. Wilson came prepared to spend a third night, entering the blind an hour earlier so as to ascertain the time of the evening feeding period in case there was one. Unfortunately, the eggs were gone and a bit of shell where they had lain revealed that they had again been removed by a predator. He had hoped this set would be spared long enough to hatch so that he could observe whether the male as well as the female brought food to the young. During his watches he noted that the female kept her eyes wide open all during the night hours as though to be alert for predators. It is his conclusion that the male does not assist in the incubation chore nor guard the eggs during her absences, and that he visits and feeds her several times during the night.

The long, curved, middle claw of the Chuck-wills-widow is equipped with a well-developed comb on its inner side, measuring 8 mm in length. This is provided to enable the bird to rid itself of insects that may crawl upon it from the ground, particularly the flat-bodied wood ticks which are difficult to brush off. In this connection, Rysgaard (1944) flushed one of these birds from a single egg at point of hatching and noted that the bird had an egg attached to or held by one of its feet as it lit on a low limb close by. A few hours later he returned to the spot and found that it had hatched in the meantime. I can readily agree with his conclusion that the long claw, above described, became embedded in the soft or pipped shell and could not readily be released.

SUMMARY

This paper presents a great deal of original information on a species that has received but little study and endeavors to correct certain errors in the literature. A critical reading of Audubon's "Biographies" will reveal numerous errors, particularly in the first volume, and it is evident that some of his stories were based on mere hearsay. It must be realized that present-day ornithological ethics had not evolved by 1831, and that "tall tales" from America were expected, if not demanded. I have searched through the literature quite fully and cannot find any contributor who has stated that he himself has witnessed the procedure described in Audubon's book. Herrick (1917) has not seen fit to discuss the story. Baird, Brewer, and Ridgway, in their *History of North American Birds*, reproduce the Audubon story and cast no doubt on its validity. A surprising number of later authors have printed the account in their works, some crediting it to Audubon and, regrettably, more have not. I think that quite enough testimony has been presented in the foregoing statements by competent ornithologists to refute the story and that future authors should avoid its repetition.

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NOTES ON INCUBATION AND NESTLING TEMPERATURES AND BEHAVIOR OF CAPTIVE OWLS

THOMAS R. HOWELL

TEMPERATURES of eggs, nestlings, and parent owls are infrequently reported, for the nests are often inaccessible, the adult birds are difficult to handle, and owls rarely nest in captivity. Nice (1962) has recently called attention to the scarcity of studies of development of young owls. One pair each of the Burrowing Owl (*Speotyto cunicularia*) and the Barn Owl (*Tyto alba pratincola*) undertook nesting in captivity at the University of California, Los Angeles, and some temperature data and observations on behavior were obtained.

BURROWING OWL

Two Burrowing Owls (*Speotyto cunicularia hypugaea*) were acquired by Mrs. Anita Long Bailey from Los Alamitos, Orange County, California, in May 1958. The nest burrow had been excavated by some small boys and contained five young birds; two of these, of an estimated age of one week, were given to Mrs. Bailey, who was at that time employed in the Department of Zoology at U.C.L.A.

On the first day in captivity the birds were force-fed small pieces of raw meat every two hours; from the second day on, they opened their mouths whenever a hand was brought near them and feeding became simpler. As might be expected, these burrow-adapted nestlings showed little skill in locomotion. When still in the downy stage but with their eyes fully open, the young owls showed no hesitancy in crawling off the edge of some surface such as a tabletop, and they were also inept at avoiding any stationary object that happened to be in their path. After they reached the fledgling stage the birds were kept in a cage measuring about 1.3 m \times 1 m \times 1 m. Even when full grown, the owls would never kill live mice placed in their cage and actually showed fear of them; however, freshly killed mice were accepted and eaten readily. The cage was kept in a windowless office in the Life Sciences Building at the University of California, Los Angeles. No fixed light regime was maintained, but the fluorescent lights in the room were usually on for at least eight hours every day.

Beginning on 18 February 1959, a male Burrowing Owl from Florida (*S. c. floridana*) that had been in captivity elsewhere for several years was kept in a cage with one of the California birds that proved to be female. The latter was then about nine months old. As both these birds were relatively tame, they were frequently taken out of the cage and allowed the freedom

of the office. During these periods of liberty the birds explored the room, and the female appeared to be seeking a nest site as she investigated various semienclosed spaces at or near the level of the floor. Usually, the male either watched or followed the lead of the female in these movements. A space about 15 cm high between the lowest shelf of a bookcase and the floor was looked into most often, and a dark corner of this space was especially favored. The female repeatedly entered and emerged from this corner, frequently followed by the male, and both birds often appeared highly excited by this activity. On one occasion when both birds were on the floor of the room, the male assumed a very erect posture with the feathers of the head and neck region fully fluffed out and the white throat patch showing conspicuously; he then bowed stiffly and rapidly toward the female. During this display he appeared to be larger than the female although he was actually smaller in weight and other dimensions. Possibly in response to the display, the female went through the pattern of entering and emerging repeatedly from the favored corner. Her behavior suggested an inducement to the male to follow her into the presumed nest site, but he did not follow or continue the display. Whether or not this or similar displays pertained to courtship or some other behavior was difficult to determine under the highly artificial conditions of captivity. The necessary routine use of the room disturbed the birds at irregular intervals, and therefore no attempt was made to describe and interpret all of the birds' activities.

On the morning of 5 March, an egg was present on the bare floor of the cage. Both birds were highly excited, and although the female did not incubate, she was unusually aggressive and would fly at one's hand if it were put into the cage. By late afternoon, however, the bird no longer was aggressive nor did she show any interest in the egg. It was removed and was found to be cracked. In an attempt to encourage a successful nesting, a cardboard box about 15 cm square and 25 cm long was placed in the favored corner under the bookshelf and arranged so that the open end of the box faced outward into the room. The birds' cage was then placed on the floor in front of the bookcase so that the box opened into the cage. Sand was provided on the cage floor and in the box, and although dry grass was placed in the cage, it was not used as nesting material. The box was evidently acceptable as a nesting burrow substitute, and both birds frequently went into it together. The male spent much more time outside the box, however, and he was aggressive toward anyone who approached the cage. No copulations were observed, but a total of five eggs were laid on the following dates: 8, 9, 12, 14 or 15, and 17 March. Whether or not any of the eggs were fertile is unknown. All were eventually eaten or broken, and no more than four were present in the nest at any one time. However, the female developed an incubation patch and

spent most of her time on the eggs as long as any remained. The male often stayed in the nest box with the female, but he did not have an incubation patch and presumably took no part in incubation.

As the owl eggs were about the same size as those of the California Quail (*Lophortyx californicus*), a quail egg that was available was prepared for recording of incubation temperature with a thermister thermometer. A hole was bored in the large end of the egg, and a small, vinyl-sheathed thermister probe was inserted so that its tip was near the undersurface of the shell. The probe was fixed to the shell with a small piece of adhesive tape, and the egg was placed in the nest among the owl's own eggs in such a way that the thermister tip was uppermost. The lead from the thermister probe was run through a small hole in the side of the nest box to the instrument proper, and temperatures could be read from it without disturbing the owl. On 6 April, at an air temperature of 23 C, the prepared-egg temperature remained constant at 35.5 C for 20 minutes; this should be virtually identical with the incubation temperature of the owl's own eggs.

On 7 April, skin and cloacal temperatures of both adult birds were taken during midday at an air temperature of 25 C. Skin temperatures were taken with a "banjo-tip" probe that was pressed flat against the body surface. The temperatures were:

Male	Female
Abdominal skin: 39.8	Abdominal skin: 39.8
Pectoral skin: 39.0	Pectoral skin: 38.5
Deep (25 mm) cloacal: 40.5	Deep (25 mm) cloacal: 40.2

The temperatures for both sexes were identical or virtually so; this included the abdominal skin temperature although the incubation patch of the female was well developed and conspicuous. The data indicate that in this species the presumably increased vascularization of the incubation patch does not bring about a rise in the surface temperature of this area. However, an augmented blood supply to the defeathered abdominal skin would result in an increase in the amount of heat continuously available for warming the eggs.

BARN OWL

On 3 April 1959 a female Barn Owl of unknown age that had been in captivity for about six months was acquired. On that date the abdominal skin temperature was 38.8 C and the cloacal temperature was 40.0 C. A few months later a male Barn Owl of unknown age was acquired, and the two birds were kept together in a small outdoor cage that included a wooden compartment at one end into which the owls could withdraw from view. They were fed freshly killed laboratory rats and guinea pigs. No courtship by the birds

was observed, but in March 1960 the female was found to be incubating four eggs. The female had an incubation patch and the male did not. On 17 March, an egg of a bantam hen was prepared with an inserted thermister probe in the manner previously described. The small hen's egg was about the same size as a Barn Owl egg although not as rounded. During approximately one hour (2 to 3 PM) of continuous incubation, the temperature inside the egg reached equilibrium at 34.3 C. On 7 April, another continuous record for almost two hours (8:15 to 10 PM) showed an internal egg temperature at equilibrium of 34.0 C. On both dates, the air temperature was about 20 C. On 19 April, temperatures of the adult owls taken during the day were as follows:

Male	Female
Abdominal skin: 38.0	Abdominal skin: 39.3
Deep cloacal: 38.7	(incubation patch)
	Deep cloacal: 40.8

The temperature of the abdominal skin in the female was somewhat above that in the male, but this appears to reflect a slightly higher overall body temperature in the female rather than an increase associated with incubation patch development.

The first clutch of eggs did not hatch as three were eaten by one or both adults and the fourth was abandoned. The latter contained an embryo about two-thirds grown, and presumably the other eggs were also fertile. Sometime in May four more eggs were laid, and this time the male owl was removed to another cage. On 7 June one egg disappeared, presumably eaten by the female, and on 8 June the other three were transferred to an incubator that was kept at approximately 37 C (36–37.7 C). One of the eggs was already pipped on 8 June, and it hatched sometime between 9 PM on 9 June and 9:30 AM on 10 June. A second egg hatched two days later. The third one, although fertile, failed to hatch. The following weights were recorded:

Unpipped egg: 26.8 g
Pipped egg: 25.2 g
Hatchling owls: 18.5 g; 18.4 g

These are higher than the figures given by the Heinroths (1924–33, II:9–10) for eggs and hatchlings of the European form, *T. a. guttata*, but accord well with the data of Sumner (1929) for other examples of *T. a. pratincola*. During the next 10 days the capacity for body temperature regulation of the two owl chicks was studied. All temperatures of chicks recorded were deep esophageal and were taken with a vinyl plastic-sheathed, copper-constantan thermocouple. Between experiments the birds were returned to their nest and were

attended by the female parent. The older of the two chicks grew much more rapidly than the other; the latter disappeared from the nest on 22 June (age about 10 days) and was presumably eaten by the female parent. The other chick grew to maturity, and this bird and both parents were released in the fall of 1960.

When less than 12 hours out of the eggs, the hatchlings were sparsely covered with short white down; this was present even on the toes, extending over the proximal $\frac{2}{3}$ of their length. The skin, bill, and cere were pink, and the cere seemed relatively large. The feet were zygodactylous and no reversal of toes was seen. The eyes were completely closed. Two different vocalizations were recognizable—a strong, oft-repeated “peep” and a harsh note that seemed to express protest. A hatchling could right itself readily when placed on its back and could even hold its head up for a few seconds, but it could crawl only slightly. At a body temperature of 24.7 C, an owl chick could still “peep,” extend its wings, and move its feet, but it could barely raise its head.

The responses of the body temperatures of the owl chicks at different ages to ambient temperatures of about 22 C are shown in Figs. 1 and 2. At a post-hatching age of less than 12 hours, a chick's body temperature had almost reached the level of ambient temperature after one hour. As they grew older the chicks showed only gradual improvement in body temperature regulation, and even at 10 days of age there was a decline of about 7 C during one hour of exposure to moderate air temperature. As body temperature fell, shivering was first noticeable in the extremities and then showed over the entire body. The 3-day-old chick began strong total-body shivering at a body temperature of 28.5 C, but its temperature continued to decline. The 8- and 10-day-old chicks showed pronounced body shivering at a body temperature of about 31–32 C, and at this point a slight leveling-off of the decline was noted.

Sumner (1933) mentions an experiment on “a day old barn owl whose temperature rose only [!] to 46.3°C. in an artificially induced air temperature of 50.5°C., although the bird died as a result of the treatment.” I attempted a similar experiment using a lower ambient temperature than did Sumner. A hatchling Barn Owl less than 12 hours old was taken from the incubator and immediately placed in a chamber in which the air temperature was maintained at 45 C (Fig. 1). Body temperature rose rapidly, reaching 41.2 C after 7 minutes, and the bird “peeped” and panted vigorously. After 15 minutes the chamber was again opened, and the owl chick bore an alarming resemblance to a cartoonist's characterization of a “dead bird”—it was lying on its back, neck extended, beak vertical, with legs slightly flexed and pointed upward. There was no vocalization or movement, and body temperature had reached almost 44 C. The bird was not dead, however, and it rapidly recovered when

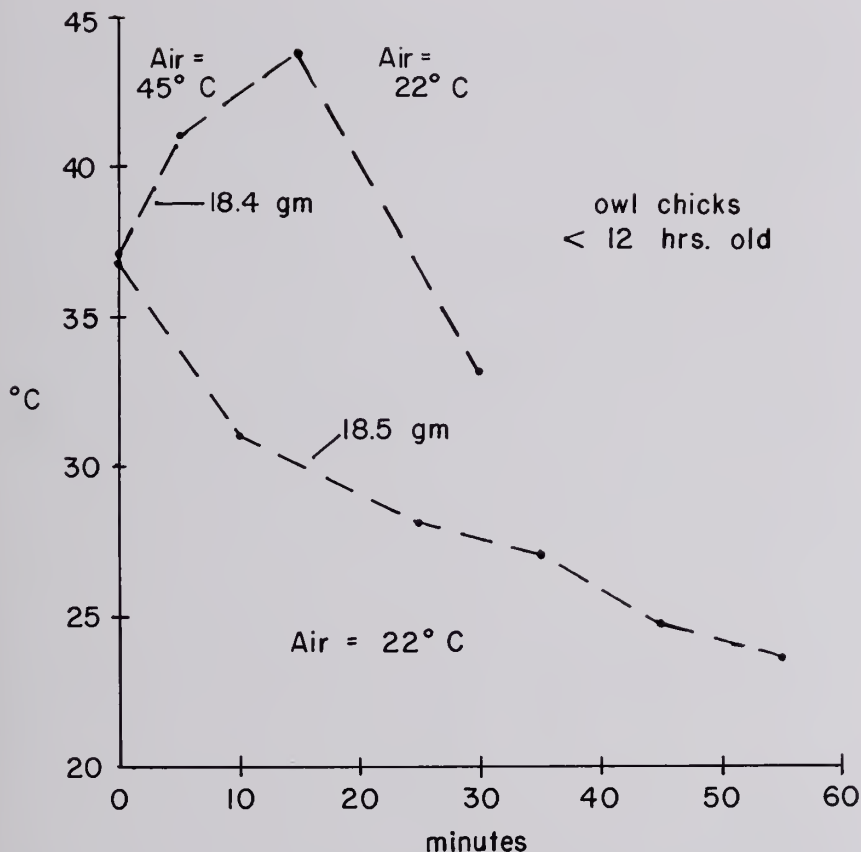


FIG. 1. Body temperatures of Barn Owl chicks exposed to high and moderate air temperatures.

removed to the moderate room temperature. There was no panting—only slow, irregular respiration—during the interval of body temperature decline, and the cooling-down process was apparently entirely passive.

DISCUSSION

Only two nestling Barn Owls were available for study, and it is possible that the experimental treatment to which they were subjected soon after hatching could have affected their later responses (Ryser and Morrison, 1954); extensive comparisons or generalizations would thus be unwarranted. Information on thermoregulation in young owls is so scarce, however, that the present data may appropriately be discussed if the above-mentioned caveat is kept in mind.

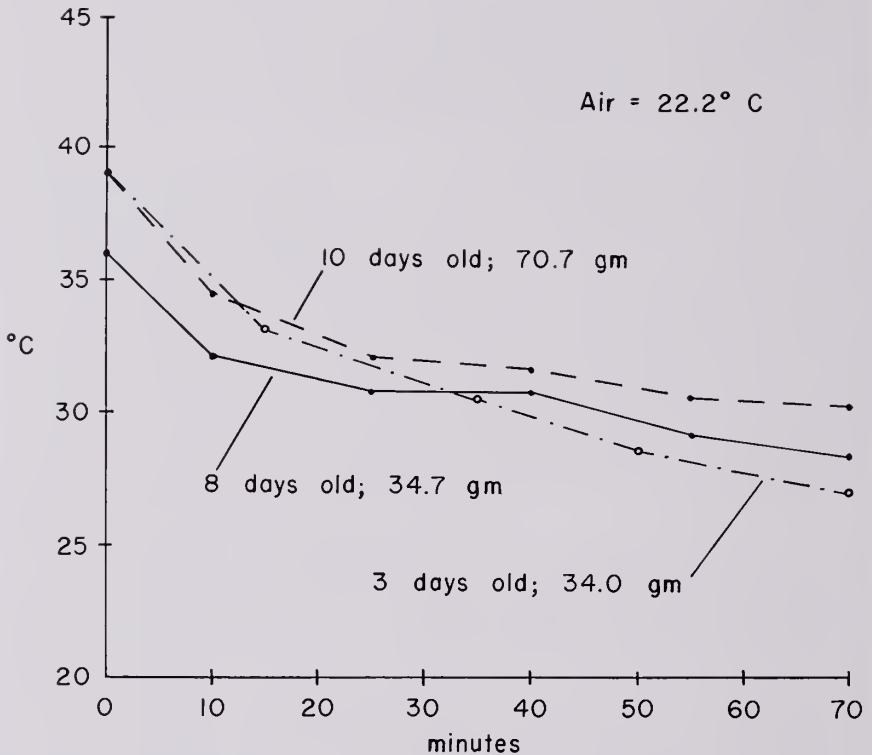


FIG. 2. Body temperatures of Barn Owl chicks of various ages exposed to moderate air temperatures.

Barth (1949) recorded body temperatures of nestling Snowy Owls (*Nyctea scandiaca*) from 0.5 to 12 days of age exposed to air temperatures of 5.5 to 10.5 C for intervals of 15 to 29 minutes after the departure of the brooding parent. The initial body temperatures of the Snowy Owl nestlings are not given, but presumably they were close to those of brooded Barn Owl nestlings (36–39 C). Despite the cold conditions to which the young Snowy Owls were exposed, the decline in their body temperatures was no greater than that shown by Barn Owls at the same ages exposed to much milder ambient temperatures. The adaptive advantage of better heat retention in nestling Snowy Owls is obvious, for this species nests on open arctic tundra; the Barn Owl usually nests in sheltered sites under mild climatic conditions.

Comparison of the capacity for body temperature regulation in nestling Barn Owls with that of various altricial and precocial species indicates that these owls are closer to the altricial condition. Nice (1962) designates newly hatched owls as semialtricial. The newly hatched Barn Owl appears unable to

maintain body temperature above even moderate ambient temperature for more than one hour, and its body temperature rises rapidly toward the lethal level at high ambient temperature. At the age of three days the rate of decline in body temperature at moderate ambient temperature seems to have slowed slightly, but the rate is more rapid and the decline greater than in a precocial pheasant chick (*Phasianus colchicus*) of the same age under similar conditions (Ryser and Morrison, 1954). Effective body temperature control is acquired much more slowly in the Barn Owl than in small altricial passerines, which may be relatively homeothermic beyond seven days of age (Dawson and Evans, 1960). Thermoregulatory ability in the Barn Owl nestlings seems also to develop more slowly than in precocial chicks. Pheasants at ages of 7 and 11 days experienced a drop in body temperature of only 2 to 3 C after 30 minutes exposure to an air temperature of 20 C (Ryser and Morrison, 1954: 257); Barn Owl chicks at age 8 and 10 days showed a considerably greater drop after 30 minutes exposure at about 22 C (Fig. 2). Young gulls (*Larus*) in this age bracket exposed to air temperatures below 22 C maintained higher body temperatures (Barth, 1951) than did the Barn Owl nestlings under less cool conditions.

The natal down does not seem to contribute importantly to heat retention in the Barn Owl, but it is probably more significant in the Snowy Owl and other species that nest under cold conditions. In nestling owls of the temperate and tropical regions, the first covering of down may possibly function to protect the skin from excessive soiling during feeding.

SUMMARY

Burrowing Owls (*Speotyto cunicularia*) and Barn Owls (*Tyto alba*) nested in captivity at the University of California, Los Angeles. The fertility of the Burrowing Owl eggs was uncertain; although incubated, they were all eventually eaten by the adults. The Barn Owl eggs were fertile and one young bird was successfully raised. Only the females developed an incubation patch, and its temperature was 39.8 C (*Speotyto*) and 39.3 C (*Tyto*). Continuous recordings of temperatures inside incubated eggs gave figures of 35.5 C (*Speotyto*) and 34.0 to 34.3 C (*Tyto*). Nestling Barn Owls are ptilopaedic but develop capacity for body temperature regulation very gradually; this is consistent with Nice's (1962) designation of newly hatched owls as semialtricial.

ACKNOWLEDGMENTS

I am grateful to Mrs. Anita Long Bailey for her skillful raising of the young Burrowing Owls and for the opportunity to refer to her notes on their development and behavior. I am also indebted to Robert Constable for obtaining two of the adult owls and for his care of the Barn Owls throughout the study.

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CONSTANCY OF INCUBATION FOR THE SCARLET TANAGER

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THE recent and interesting paper by Alexander F. Skutch (1962) stimulated me to reexamine the incubation data which I had gathered on female Scarlet Tanagers (*Piranga olivacea*) in southern Michigan during 1947,

1948, and 1949. Utilizing his formula $T = \frac{100S}{S + R}$ to determine the percent-

age of constancy, I reworked the data for my ten females, arranging them in accordance with Skutch in Table 1. The average constancy, 77%, seems to fit nicely within the range of constancies given in his Table 2. Moreover, it falls within the range of constancy, 60–80%, mentioned by him as being “normal” for birds incubating alone and given food occasionally on the nest.

In reorganizing my data, it became apparent that additional columns of information might be helpful in interpreting the constancy of incubating females. For example, wherever possible, observations for individual females should be separated to show their patterns by the day of incubation, time of day, and average temperature. Table 2 shows these data for my ten females. Time of day is arbitrarily divided into three approximately equal divisions as: morning = dawn–09:00, midday = 09:00–16:00, and evening = 16:00–dusk. Where observation spanned somewhat equally two periods, they are so indicated. Temperatures recorded at ground level and in the shade each hour were averaged for the period. Arranged in this way, these factors may be examined for possible correlation with computed constancies. All observations were made from a blind and through a 20 power spotting scope supplemented with 7 × 50 binoculars. All times were computed to the nearest ½ minute with a sweep-second hand watch.

Influence of male on mate's constancy.—Skutch (op. cit.) suggests several ways in which the nonincubating male may influence the female. As is generally known, only the female Scarlet Tanager incubates. While she is occasionally fed on the nest by her mate, there appears to be considerable variation with some males feeding the incubating females often, and others rarely or not at all. It is quite possible that feeding of the incubating female on the nest by the male Scarlet Tanager does increase session length, although not significantly so. While males #1 and #10 fed their mates on the nest, I did not notice this for the other males. The average of female #1's constancies is 78.5% and that of female #10 is 82.1%. These are slightly, but probably not significantly higher than the averages for the other females:

TABLE I
SUMMARY DATA FOR INCUBATION PATTERNS OF TEN FEMALE SCARLET
TANAGERS AT TEN NESTS

Hours watched	No.*	Sessions in minutes		Recesses in minutes		Constancy %
		Range	Average	Range	Average	
114.5	267	0.5-71.5	19.5	0.5-41	5.8	77

* Number of sessions; number of recesses = 269.

FEMALE NO.	% CONSTANCY
# 3	74.5
# 5	59.3
# 6	75
#13	75
#15	80
#16	81
#17	85
#18	64.5

Males frequently feed the female within seconds after she leaves the nest. It would appear that these feedings are a contributing factor to shortening the recess length. This was particularly noticeable for females #10 and #17 whose patterns of remarkably short recesses seem the direct result of ready (almost instantaneous) feeding by the male. This is not the entire explanation for short recesses because females often darted from the nest to take insect food from leaves or branches which, apparently, they had sighted while still on the nest. Skutch mentions (op. cit.) that for the Orange-billed Nightingale-Thrush (*Catharus aurantiirostris*) and the Streaked Saltator (*Saltator albicollis*) the females' sessions were longer when the mates were not in sight, with the females' shorter periods apparently the result of the male appearing and/or calling. The male tanager is almost always close at hand in the territory and would usually be within her sight. I have many observations of the incubating female looking in his direction, at times changing position on the nest to face him, and occasionally leaving abruptly as he calls nearby. Sometimes (above) he feeds her but more often they forage together within the territory.

Temperament—Both Skutch (op. cit.) and Kendeigh (1952:40, 44, 89) suggest that individual differences of the females studied must be explained, at least in part, by innate individual characteristics. I was impressed by the quite individualistic behavior of the female tanagers, not only on the nest, but their manner of arriving and leaving, their response to the male, and other environmental circumstances. It seems that the constancies, length of

TABLE 2
INCUBATION PATTERNS OF TEN FEMALE SCARLET TANAGERS AT TEN NESTS

Female	Day of incubation	Hours, minutes watched	No. of		Sessions in minutes		Recesses in minutes		Constancy %	Time of day			Average temperature f
			Sees.	Rec.	Range	Average	Range	Average		Morn	Mid	Even	
1	1	3:07	7	6	9-29	19.28	2-20	8.66	69		x		
"	2	5:54	15	15	4-22	14.50	1-10	4.90	75		x		
"	5	3:21	14	14	5-15.5	10.53	0.5-9	3.35	76		x		
"	6	3:29+	8	7	6.5-36	18.68	0.5-5	2.93	86		x		
"	7	2:15+	6	6	1.5-36	17.83	1-9	4.67	79			x	
"	8	3:13.5+	9	9	2-56	18.83	0.5-7.5	3.17	86			x	
3	12	1:56	5	5	4-26	16.80	3-12	6.40	72				x
"	13	4:46	10	10	3.5-39	22.00	0.5-14	6.70	77			x	
5	7	3:26	9	9	0.5-45	15.61	0.5-18	8.39	65			x	
"	9	2:30	6	5	2-23	13.16	7-34	14.20	48			x	
"	11	1:48	3	3	0.5-64	24.50	3.5-25	11.50	68				x
"	12	1:08	2	2	3-30	19.00	1-29	15.00	56				
6	2	1:31	5	5	3-23	13.60	1-7	4.60	75				
10	1	5:36	12	12	5-55.5	23.00	1.5-10	5.00	82			x	76.2
"	2	2:25	6	6	5-36.5	21.58	0.5-8.5	2.58	89			x	66.2
"	3	4:15+	9	10	5-52	22.50	0.5-4.5	2.45	90				61.6
"	4	5:44.5	15	15	2-52	19.40	0.5-13	3.63	84			x	67.0
"	5	2:08.5	5	6	9.5-27.5	22.00	0.5-5.5	3.83	85			x	67.7
"	6	7:26	20	20	3-26	13.05	0.5-30	9.25	58			x	79.6
"	7	5:26+	8	8	1.5-71.5	39.67	0.5-20	6.17	87			x	68.3
13	1	3:04+	5	5	3.5-49	28.10	4.5-14.5	8.30	77			x	66.8
"	2	2:59.5+	4	5	25-36.5	30.63	5-28.5	11.40	73			x	42.8
15	1	1:44.5	5	5	11.5-22	16.80	3-6	4.10	80			x	58.4
16	1	1:49	3	3	29-33	30.33	5-7	6.00	81			x	79.3
17	8	3:22.5	6	6	3.5-55.5	29.50	3.5-5	4.25	87			x	74.5
"	9	3:01	6	7	6.5-39.5	25.83	1-5	2.29	92			x	56.0
"	10	3:25.5	10	10	7-35	17.95	0.5-6	2.60	87				61.5
"	11	3:14	7	7	9.5-42.5	24.43	1-5	3.29	88			x	64.9
"	12	3:37	10	9	4-33.5	18.65	1-8	3.39	85			x	71.5
"	13	5:84	14	15	1.5-35	18.71	0.5-21.5	7.77	71			x	80.3
18	1	2:07	6	6	7-18	13.75	5-10	7.42	65			x	78.3
"	3	2:50+	5	5	16-34	23.71	7-13.5	10.30	70			x	64.8
"	4	3:13+	7	8	11-32	20.21	1.5-11	6.44	76			x	67.0
"	5	2:07+	5	5	8-20	12.00	6-41	13.40	47			x	76.7

recesses, sessions, etc. for the females given in Table 2 do reflect to an unknown degree, individual variations.

Stage of incubation.—Skutch (op. cit.) raises several interesting questions concerning the day-to-day incubation patterns for individual females. He concludes that the majority of studies fail to demonstrate an increase in attentiveness as day of hatching approaches, that once "normal" attentiveness is reached it is maintained with irregular daily fluctuations to hatching. Kendeigh (1952:27, 169), however, suggests that there is an increase of attentive time, and a corresponding decrease of inattentive time, during the first three days, after which there is a rather constant fluctuation around a median giving in general a rather uniform attentive behavior.

My data are not sufficient to add materially to this question, although the pattern seems rather clear even if not definite. There appears to be an increase of attentiveness the first three days, with a slight falling off for the next three days, followed by an increase up to the eleventh day, and then a decrease during the last two days of incubation. Kendeigh (1952:169), discussing attentive behavior of many species, states that there is no evidence that the incubating birds consistently spend more time on the eggs during the latter days just before hatching. Certainly this appears to be the case for the Scarlet Tanager. Perhaps additional observations will smooth out the apparent irregularities of my data, especially, during the last two days. I would have expected a slight increase the first three days and then, as Kendeigh suggests, a slight variation around the median up to time of hatching.

Rain.—In general, the female Scarlet Tanager remains on her nest during rain. This does, of course, lengthen her sessions, but does not account for the longest observed sessions which actually occurred in clear weather. Sessions shorter than might be expected during rainy days may be accounted for in part by the fact that the female slips off the nest between showers. Moreover, because most nests are well sheltered by a leaf canopy overhead, she may leave the nest during a rain when the drops are not actually striking her on the nest.

Sunlight.—Although the Scarlet Tanager nest is well shaded, there are times when direct sunlight shines on the nest. I have never observed a female tanager to leave her nest when direct sunlight strikes her even though, at times, she appears uncomfortable, even opening her bill as if "panting." Even though constancy tends to decrease as temperature increases, this factor of sunlight on the nest may account, in part, for unexpected fluctuations at higher temperatures.

Temperature.—In general, there is an inverse relation between temperature and session length. The relationship demonstrated by my data is not as definite as one might wish it to be, yet it is quite evident from a consideration of the

TABLE 3
TEMPERATURE AND CONSTANCY DATA FOR THREE INCUBATING SCARLET TANAGERS

Female	Day of incubation	Per cent of constancy	Temperature F
10	3	90	61.6
"	2	89	66.2
"	7	87	68.3
"	5	85	67.7
"	4	84	67.0
"	1	82	76.2
"	6	58	79.6
17	9	92	56.0
"	11	88	64.9
"	10	87	61.5
"	8	87	74.5
"	12	85	71.5
"	13	71	80.3
18	4	76	67.0
"	3	70	64.8
"	1	65	78.3
"	5	47	76.7

patterns for the three females in Table 3. Day of incubation is included to show that as a factor, it is not as closely correlated as are temperature and constancy. For those temperatures 67 F and below, there is a definite increase in constancy as the temperature lowers, and considering those temperatures 75 F and over, there appears a corresponding decrease of constancy as temperatures increase. Kendeigh (1952:42), Skutch (op. cit.), and others have shown this correlation with a number of passerine bird species. The temperature effect, however, does not act in an isolated manner and must be considered as only one ingredient of the many affecting the female tanager's constancy.

Time of day.—Skutch (op. cit.) distinguished between the influence of temperature on incubation not only from the standpoint of colder or warmer days but by hourly variations within the day pointing out "that many birds spend more time on their eggs in the cool of the morning and evening than in the middle of the day when the air is usually warmer" etc. Kendeigh (1952:170) likewise noted a decrease of incubating attentiveness in early or mid-afternoon and increase in the evening. My observations of the female Scarlet Tanager do not agree with this trend. The average of eleven "morning" (see paragraph 2) constancies is 74.8% and for ten "evening" is 71.1%, while the

average of sixteen "midday" is 78.3%, an apparent reversal of what has been found for similar passerine birds.

While the differences in the average constancies are not great and the sample is small, I believe the explanation is in part due to the feeding behavior of the female. In the morning after a long period without food, she tends to spend more time foraging, preening, and "exercising" after the night of immobility. Then she settles down to a more stable incubation pattern throughout the major portion of the day. In the late afternoon and just before dusk she becomes more active, searching for food and feeding while insects are plentiful and just prior to the approach of the long nonfeeding portion of the daily cycle.

Is high constancy of advantage?—Skutch (op. cit.) interestingly discusses this for several species from various standpoints, stressing that increased constancy might reduce the incubation period as well as lessen the hazards of egg loss to predators. There is no evidence, and I would expect none, that the increased constancy shortens the Scarlet Tanager incubation period. However, it seems to me that the more constant the incubating and inconspicuous female Scarlet Tanager is on the nest, the less opportunity for predator detection *unless* the increased constancy is the result of periodic feeding by her conspicuous mate, for I have found that it is the tanager activity itself which gives the nest location cue to predators.

SUMMARY

Incubation data on female Scarlet Tanagers, gathered in southern Michigan in 1947, 1948, and 1949 were reworked according to the formula presented by Skutch to determine Constancy of Incubation, giving an average constancy of 77% which lies within the range of Skutch's constancies. It is suggested that additional data be gathered for individual females wherever possible including day of incubation, time of day, and temperature and that these be analyzed in relation to the species constancies.

Various factors influencing the female Scarlet Tanager's constancy on the nest were discussed. Among those influencing constancy were: male feeding female on nest; male feeding female soon after she left the nest; temperature; time of day; sunlight; rain; and day of incubation. The interplay of all these factors influenced the individual female incubation patterns.

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NEW JERSEY STATE MUSEUM, WEST STATE STREET, TRENTON 25, NEW JERSEY, 24
SEPTEMBER 1963

FOSSIL IBISES FROM THE REXROAD FAUNA OF THE UPPER PLIOCENE OF KANSAS

CHARLES T. COLLINS

THE extensive fossil collections made by Claude W. Hibbard and his field assistants since 1936 from the Upper Pliocene deposits of Meade County, Kansas have made the Rexroad fauna, Rexroad Formation, Blancan age, perhaps the most completely known fauna from the High Plains. In this fossil material of both invertebrates and vertebrates there has been a wealth of bird material, some of which has been previously identified by Wetmore (1944) and Tordoff (1951, 1959).

Among the elements described by Wetmore (loc. cit.) was part of a coracoid of a small ibis which could not be definitely identified. Miller and Bowman (1956) described an extinct species of small ibis, *Plegadis gracilis*, from deposits of slightly later age in Cita Canyon, Randall County, Texas. They felt that *gracilis* perhaps represented the same species previously encountered by Wetmore. Since that time additional ibis remains have been recovered from the Rexroad fauna and form the basis of this paper.

METHODS AND MATERIALS

The skeletal collection of The University of Michigan Museum of Zoology was supplemented by material borrowed from the United States National Museum and the Chicago Natural History Museum through the kindness of Philip S. Humphrey and Dwight D. Davis, respectively. The type tarsometatarsus of *Plegadis gracilis* was loaned by the University of California Museum of Paleontology through the kindness of R. A. Stirton. Skeletal material of twelve of the seventeen genera recognized by Peters (1931) were examined in the course of this study. Skins of the remaining genera, *Pseudibis*, *Geronticus*, *Nipponia*, *Lampribus*, and *Cercibis*, were examined with regard to overall size and bill shape.

The classification of Peters (1931) is used except for the New World species, where the changes of Hellmayr and Conover (1948) are followed. Names of bone structures are those used by Howard (1929). Catalogue numbers, unless otherwise indicated, refer to the collections of The University of Michigan Museum of Paleontology.

FOSSIL LOCALITIES

The fossil material of the Rexroad local fauna has been collected at several separate localities in Meade County, Kansas: Locality No. 3 (Hibbard, 1950: 173; Taylor, 1960:29), Fox Canyon Locality (UM-K1-47) (Hibbard, 1950:

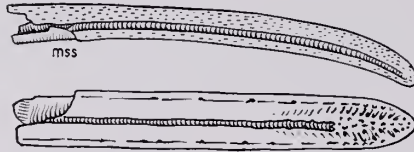


FIG. 1. *Mesembrinibis cayennensis*. Upper mandible. Two times natural size. Drawn by Margaret Skeels Stevens.

120, pl. 5, Fig. 1), and Wendel Fox Pasture Locality (Oelrich, 1952:301; Woodburne, 1961:64, Fig. 1). Dr. Hibbard's most recent views on these deposits are that the Fox Canyon and Wendel Fox Pasture localities represent stream deposits while Locality No. 3 represents a marsh deposit supported by seepage from a large artesian spring.

DESCRIPTION OF MATERIAL

Mesembrinibis cayennensis.—Two elements of this species have been recovered to date: the distal 27 mm of an upper mandible (U.M.M.P. 41286) (Fig. 1) from Fox Canyon, and the distal half of a right coracoid (U.M.M.P. 45731) from Locality No. 3. The mandible which is quite small for an ibis, 3.5 mm wide, 2.0–2.3 mm in depth, lacks the lateral swelling of the bill near the tip found in many genera of ibises, as, for example, *Eudocimus*. This fossil mandible also has a distinctive midventral groove which ends 6 mm from the tip. The combination of uniform width, small size, and the midventral groove ending short of the tip will serve to differentiate this species from all other New World species of ibis and all Old World forms except *Pseudibis* of which no skeletal material was available. This element is a bit wider than in the available skeletons (3) but within the range of expected variation as determined from skins of this species. *Theristicus caudatus* is extremely similar in most respects but the midventral groove stops farther back from the tip (15 mm) and the bill has fewer perforations in the ventral surface than in *Mesembrinibis*. The coracoid in *Mesembrinibis* is quite stocky and has a distinctively depressed coracohumeral surface which places this surface at a greater angle with respect to the glenoid facet. There is also a distinctive patterning to the triossial canal in the region of the pneumatic foramina.

Phimosus injuscatus.—Two elements of this species have been recovered from Locality No. 3: a 15-mm fragment of a lower mandible (U.M.M.P. 45735) and a worn proximal phalanx of right digit two (U.M.M.P. 45734). The section of the lower mandible was judged to have been located about 10 mm proximal to the tip. Aside from the midventral groove which distinguishes it as being from an ibis, and its extreme small size, 2.5 mm in width, 1.4–1.7 mm in depth, there is little that is distinctive about this fragment. Its small size can be matched by but one species, *Phimosus injuscatus*, of those for which skeletons were observed. The South African species *Lampribus rara* seemed, from examination of skins, to possibly approximate it in bill size. The proximal phalanx of digit two is also slightly smaller than in most species. The distinctive posterior curvature and the more heavily ossified medial region with a less prominent anterior–posterior bar serve best to distinguish this species from *Plegadis chihi*, which most closely approximates it in size.

Eudocimus sp.—Two proximal phalanges from the right alar digit two were recovered:

TABLE 1
MEASUREMENTS OF THE DISTAL END OF THE TIBIOTARSUS IN *PLEGADIS*

	Width at condyles	Anteroposterior depth
<i>Plegadis gracilis</i>	7.1 mm	7.8 mm
	7.5 mm	8.2 mm
<i>Plegadis chihi</i>	7.7 mm	9.0 mm
(North America)	7.6 mm	8.4 mm
<i>Plegadis chihi</i>	8.1 mm	8.9 mm
(South America)	8.3 mm	8.8 mm

(U.M.M.P. 45733) complete and unworn from Locality No. 3, and (U.M.M.P. 45417) distal two-thirds, unworn, from Fox Canyon. These are comparable in size and conformation to recent species of the genus *Eudocimus* but the intraspecific variation is too great to separate *E. ruber* and *E. albus*.

Plegadis gracilis.—The distal ends of two tibiotarsi have been recovered; a badly broken fragment of a left tibiotarsus having both condyles present but little of the shaft, from Locality No. 3 (U.M.M.P. 45737), and a well-preserved portion of a right tibiotarsus (U.M.M.P. 45736) 14 mm long from Wendel Fox Pasture. In the genus *Plegadis* the groove for the peroneus profundus is located much farther laterally than in any other New World species. The anterior portions of the intercondylar fossa are also particularly deep and the proximal edge is raised into a definite crest. As indicated in Table 1 these elements are slightly smaller than the corresponding elements of the recent species *P. chihi*. The smaller of these two fossils articulates perfectly with the type tarsometatarsus of *P. gracilis* (Univ. Cal. Mus. Paleo. 45088).

Plegadis sp.—The distal portion of a left coracoid broken through the proximal portion of the glenoid facet was recovered from Locality No. 3. This fragment (U.M.M.P. 45732) agrees exactly in size and conformation with a right coracoid previously recovered from this deposit (Kans. Univ. Mus. Vert. Paleo. 4741). This earlier element was described by Wetmore (1944) as being "from an ibis smaller than *Plegadis* and *Guara* [= *Eudocimus*] . . . [and] . . . it represents an unknown species probably allied to *Plegadis*." These elements have conformations similar to that of *Plegadis* and there is no difference in size between them and specimens of *P. chihi* used in this study. However, until we have more definite information on the size of the body elements of *P. gracilis*, identification of these elements as belonging to the recent species *chihi* seems unjustified.

PALEOECOLOGY

The ecology and food habits of ibises of the genera *Eudocimus* and *Plegadis* are quite similar to that recorded for *Eudocimus albus*, which occurs "in the muddy shallow waters of small lakes, ponds, and bayous, or on the fresh or salt marshes or meadows, where crawfish and fiddler crabs abound" (Bent, 1926:30) and feed mostly on cutworms, grasshoppers, crayfish, and small snakes (Baynard, 1913). *Plegadis* species are, however, less often found in tidal or brackish areas than *Eudocimus* species. In Venezuela (Phelps and Phelps, 1958) and Surinam (Penard and Penard, 1903) *Mesem-*

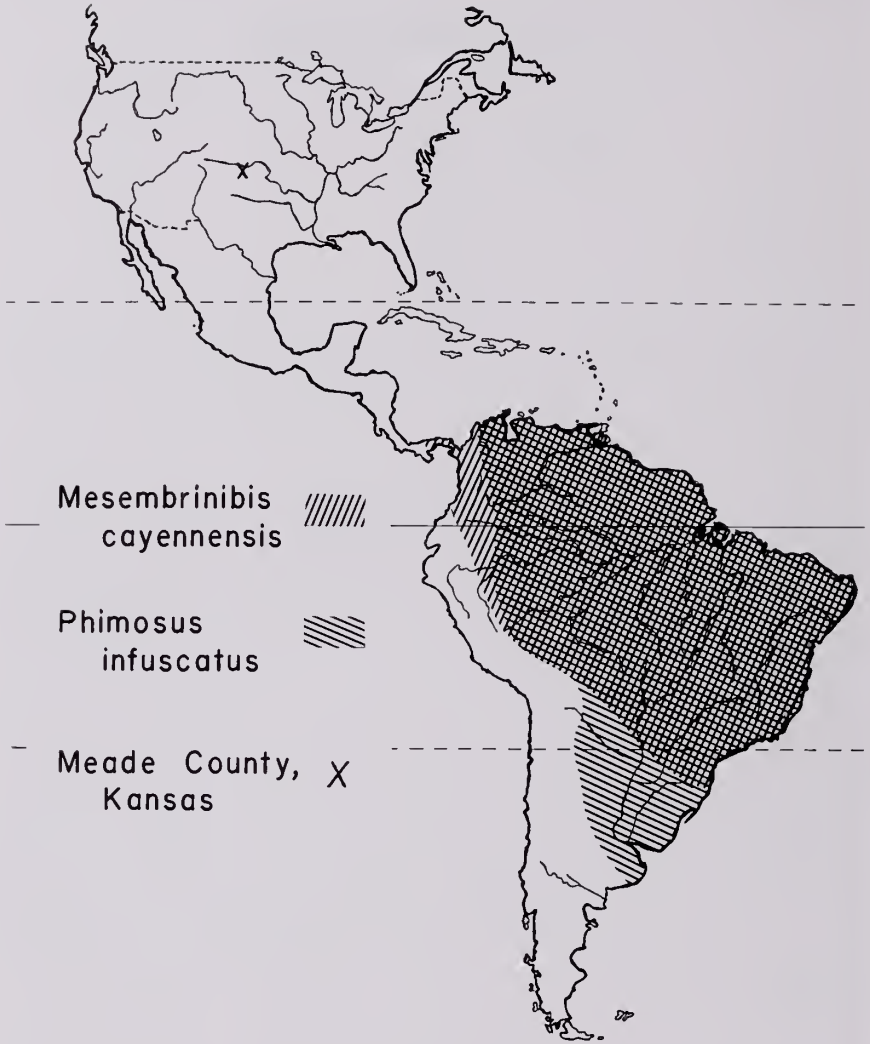


FIG. 2. Present range of *Mesembrinibis cayennensis* and *Phimosus infuscatus*.

brinibis and *Phimosus* are found in this same sort of freshwater situation and their food habits are also similar. In Surinam *Mesembrinibis* has additionally been recorded from "wet forests and neglected coffee plantations" (Haver-schmidt, 1955) and "swamp-like savannahs of the uplands during the rainy season" (translated from, Penard and Penard, loc. cit.). Although *Eudocimus* and *Plegadis* are well represented in the subtropical and temperate regions of

North and South America, *Mesembrinibis* and *Phimosus* are entirely confined to the tropical areas of South America from Panama to Argentina as shown in Fig. 2.

Hibbard (1941) felt that the fossils identified up to that date indicated the following communities to be present in the area encompassed by the Rexroad fauna: upland grass community, semiaquatic community, meadow and marsh community, forest community, and valley slope community. Since then additional mammals (Hibbard, 1950), birds (Wetmore, 1944), amphibians (Taylor, 1942), turtles (Oelrich, 1952), fish (Smith, 1962), and mollusks (Taylor, 1960) have been identified and greatly increase our knowledge of the paleoecology of these deposits. A crayfish and numerous snake remains representing the genera *Natrix* and *Thamnophis* have also been recovered and these are among the principal food items of the ibises described in this paper. By 1950 the overall conclusion from these fossils was that "the climate of the Upper Pliocene was more equable than at present, without extremely cold winters or severely hot summers, and that there was a greater degree of humidity in the region than there is now" (Hibbard, 1950).

These extensive vertebrate and invertebrate collections in addition to supporting Hibbard's early views on the community structure have provided bits of detailed ecological information about these deposits. On the basis of the amphibian material Taylor (1942:220) felt that "so large a number of ranid frogs warrants the postulation that the climate was such as to supply a much heavier rainfall, in order to provide sufficient moisture for these water loving frogs." Also, the large tortoises found in these deposits (Oelrich, loc. cit.) could not endure freezing temperatures and since there is no indication that they burrowed or had cave or fissure refugia, "it is assumed that they lived at a time when freezing conditions did not exist" (Hibbard, 1960:16). These observations offer the additional interpretation that this area had a warm, wet, tropical climate similar to that found at present in parts of northern South America, the only region today where the genera *Mesembrinibis*, *Phimosus*, *Eudocimus*, and *Plegadis* are sympatric.

In addition to the ibises the fossil toad from the Rexroad fauna, *Bufo suspectus* (Tihen, 1962b:22), which was "tentatively referred to the Caribbean section of the *Valliceps* group" (see Tihen, 1962a:171), may have Caribbean or South American faunal affinities. Also indicative of tropical conditions is the presence in the Rexroad fauna of a medium-sized parrot (Wetmore, 1944) which was unfortunately too fragmentary for accurate identification.

Mesembrinibis cayennensis and *Phimosus infuscatus* are new to the fossil record while Recent species in the genera *Eudocimus* and *Plegadis* have been recorded from several Pleistocene deposits and prehistoric sites (Brodkorb,

1963). Prior to this *Plegadis gracilis* has only been recorded from the type locality in Cita Canyon, Texas.

SUMMARY

Among the extensive vertebrate and invertebrate fossils recovered from the Rexroad local fauna of the Upper Pliocene of Meade County, Kansas are remains of the Recent species of ibis *Mesembrinibis cayennensis* and *Phimosus infuscatus*. The extinct species *Plegadis gracilis* and an ibis of the genus *Eudocimus* were also identified from this fauna. Ecological information derived from these ibises and previous work indicate that this area probably had a warm, moist, frost-free, tropical climate as is found today in parts of northern South America where ibises of these genera are sympatric.

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BILL SHAPE AS A GENERIC CHARACTER IN THE CARDINALS

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MANY genera in birds and other animal groups have been based essentially upon a single character. This character may be a single morphological feature, such as the presence or absence of the hallux, or it may be a complex of characters which are all closely correlated functionally, such as the bones, muscles, and ligaments of the jaw apparatus. The validity of many of these genera has been questioned in recent years with the general acceptance of the polytypic species concept and the increasing acknowledgment of the grouping service at low taxonomic levels provided by the genus. An example is the North American passerine genus *Pyrrhuloxia*, which is distinguished from *Richmondena* essentially on the basis of bill shape. The overall similarity of *Pyrrhuloxia sinuata* to the two species of *Richmondena* in morphology and in general life history (Gould, 1961) has led several recent authors to synonymize *Richmondena* with *Pyrrhuloxia*. Other workers have maintained the validity of the generic separation, basing their decision largely on the difference in bill shape. The object of this paper is to ascertain the importance of this difference as a taxonomic character and whether the difference if confirmed is of generic significance.

THE JAW APPARATUS

Ridgway (1901:624-625) described the bill of *P. sinuata* (see Figs. 1 and 2) as follows:

"Bill very short, thick and deep, with culmen strongly convex and maxillary tomium deeply and angularly incised a little posterior to the middle portion; mandible deeper than the abruptly bent maxilla, with its distinctly toothed tomial angle about midway between base and tip; gonys straight, greatly ascending, shorter than distance from nostril to tip of maxilla; depth of bill at base much greater than its width."

He described (1901:629-630) the bill of *Richmondena* as:

"Bill stout, conical, deeper than broad at base, where its depth is about equal to length of exposed culmen; culmen decidedly, sometimes strongly convex; gonys straight, shorter than distance from nostril to tip of maxilla; maxillary tomium situated a little anterior to or directly beneath nostril, with nearly obsolete subterminal notch or none at all; mandibular tomium either nearly straight or decidedly convex anterior to its subbasal angle, the latter more or less posterior to the middle portion and with or without a notch in front of it."

The differences between the genera can be summarized by noting that the bill of *P. sinuata* is shorter and more decurved than the more elongated bill of

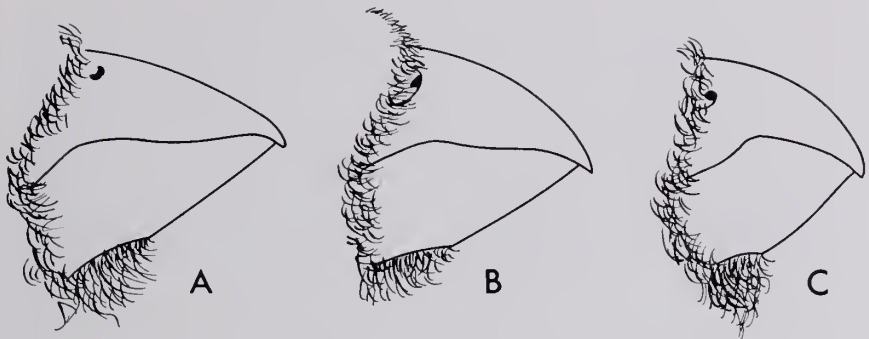


FIG. 1. Lateral view of the bills of (A) *Richmondena cardinalis*, (B) *R. phoenicea*, and (C) *Pyrrhuloxia sinuata*. The intermediate shape of the bill of *phoenicea* between those of *cardinalis* and *sinuata* can be readily appreciated.

R. cardinalis. This distinction is most evident in the mandible which is deeper in *sinuata* with a decided ventral bony boss at the gonys of the mandible, and in the strongly decurved, almost parrot-like, upper jaw of *sinuata*. The morphological difference between the bills of *sinuata* and *cardinalis* is essentially bridged (Fig. 1) by that of *R. phoenicea* found in northern South America. The upper jaw of *phoenicea* is less elongated and more decurved than that of *cardinalis* and closely approaches that seen in *sinuata*. Although the mandible of *phoenicea* is much deeper than that of *cardinalis*, it lacks the heavy ventral bony boss found in *sinuata*. If the bills of the three species are superimposed on one another (Fig. 2D), the intermediate position of *phoenicea* between *cardinalis* and *sinuata* is clearly shown. Ridgway (1901: 630) pointed out many years ago that: "The evident gap between *Cardinalis* and *Pyrrhuloxia* is nearly bridged by *C. phoeniceus*. . . ."

The jaw muscles of *sinuata* and *cardinalis* reflect the differences in their skull morphology, although the basic pattern of musculature is the same in the two species. The skull of *cardinalis* is larger absolutely than that of *sinuata* and hence one could expect the jaw muscles to be larger, which is the case. Moreover, the jaw muscles of *cardinalis* appear, in general, to be larger, relatively, than those of *sinuata*. Another general difference is that the major dorsal adductors have a more anterior insertion on the mandible in *cardinalis* than in *sinuata*. Detailed differences and similarities in the jaw muscles of these birds are as follows. *M. depressor mandibulae* is much the same in both species, in size as well as shape. *M. adductor mandibulae externus* is larger in *cardinalis*, but not uniformly. The temporal part of *M. adductor mandibulae externus rostralis* is about 25% larger in *cardinalis* and has a small posteroventral pinnate bundle that is lacking in *sinuata*. Similarly, the medial segment of the *pars rostralis* which originates from the posterior wall of the orbit is about 20% larger in *cardinalis*. The lateral bundle arising from the tip of the zygomatic process and from the external surface of the underlying *M. adductor mandibulae externus ventralis* is about the same relative size in both species, although a thin sheet of parallel fibers extends farther ventrally in *sinuata*. The *M.*

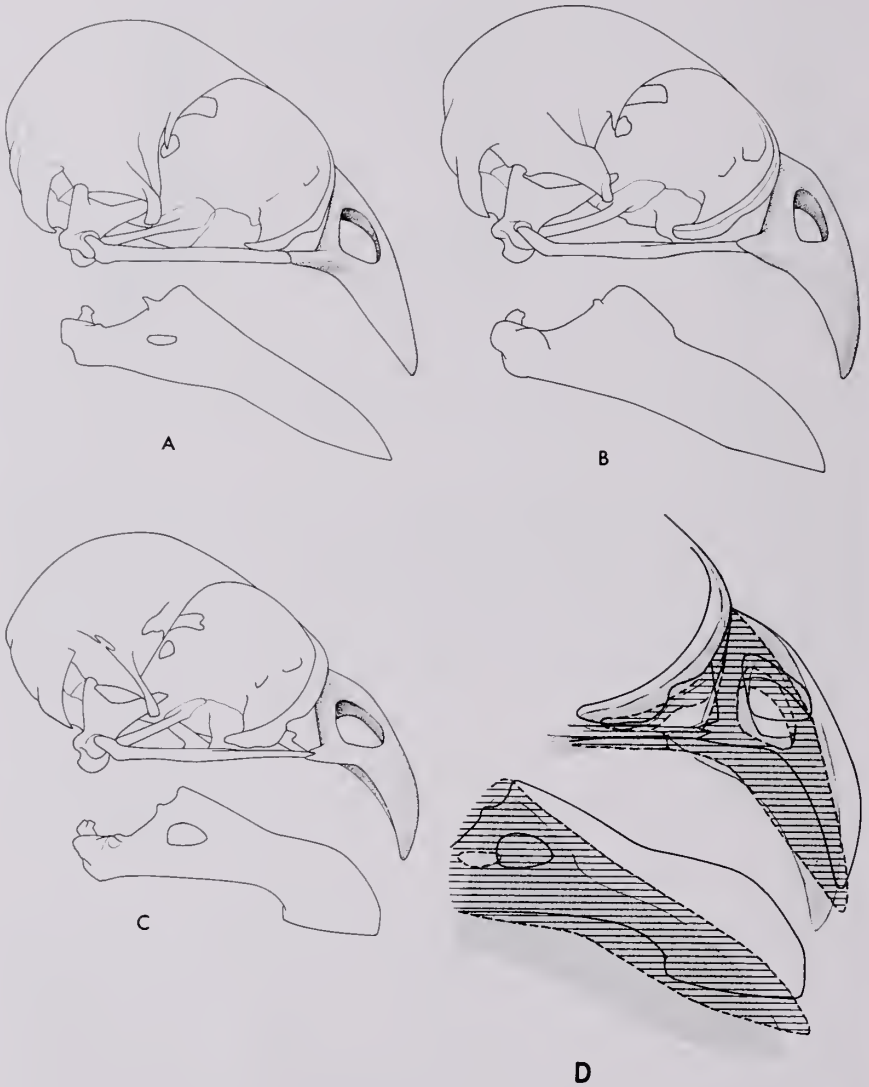


FIG. 2. Lateral view of the skull of (A) *Richmondena cardinalis*, (B) *R. phoenicea*, and (C) *Pyrrhuloxia sinuata*. Note especially the differences in the shape of the upper jaw and of the mandible. Other differences, such as the shape of the zygomatic process and the structure of the quadrate, are of lesser importance and have not been emphasized in the drawings. The jaws of the three species have been superimposed upon each other (D) to show the intermediate position of *R. phoenicea* in this morphological series. The bill of *cardinalis* is indicated by horizontal lines, that of *phoenicea* by stippling, and that of *sinuata* is blank.

adductor mandibulae externus ventralis is slightly larger in *cardinalis*, perhaps about 10–20%. The posterior and deep-lying M. adductor mandibulae externus caudalis is about the same size in both, perhaps slightly smaller in *cardinalis*. All parts of the M. adductor mandibulae externus have a more anterior insertion in *cardinalis* than in *sinuata*. The M. adductor mandibulae posterior is about 30–40% larger in *sinuata*, but it does not add greatly to the force of the adducting muscles because this muscle is relatively small compared to the other jaw muscles. The M. pseudotemporalis superficialis is considerably larger in *cardinalis*, at least twice as large as in *sinuata*, and inserts much farther forward on the mandible. It covers much of the M. pseudotemporalis profundus in *cardinalis*, while this latter muscle is largely exposed in *sinuata*. M. pseudotemporalis profundus is about the same size in both species or perhaps a bit larger in *cardinalis*. All parts of M. pterygoideus are similar morphologically in the two species; the entire muscle seems to be larger in *cardinalis*. The superficial part (ventralmost) of M. pterygoideus ventralis lateralis that originates from the free palatine process of the premaxilla cannot be easily separated from the rest of the ventralis lateralis. A substantial bundle of fibers from M. pterygoideus dorsalis medialis and from M. pterygoideus ventralis medialis runs directly posterior and inserts on the base of the skull. M. protractor pterygoidei is similar in both species.

A most interesting aspect of the jaw apparatus is that the postorbital ligament has almost completely disappeared in both species. All that remains is a faint strand of connective tissue that can be overlooked easily even when special attention is given to it. Without doubt this ligament is functionless in these finches and has no role in cranial kinesis.

The differences in the jaw morphology and in the musculature of *sinuata* and *cardinalis* appear to be correlated mainly with the difference in elongation of the bill. In *cardinalis*, the upper jaw is not as deep at its base and is less decurved. The mandible is correspondingly straighter and thinner. The jaw muscles, especially the dorsal set of mandibular adductors, are larger and have a more anterior insertion. This combination of features suggests that these muscles provide a stronger and more effective force to the mandible when the bird is cracking seeds. Hence, the Cardinal would be able to feed upon larger seeds or to hold the seeds in a more anterior position in the bill when they are crushed.

The Pyrrhuloxia has a shorter, deeper, and more decurved bill. In appearance the bill of the Pyrrhuloxia is quite reminiscent of a parrot's bill. Corresponding to the short, decurved upper jaw, the mandible is shorter and deeper with a ventral boss at the gonys. This reinforcing mass of bone lies ventral to the heavy postnasal bar of the upper jaw when the bill is closed. Presumably the major stresses on the bill occur at its posterior end between the postnasal bar and the ventral boss of the mandible. The more posterior insertion of the dorsal adductors suggests either that smaller seeds are eaten by the Pyrrhuloxia or that the seeds are held farther back in the bill when crushed. The latter possibility is in closer agreement with the structure of the underlying skeleton. If the Pyrrhuloxia were to be able to crush larger

or harder seeds than the Cardinal in spite of its smaller jaw muscles, the seeds would have to be held far back in the bill. This would reduce the required forces that must be applied to the system by the jaw muscles. Such a reduction may be significant although exact figures are not available. A reduction in required forces would permit the *Pyrrhuloxia* to have smaller muscles inserting closer to the articulation. A more posterior insertion would reduce the mechanical advantage of the jaw muscles, but their angle of insertion would be larger and thus increase the useful component of force. Without knowing the physical properties of the seeds eaten by the two species and the position the seed is held in the bill, it is not feasible to speculate further on the relative adaptations of their jaw apparatus. To judge from the differences in the jaw apparatus of these forms, one can conclude with assurance that these species feed upon different seeds which are cracked in somewhat different methods.

The South American Cardinal, *R. phoenicea*, is clearly intermediate between *cardinalis* and *sinuata* in the structure of its bill. Specimens for dissection were not available: it can only be presumed that the jaw muscles are well developed, perhaps larger than in *cardinalis* but with a more posterior insertion. It may be postulated that *phoenicea* uses a feeding method intermediate between those used by *cardinalis* and by *sinuata*. It may also be suggested that *cardinalis* and the *sinuata* bill structure and jaw muscles could both be derived from a *phoenicea*-like condition.

TAXONOMIC IMPLICATIONS

Judgment of generic limits and of the taxonomic significance of observable differences is a most subjective inquiry depending upon the philosophy of classification accepted by the individual worker. No proof can be offered for or against any particular philosophy (e.g., advocating taxonomic categories embracing a wide adaptive range or a narrow adaptive range), no matter how radical or how widely accepted it may be. As a general principle, no a priori means of ascertaining specific, generic, etc., characters are known, nor can a certain difference be evaluated a priori as generic, familial, and so forth. It is, thus, futile to argue whether the differences between *Richmondia* and *Pyrrhuloxia* are or are not of generic value. It should be stressed that many genera contain one or two species which deviate quite strikingly from their congeners in one character or one character complex, but that this deviation does not justify generic separation.

No question exists on the close relationship between the Cardinal and the *Pyrrhuloxia*. The species *cardinalis*, *phoenicea*, and *sinuata* form a natural group separated by a distinct gap from all other cardinaline finches. Yet in spite of the overall resemblance in many aspects of the plumage, behavior,

ecology, and anatomy, certain differences do exist, some of them being quite striking. The question, then, is how can one judge whether the differences between *Richmondena* and *Pyrrhuloxia* warrant generic separation. Only two alternatives are seriously possible. Either the genera *Richmondena* and *Pyrrhuloxia* should be maintained as separate genera or they should be merged into one genus. A third possibility—to place the intermediate species *Richmondena phoenicea* in a separate genus—has not been supported by anyone in recent years and can be ignored. Another principle of classification, independent of the degree of difference accepted for generic distinction, must be applied. No matter what degree of difference is accepted as the basis for distinction at any taxonomic level, this measure must be applied consistently to all taxa belonging to the taxon of at least the next higher rank. Hence, whatever degree of difference is chosen as a measure of generic distinction, this measure should be applied consistently to all genera belonging to the same family or subfamily. Ideally then, the question of the distinction between *Richmondena* and *Pyrrhuloxia* should not be answered until a comparison is made between all genera of the subfamily of cardinals. Such a study is not possible at this time because the limits of the subfamilies of the Fringillidae and even the limits between the Fringillidae and closely related families are still quite indefinite. An extensive investigation of the entire New World nine-primaried oscine complex, especially of the tropical forms, is needed before all the problem genera can be allocated to the correct family group. But the urgency of the nomenclatural problem associated with the generic names of these forms and the name of the subfamily (Mayr, ms) justifies the use of less intensive methods. The differences between the cardinals and *Pyrrhuloxia* can be evaluated by a comparison with the range of bill variation in a few select genera. The genera chosen are ones that are fairly closely related to the *Richmondena*-*Pyrrhuloxia* complex and ones whose limits are accepted by a majority of workers including many who advocate narrower generic limits.

The differences in the shape of the bills in the extreme forms *cardinalis* and *sinuata* are reflected in a series of differences in the structure of the skull and in the configuration of the jaw muscles. If all of these differences were listed, the ledger would be quite impressive, but would not present an accurate picture of the evolutionary divergence of the two species. These differences do not represent a series of independent evolutionary adaptations. All of the characteristics of the skull and of the jaw muscles which differ between these species (see above) are associated with the same modification in function, presumably resulting from a difference in the seeds utilized by these forms. These cranial features belong to the same character complex (= functional unit of structures) and should be treated as a single taxonomic character.

The fact that *phoenicea* bridges the morphological gap in the jaw apparatus of *cardinalis* and *sinuata* is suggestive, but not conclusive as far as generic separation is concerned. It should be noted that *phoenicea* is not intermediate in all of the features separating the extreme species, but is intermediate in the apparent adaptive significance of the bill; this does not affect its relevancy to the taxonomic argument. Certainly the distinctive gap between *cardinalis* and *sinuata* is greatly reduced, but a decided difference still exists between *phoenicea* and *sinuata*. This latter difference may still be sufficient to warrant generic recognition of *Richmondena* and *Pyrrhuloxia*. The mandible of *P. sinuata* is quite unique for the group, suggesting that this bird differs from *phoenicea* as well as *cardinalis* in feeding habits. Actually the differences between individual species of this complex are not as important as the total adaptive range embraced by the complex. Judgment of generic limits in the Cardinal-Pyrrhuloxia complex should be made by comparing the adaptive range embraced by these birds with the adaptive range of other closely related genera. The total range of the variation of bill structure may be used as an index to the adaptive range of the group in feeding methods.

The bills of *cardinalis*, *phoenicea*, and *sinuata* are shown in Fig. 1, which illustrates clearly the shift from an elongated bill in *cardinalis* to a short, parrot-shaped one in *sinuata*. The bills of the four species of *Paroaria* are shown in Fig. 3. These birds differ somewhat in the thickness of their elongated bill although they exhibit less variation in shape than in the *Richmondena*-*Pyrrhuloxia* complex. However, the range of bill shape in the genus *Saltator* (Fig. 4) is much greater than in the Cardinal-Pyrrhuloxia group, although the limits of *Saltator* are accepted by most, if not all, ornithologists. The extreme forms in this genus, *maxillosus* (Fig. 4A) and *a. atripennis* (Fig. 4G) or *maximus* (Fig. 4I), are certainly more different in bill shape than are *R. cardinalis* and *P. sinuata*. Another example, although of a more distantly related genus, is *Geospiza*. The difference in the shape of the bill between *G. magnirostris* and *G. scandens* (Lack, 1947) is greater than between the Cardinal and Pyrrhuloxia. The variation in the relative size of the bill within *Geospiza* aside from any difference in configuration is alone far

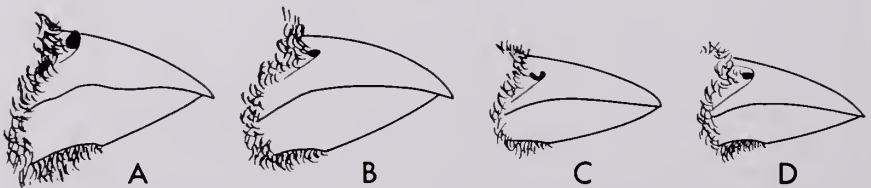


FIG. 3. Lateral view of the bills of (A) *Paroaria dominicana*, (B) *P. coronata*, (C) *P. capitata*, and (D) *P. gularis* to show the variation of the bill in this genus.

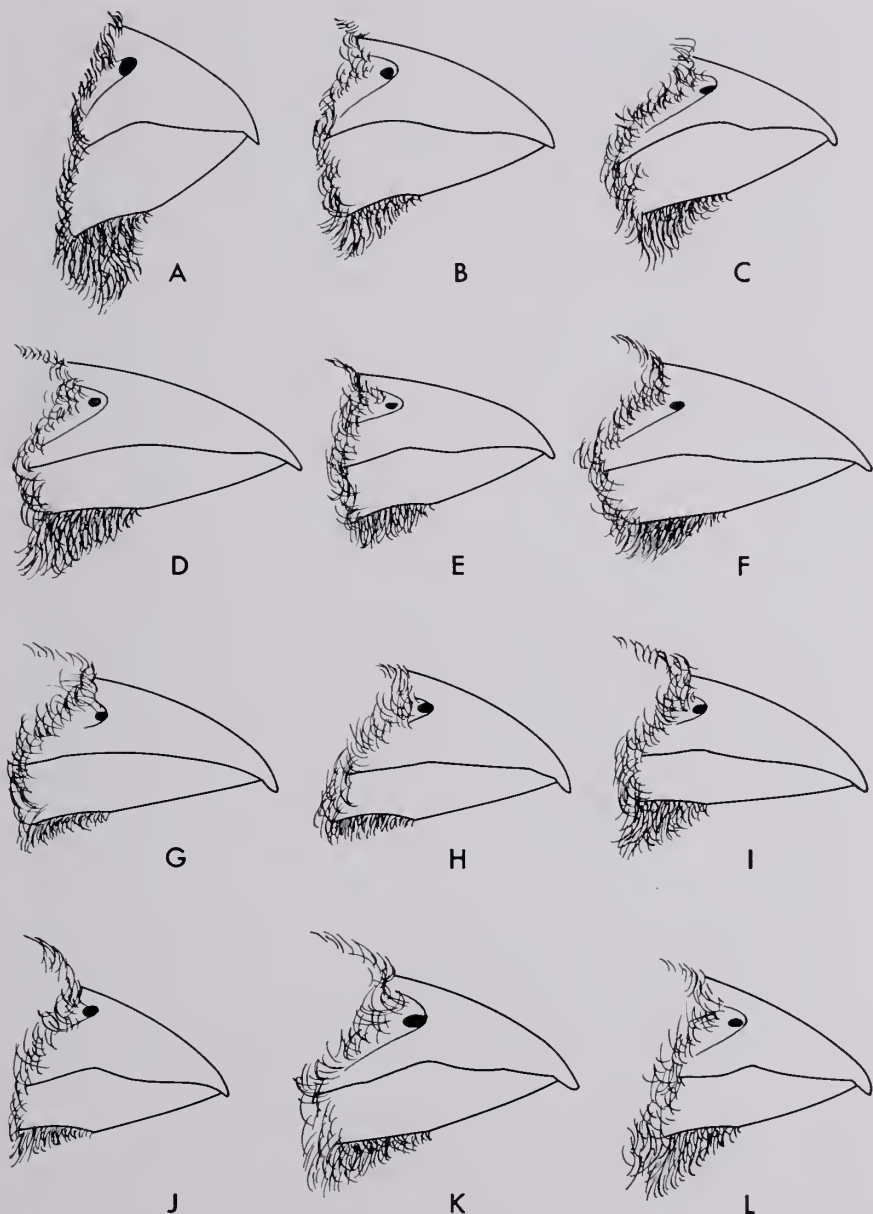


FIG. 4. Lateral view of the bills of (A) *Saltator maxillosus*, (B) *S. sinilis*, (C) *S. atricollis*, (D) *S. coerulescens hesperis*, (E) *S. c. grandis*, (F) *S. atriceps raptor*, (G) *S. atripennis atripennis*, (H) *S. a. atripennis*, (I) *S. maximus intermedius*, (J) *S. aurantirostris*, (K) *S. albicollis guadelupensis*, and (L) *S. a. isthmicus* to show the great variation in the shape of the bill in a closely knit genus. Note especially the differences between the extreme forms *maxillosus*, *atripennis*, and *maximus*, and compare this difference with that seen between *R. cardinalis* and *P. sinuata*.

greater in adaptive significance than the difference in either *Saltator* or the *Richmondena-Pyrrhuloxia* complex.

The evolution of the differences in the bills of *cardinalis* and *sinuata* may provide additional evidence for determination of the degree of relationship between these birds. The essential similarity of these species suggests that their divergence was recent. The nature of their differences suggests that most of the divergence was a result of direct competition between these species. The major differences are (a) the morphology of the bill and the jaw muscles; (b) the color of the bill; (c) the male plumage; and (d) the general ecology and distribution. The *Pyrrhuloxia* appears to be restricted to the dry mesquite plains of the Southwest while the Cardinal appears to require a slightly more mesophytic habitat. This ecological difference between the two species may form the basis for their general geographic separation. Gould (1961) concluded that these species did not differ in their ecology in his study area, but it seems likely that the habitat in this study area was disturbed by previous cutting and agricultural practices. Certainly these species differ in their climatic tolerances and hence in their distribution as noted by Gould. This present-day lack of geographic overlap is the major snag for the hypothesis that the divergence between *cardinalis* and *sinuata* resulted from competition. Yet there is no reason to assume that these species were always separated geographically in the recent past. During the periods of glacial advance, one of the greatest changes in the climate of the Southwest was an increase in rainfall. Thus, it is quite conceivable that the Cardinal was able to extend farther into the now dry plains of the Southwest and overlap broadly the range of the *Pyrrhuloxia* during periods of glacial advance.

Assuming that the ranges of the Cardinal and the *Pyrrhuloxia* did overlap at one time, two major changes had to evolve if these closely related birds were to coexist in the same habitat. Little doubt exists that these birds descended from the same immediate common ancestor and hence were, at some time in the past, more similar in plumage, bill structure, and ecological requirements. A difference in feeding methods must have developed. This could account for the divergence in the morphology of the bill and jaw muscles. Different and distinct species recognition marks were essential. The great difference in the male plumage could be the result of this requirement, especially if the female chooses the singing male as in most passerine birds. Yet it is interesting that the songs of these species are so similar. The silhouette of a singing Cardinal is almost indistinguishable from that of a singing *Pyrrhuloxia* to the human observer and presumably also to the females of these species, and it is difficult to separate them by song. The females of these species are even more similar. However, the shape and color of the bill of each species are quite distinct, so much so that these birds can be

identified at a long distance if the bill can be seen. Lack (1947) has shown that the various sympatric species of *Geospiza* use the bill as species recognition marks. It is thus reasonable to suggest that the disparity in shape in the bills of the Cardinal and the Pyrrhuloxia serves as species recognition marks as well as enabling these birds to feed on different seeds. The present-day differences in habitat preferences which account for the geographical separation could have also evolved through competition. Although these species may have overlapped broadly, they may have segregated out into different parts of the habitat, the Cardinal to the more mesophytic areas along river bottoms and the Pyrrhuloxia to the xerophytic uplands.

With the retreat of the ice fronts and the general drying of the climate in the Southwest, the Cardinal may have been forced out of the drier sections. The xerophytic mesquite plains were left to the Pyrrhuloxia. The Cardinal is still spreading north and northeast, which may be a continuation of the range expansion that started with the retreat of the glaciers (see Beddall, 1963, for a discussion of this point).

The hypothesis that the divergence between the Cardinal and the Pyrrhuloxia resulted from competition between these species is important owing to its taxonomic consequences. In general, specific differences that are the result of ad hoc selection to mitigate interspecific competition are of lower taxonomic relevance than differences that are the result of a general genetic divergence. The fact that these differences resulting from interspecific competition may appear striking to the ornithologist does not affect the validity of this general conclusion. Indeed, this category of differences constitutes one of the special cases for which the general rule that taxonomic distinction is correlated closely with morphological divergence cannot be applied. Closely related species may be more distinct in a few special characters (ones that are often extremely important for the species) than is usually the case. This special situation has been shown, on one hand, for species-specific recognition features (see Sibley, 1957). On the other hand, it has been shown for feeding methods and other ecological preferences by Lack (1947), Varie (1951), Brown and Wilson (1956), and others under the general heading of character displacement.

As a general conclusion, it can be stated that generic distinctions should not be based upon morphological and other differences which have resulted from competition or other types of direct interaction between closely related species.

CONCLUSION

The evidence and arguments presented allow only the conclusion that the three species *cardinalis*, *phoenicea*, and *sinuata* are congeneric. The reasons

supporting this conclusion are: (1) Many good genera of birds contain one or two species that are strikingly different in a character or character complex without justifying generic separation; (2) these species form a natural group separated by a distinct gap from other cardinaline finches; (3) differences resulting from ad hoc selection to mitigate interspecific selection have less taxonomic value; (4) the adaptive range encompassed by this group is no greater than by *Saltator* and *Geospiza*; and (5) the gap between the two extreme species *cardinalis* and *sinuata* is bridged by an essentially intermediate species—*phoenicea*. If *Richmondena* and *Pyrrhuloxia* are maintained as separate genera, then the principle of consistency would require that genera such as *Saltator* and *Geospiza* be divided into several smaller genera. Such action would greatly decrease the usefulness of our taxonomic system and in particular would decrease the utility of the genus as a taxonomic category between the species and the family. Thus the species *cardinalis*, *phoenicea*, and *sinuata* would be placed in the genus *Pyrrhuloxia* with *Richmondena* in synonymy.

ACKNOWLEDGMENTS

I wish to thank Dr. William George who supplied several specimens of the *Pyrrhuloxia* and Dr. Lester L. Short who obtained some specimens of the Cardinal which allowed me to examine the jaw muscles of these species. I am also indebted to the officials of the Department of Ornithology, American Museum of Natural History, for the loan of study skins of *Pyrrhuloxia*, *Saltator*, and *Paroaria*, and to the officials of the Division of Birds, United States National Museum, for the loan of skeletal material of these genera. I wish to thank Miss Alice Boatright for her suggestions concerning the illustrations and for her great care in executing them. Lastly, I wish to acknowledge my gratitude to Dr. Ernst Mayr for his suggestions during the study and for his helpful criticisms of the manuscript.

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DEPARTMENT OF ZOOLOGY, UNIVERSITY OF ILLINOIS, URBANA, ILLINOIS, 9 AUGUST
1963

NEW LIFE MEMBER

Francis M. Uhler, of Laurel, Maryland has become a Life Member of The Wilson Ornithological Society, which he first joined in 1931. Mr. Uhler, a graduate of Gustavus Adolphus College, is a biologist with the U.S. Fish and Wildlife Service, specializing in waterfowl habitat management. His principal ornithological interest is in the food habits of waterfowl, and the picture shows Mr. Uhler harvesting wild millet for the seeding of duck impoundments. Mr. Uhler is the co-author of a Fish and Wildlife Service report on "Food of Game Ducks of United States and Canada" as well as various other papers on aquatic wildlife. Mr. Uhler is a member of the American Ornithologists' Union, the Cooper Ornithological Society, The Washington Academy of Science, as well as of other biological societies. His hobbies are canoeing, photography, and the study of wetland ecology.



NESTING OF PURPLE MARTINS ABOARD A SHIP¹

HERBERT W. KALE II

IN 1961, a pair of Purple Martins (*Progne subis*) succeeded in nesting in a gourd attached to the mast of the University of Georgia Marine Institute's research ship, the *Kit Jones*, despite the vessel's frequent cruises that lasted from one to nine hours. When the vessel was absent from the dock, the parents did not accompany the boat, but returned to the nest as soon as the vessel returned. Since this incident demonstrates remarkable ability of both eggs and young to survive long periods of inattentance by the parents, the history of the nest is recorded in detail in this paper.

The martin gourd was fastened to the mast of the *Kit Jones* in April 1961, by Mr. Ralph Olson, retired captain of the vessel. Several gourds were also placed on light poles and boat davits at the nearby dock. Martins nested in the dock gourds early in May, and by early June a pair occupied the gourd on the *Kit Jones*.

The young from two of the gourds on the dock were banded with U.S. Fish and Wildlife Service bands in mid-June (four on 14 June and three on 16 June). On 17 July, three nestlings in the gourd on the mast were banded. Judging from the extent of feather development, the nestlings were estimated to be about 20 days old. The approximate dates of egg laying (9-12 June), start of incubation (12 June), and hatching (27 June) were then estimated according to the data of Allen and Nice (1952).

Unfortunately, I was away from the island from 25 July to 1 August and did not actually see the birds leave the gourd. Allen and Nice (op. cit.) state that "The young spend from 27 to 35 days in the nest, usually about 28." If these nestlings fledged on their 28th day, or early on their 29th day, they certainly survived. However, the *Kit Jones* left its berth at 0900 on 26 July and went into drydock at Brunswick, Georgia, 30 miles south of Sapelo, and did not return until 31 July. Unless the young fledged prior to this voyage, they possibly did not survive, since the adults did not accompany them. At any rate, the young did leave the nest either during this period or prior to it, because the gourd was empty on 1 August.

The Sapelo Island dock (Marsh Landing) is located on the Duplin River, a tidal bay which empties into Doboy Sound several hundred yards south of the dock. According to Mr. Olson, whenever the *Kit Jones* left the dock, the adult martins would follow until the vessel entered the sound, at which point

¹ Contribution No. 56 from the Marine Institute for the University of Georgia. This research was supported by funds from the Sapelo Island Research Foundation and the Frank M. Chapman Memorial Fund.

TABLE 1

SUMMARY OF MARTIN NEST INATTENDANCE DUE TO ABSENCE OF *KIT JONES* FROM DOCK

Stage of nesting		Incubation	Nestling
Length of stage (days)		16	28
Days absent from dock		10	13
Time lost for nest attendance			
Hours lost per day:	Range	1-8	1-9
	Average	5.7	5.5
Per cent day-length lost:	Range	5-34	
(incubation stage)	Average	24	
Per cent daylight lost:	Range		10-60
(nestling stage)	Average		36
Total hours lost		57.3	72-84*
Per cent total hours**		15	17-20
Daily mean temperature	Range	60-84	75-84
(Fahrenheit)	Average	76.2	80.2

* Second value includes 12 additional hours lost during storms.

** Total hours during incubation stage = 384 hours.

Total photoperiod during nestling stage = 422 hours.

they would turn back to the dock area. Upon the return of the boat to the dock the birds would return to the gourd.

Throughout June and July the *Kit Jones* was being used several times weekly for offshore collecting or trips to the mainland, about six miles away. From the vessel's log it was possible to determine the dates, time of day, and duration of time the vessel was absent from its berth during the incubation and nestling periods. These data are summarized in Table 1, which shows the range and mean of the time lost from nest attendance by the parents. The range of daily mean temperatures and the average temperature for each period are also given. The daily photoperiod during the nestling stage was obtained from sunrise and sunset data in the U.S. Coast and Geodetic Survey 1961 Tide Tables. One hour of daylight was added to these data to allow for light prior to sunrise and after sunset.

During the estimated 15-day period of incubation (cf. Allen and Nice, op. cit.) the *Kit Jones* was away from its berth nine days out of 15 for varying periods ranging from one to eight hours duration. The maximum periods (on five different days) represent a loss of only approximately 35% of the total daylength (24 hours) available for incubation. Thus the adult, on those days, could still, theoretically, incubate the eggs for 65% of the day. Allen (Allen and Nice, op. cit.) states "The female incubates about 70% of the day. . . ." For three nests he found incubation coverage to range from 49 to

90% at temperatures of 58 F to 70 F, respectively. Kendeigh (1952) found the percentage of total incubation time during the day varied from 67.6 to 81.2% (mean 76.7%) depending upon the mean air temperatures which ranged from 57 F to 70 F. During the incubation period the daily mean temperatures on Sapelo Island ranged from 60 F to 84 F, with a mean for the period of 76 F. During those days when the *Kit Jones* was absent for periods of seven or eight hours the mean maximum temperature was 85 F. In addition, while at sea the gourd was exposed to direct sunlight and as a result the inside nest temperature was probably somewhat higher. From the foregoing one must conclude that the loss of time for incubation by the female during these days was probably of no consequence in the long run to normal development of the embryos within the eggs.

Table 1 also presents the average daily loss of feeding time of the young by the adults as a result of the *Kit Jones*' absence from the dock area. Assuming a 28-day nestling period, the young were separated from their parents on 13 days for varying periods of time ranging from one to nine hours or 10 to 60% of the available daylight hours. On five of these days the separation ranged from 52 to 60%: on two days, 40-50%; and on six days, 10-20% of the daylight hours. The longest absence of nine hours occurred on 3 July, when the young were six days old. The shortest absence, for one hour, occurred on 12 July, when the young were 15 days old, although the boat left the dock twice that day, the second trip in late afternoon being for 1.5 hours.

The greatest feeding activity of nestlings by adult birds, in general, takes place during the early hours of the morning and the hours just before dusk. All of the periods of long absence, i.e., periods over seven hours duration, occurred between the hours of 0800-1900, thus on those days the adults were able to feed their young for at least two hours prior to departure and two hours after return of the *Kit Jones*. Only once, on 4 and 5 July when the young were eight and nine days of age, did two absences of long duration occur consecutively. During the remainder of the nestling period the days with long absences were interspersed by days with absences of zero, one, or two hours duration. The percentage of daylight available to the adults for feeding the young each day during the nesting period is illustrated by the histogram in Fig. 1. A maximum of 350 hours, or 83% of a total photoperiod of 422 hours, was available for feeding the young birds during the nestling stage. Since this figure includes daylight hours during thunderstorms which occurred several times weekly in the late afternoon and lasted about an hour, probably not more than 80% of the total photoperiod was available.

A protracted period of several hours of daylight without food can be a serious hazard for nestling passerines by preventing normal rates of growth and development. It is suggested here that perhaps martins possess the ability

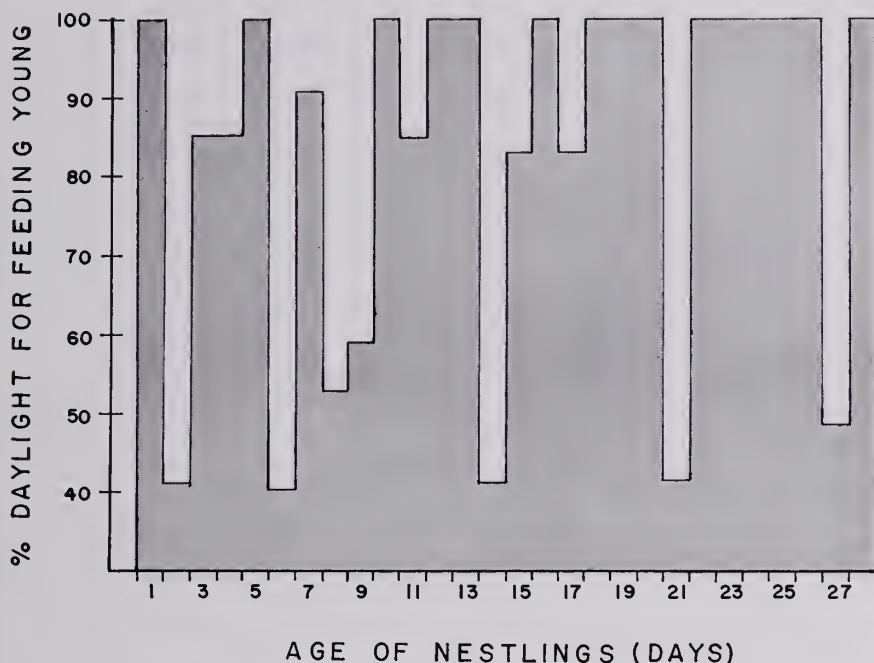


FIG. 1. Percentage of daylight available for feeding young martins during nestling stage, 28 June-25 July 1961.

to store food reserves during periods of adequate feeding which, in the present instance, enabled them to survive the prolonged absences from their parents. It is known, for example, that nestlings of swifts store food reserves during periods of good weather (Lack and Lack, 1951), an adaptation enabling them to survive rainy or cold periods. The extent of lipid reserves in nestling or adult martins has not been determined; however, Allen and Nice (*op. cit.*) state that "the birds gain rapidly until 12 days of age, when they weigh from 42 to 47 grams. After this they gain less rapidly until about the 20th day when they weigh between 55 and 60 grams." This is several grams above the average weight of fledged young and adult birds. Some of this excess weight, of course, is going into feather development.

The fact that the adult martins were able to raise three young that were as healthy and well developed as the young raised in gourds located on the dock, yet with 20% less feeding time during the entire nestling period, raises the question as to whether the martins are rearing the largest number of young for which they are capable of providing. Lack (1951) stated: "It is considered that the clutch-size of each species of bird has been adapted by

natural selection to correspond with the largest number of young for which the parents can, on the average, provide enough food." Skutch (1949) holds that although this may be true for birds at high latitudes, it does not apply to birds of the humid tropical areas. The clutch size for martins on Sapelo Island ranges from three to five eggs, with most nests containing four eggs. Most nests with young, however, contain only three nestlings, with one egg usually being infertile or addled. Thus the average clutch size is four eggs, while average brood size is three young. Sufficient observations have not been made yet to allow me to state this unequivocally. Allen and Nice (op. cit.) report mean clutch size in Michigan to be 4.9 eggs per nest, with a range of 3-7 eggs per nest. Fifty-four per cent of the nests contained five eggs, while 25% contained four eggs. Sapelo Island is near the southern limits of the breeding range for Purple Martins, and it is well known that among passerines with wide distribution clutch size tends to become smaller in the lower latitudes of the breeding range. Although one should not make broad generalizations on the basis of one example, the present case suggests that the martins on Sapelo are not raising the largest number of young for which they can provide enough food. As Gibb (1961) points out, the proximate factors involved with the variation in clutch size of birds are largely unknown, the present observations give no indication as to what these may be.

SUMMARY

Observations of a Purple Martin (*Progne subis*) nest in a gourd located on the mast of a research vessel at Sapelo Island, Georgia, were made during June and July 1961.

Three young were successfully raised to the fledgling stage by the adult martins even though interruptions of one to nine hours duration in incubation and feeding occurred several days each week by absence of the vessel from its dock. The loss of feeding time amounted to 20% of the total photoperiod available during the nestling stage.

It is hypothesized that nestling martins are able to store food reserves during periods of adequate feeding which enable them to survive prolonged periods of no feedings.

The average clutch size and brood size of martins on Sapelo Island do not appear to correspond with the largest number of young which the parents can nourish.

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I am indebted to Dr. Eugene P. Odum for kindly reading this manuscript and making useful suggestions concerning it.

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UNIVERSITY OF GEORGIA MARINE INSTITUTE, SAPELO ISLAND, GEORGIA, 24 MAY
1963

HISTORY OF THE CAROLINA PARAKEET IN ITS SOUTHWESTERN RANGE

DANIEL MCKINLEY

THE Carolina Parakeet (*Conuropsis carolinensis*) is extinct, but so sketchy is knowledge as recorded in ornithological accounts, so widespread are the memories of the bird preserved in diaries and journals of America's frontier days, that a synthesis of the two streams of evidence seems desirable. This union is a fitting tribute to the bird as well as to the travelers who faithfully recorded its vivid beauty.

This report covers references to the parakeet in the region that now comprises the states of Texas, Oklahoma, Kansas, and Colorado. It is proposed to divide the range of the species into four additional regions for similar treatments. The parakeet in the state of Missouri has already been treated (McKinley, 1960). The present account is not meant to be an integrated life history of the species; a monograph now in preparation will attempt that. I shall be grateful to anyone willing to share information on the habits or distribution of the parakeet, and in no place do I need more help than in searching the historical records of America's pioneer period.

TEXAS

General literature.—The first Check-list of the American Ornithologists' Union (1886:206) merely listed the Carolina Parakeet as appearing formerly in Texas. Check-list compilers were probably guided by the very general statement of S. W. Woodhouse that parakeets were "quite numerous in eastern Texas." Just when is not clear and upon whose evidence is not known, for the exploratory report to which the statement is attached did not concern eastern Texas (Sitgreaves, 1853 [also 1854]:89). Coues (1874:296) merely cited Woodhouse; and Hasbrouck (1891:376) noted the vagueness of the reference, but on the basis of it, placed the boundary line "between the Brazos and Trinity rivers. . . ." Strecker (1912:30) followed Woodhouse (or Hasbrouck); but it is interesting to note that Ridgway (1916:148, 149) followed Hasbrouck in placing the species' southwestern boundary, but then went on to put a question mark after "Texas" in citing Woodhouse's original record.

I cannot claim to have read nearly all accounts of travel in early Texas, but many good narratives at least do not mention the parakeet in Texas. The first evidence that the bird was to be found in Texas appeared in a book (Anon., 1840:195) that sounds authentic but merely listed "Paroquets" in the text, giving no information on them. William Kennedy (1841, 1:131) about the same time included in an ordinary list of birds that emphasized game species

“. . . the gay, clamorous, and pilfering paroquet.” He was an Englishman who went to Texas in 1839, and most of his book seems to have resulted from a thorough study of other books. J. G. Burr (1938:22) has quoted Kennedy’s bird list.

An anonymous author (1874) included “paroquets” in a motley list that seems unreliable; and O. M. Roberts, then governor of Texas, treated only four birds besides game, one of which was the “parrakeet of south-eastern Texas” which “gives a harsh, grating squall in its rapid flight, always seen in small numbers, but never singly, dashing through and around the tops of trees, . . . a bird of beautiful colors of green and yellow or pale red” (Roberts, 1881:89). I likewise have assurance from Hubert Loomis Smith (letter, 19 January 1960) that an elderly friend from Texas said that the species was “still abundant in that state when he left it about 1889 or 1890.”

Eastern Texas.—There is little concrete information to back up Woodhouse’s statement concerning eastern Texas even though there is no reason to doubt its general accuracy. An anonymous writer, now presumed to be F. B. Page (1846:63), who traveled on the San Antonio road in Angelina County, found “. . . a flock of parroquets filling the air with their noisy cries” on the Neches River. The account refers to the spring season of probably the year 1845 and describes the area as already scantily settled and under cultivation.

R. H. Baker (1956:357), while interviewing old-timers in Angelina, Nacogdoches, Polk, and Tyler Counties, between the Sabine and Trinity Rivers in eastern Texas, in 1940–42, found the parakeet “unknown to most persons interviewed. One or two informants said they had heard older people tell of paraquets in eastern Texas; only two people could remember actually seeing the birds. M. B. Hickman said that paraquets were plentiful in eastern Texas before the Civil War. No one knew from where the birds came; some thought they were from Mexico. Hickman said flocks of these fast-flying paraquets came to Polk County in midsummer and remained until autumn. He saw none after 1875. The birds were partial to corn in the milk stage and damaged fields severely. People would kill the birds on sight and erect scarecrows to drive them away. Floyd Pope remembered that as a small boy he saw a flock of several hundred paraquets and that his parents told him that these birds were more abundant in earlier days. He remarked also on their destructiveness to corn. Pope thought that they were most abundant at the time when corn began to ripen but also thought that the birds nested in Tyler County.”

It is of interest that even before 1875 the birds were erratic enough in appearance to be considered possibly of exotic origin; their alleged damage to corn is likewise noteworthy, for certain writers have said that corn was not much used by parakeets.

Although I have not been able to find any substantiating evidence, J. F. Combs has written to me (letter, 4 May 1960) that he was told that "Mr. Attwater [H. P. Attwater?], noted naturalist, was scouting in this region, and . . . that he and a Mr. Weiss of Beaumont saw a Carolina Parakeet on the Neches River, less than a mile from Beaumont. That must have been some time after 1910."

Red River Valley.—Rather satisfactory sight records exist for the parakeet in this section of Texas, although for a relatively late period only. In the file of the old Bureau of Biological Survey in the U.S. Fish and Wildlife Service offices at Patuxent, Maryland, there is an undated note stating that an observer named Peters had found the parakeet to be a "common resident on Red River," presumably at Bonham, Fannin County, where the report originated. (It seems likely that Peters was one of W. W. Cook's migration observers of the 1880's.)

This vague report is backed up a little more substantially by a note from E. C. Davis (1887) written from Gainesville, just to the west of Fannin County. Doubting a report that parakeets were resident and breeding in large numbers on the Red River fifty miles to the east of his home (and therefore surely within the bounds of Fannin County), he had written to S. E. Watson who resided in that area and got in reply a letter stating that "there are a great many Parakeets in this section of country. They are exactly like the large green parrot, except smaller, have some yellow about the wings and head. They are very destructive to orchards, and it is almost impossible to keep them away from here in the fall." Watson had kept them in cages frequently and found that they were fond of cocklebur.

It is interesting that H. C. Oberholser of the U.S. Biological Survey reported (Fish and Wildlife Service files—cited hereafter as FWS file) in 1902 from Boston, Texas, that the species "until within a few years was of regular though not very common occurrence in the Red River bottoms north of this place. The last one of which I was able to obtain trace was killed there about five or six years ago." Boston is in central Bowie County, extreme north-eastern Texas, bordering Oklahoma and Arkansas.

Gulf coast.—Records for the coastal region of Texas are in an uncertain condition and seem likely to remain so. Vernon Bailey (FWS file) reported in 1900 during his work in the region from Corpus Christi to Brownsville that he had seen at Mr. Priour's a mounted specimen "said to be one of a number that appeared in the neighborhood a few years ago." Much later, Bailey appears to have received from the owner of the specimen, John M. Priour, a letter (9 November 1914; FWS file) that his collection had been dispersed and that he did not then know who had the parakeet specimen. His son had shot it from a flock of the birds in the Ebony Woods, five miles east of

Corpus Christi. Priour's letter unfortunately engaged in a good deal of gossipy speculation about the status and migratory habits of the species that makes the whole story somewhat open to doubt, although there can be no question about the specimen, whatever its origin. Hagar and Packard (1952: 9) and Wolfe (1956:35) have accepted this record.

William Lloyd reported to the Biological Survey (FWS file), after field work during the summer of 1891 in Cameron County, the lower Rio Grande, and adjacent Mexican Territory, that the parakeet was said to occur as an accidental visitor in the palmetto ranches south of Brownsville. Griscom and Crosby (1926:34) in a study of the birds of Cameron County, however, put the species on their hypothetical list, noting that a specimen in Jonathan Dwight's collection labeled "Brownsville" was not regarded by Dwight as properly labeled. (See note under "Specimens and Summary" at end of Texas account.)

Central Texas.—There is no reason to doubt that the parakeet was capable of wandering up rivers wherever timberlands made the countryside inviting to them. It is not surprising, therefore, that there are scattered reports of the species in central Texas. There are, however, no records from early days, not even from the great marches of the Pacific Railroad Survey.

The most widely cited record is listed in Bent (1940:11), which turns out to be an editorial notice (Anon., 1886) referring to 1885 in an ephemeral bird journal, *The Sunny South Oologist*, whose life-span was just three issues in 1886. A chatty note related: "Hundreds of bright colored parrots were seen near Brownwood, Texas, last summer (supposed to have come from Central America), something which has never happened before. There were also a good many more crows than usual. Many of the superstitious people of that place consider it an omen of bad luck." Brown County is in north-central Texas on the Pecan River, a branch of the Colorado River of Texas.

J. D. Mitchell, in a letter of 1914 (FWS file), reported the parakeet as having been reported by Chadoin, a trapper and hunter, in the early days (no date given, but Mitchell's information seemed to go back to the 1860's—see below) at Colorado in Mitchell County, some 125 miles west of Brown County. Mitchell also reported that there was "1 taken several seen fall 1863" in Lavaca County (southeast-central Texas, near the Colorado River). These were identified by Mitchell's mother. Lavaca County lies just east of Gonzales County, in whose town of Gonzales D. B. Edward, a Scotsman, taught school prior to 1836. Edward (1836:75) apparently also resided elsewhere in Texas, so that it is not possible to pinpoint his observations; his catalog of birds included some with British names, but the overall list sounds convincing with its "also a few flocks of the green paroquet, whose scream is any thing but pleasant."

Specimens and summary.—Mitchell's report of a specimen taken in Lavaca County is doubtful; Vernon Bailey saw a specimen supposedly killed at Corpus Christi in the 1890's. The American Museum of Natural History owns the adult male collected by G. Loucke, whose labeled locality of Brownsville was doubted by Dwight. The Geneva (Switzerland) Museum d'Histoire Naturelle has two specimens from Texas acquired in 1844 from M. Merle, but without further data. The Academy of Natural Sciences of Philadelphia contains in its Rivoli Collection a female without information simply labeled "Texas" (De Schauensee, 1941:294).

No seasonal summary of the parakeet in Texas is warranted. Truly pioneer accounts of the presence of the bird are almost nil and the bird's distribution in later days, with a nearly complete absence of breeding reports, can only be called erratic. There are scattered reports for the 1830's and a final one for perhaps the mid-1890's.

OKLAHOMA

General references.—General references to the Carolina Parakeet in Oklahoma begin with S. W. Woodhouse's vague statement that the parakeet was "quite numerous in eastern Texas and in the Indian territory, confining itself to the timber lands of the large streams" (Sitgreaves, 1853:89). The date is not clear; Woodhouse's report is an account of the Zuñi expedition, not referable to Oklahoma, that took place in 1851. Woodhouse accompanied Sitgreaves, however, in Oklahoma in 1849 and 1850 in surveying the Creek Boundary line from the mouth of the Red Fork of the Arkansas westward (Warren, 1859:63-64; Hume, 1942:498); this would correspond more or less to the northern boundaries of present Creek and Payne Counties. The Fish and Wildlife Service files indicate that a specimen was taken, but I have no evidence for the statement. The general picture is further obscured by the fact that Baird et al. (1858:67-68) did not even mention the parakeet in Indian Territory. Baird et al. (1874, 2:587) merely stated that "in Western Louisiana, Arkansas, and the Indian Territory, they are still found in considerable numbers," but predicted their early extinction. Coues (1874:296) cited Woodhouse's early statement.

W. W. Cooke (1888:124) alleged that "formerly immense flocks were found all over Indian Territory," but "Indian Territory" may have been used vaguely, and it is even less clear upon what observations he based his statement. He went on to note, however, that "at present it is almost extinct in the eastern part of the Territory, though a few are still found around Caddo [Bryan County], and in the middle and western parts they are almost as numerous as ever." Substantiating evidence for any general abundance of

the species at so late a date, especially in the western part of Oklahoma, is not available at present.

Oddly enough, the first American Ornithologists' Union Check-list (1886: 206) noted that the parakeet was *formerly* found in Indian Territory, but the second edition (1895:152) changed the status and included Indian Territory, "where it is only of local occurrence."

Bendire (1895:1-2) added very appreciably to general and specific knowledge of the parakeet's distribution and habits, particularly in the region of the Arkansas River. He saw flocks of the birds "near several of the military posts in the Indian Territory" in the year 1860 but held that the parakeet was rapidly disappearing from all its former strongholds, especially in that Territory. In truth, by the time Bendire wrote, the species was probably already gone, but Cory (1899:360) and Chapman (1912:145) provided a fictitious existence for a good many years. In maintaining this spurious status, Hasbrouck (1891:371) is partly to blame, for he claimed in his comprehensive review that, at the time he wrote, parakeets were still found in certain inaccessible regions of the area, and his map (facing p. 369) indicated that the bird was present in roughly the southeastern quarter of the Territory, its range not reaching quite to the eastern border.

In the present century, Ridgway (1916:147-148) reviewed rather sketchily the species' history in Oklahoma; Nice's admirable account appeared in 1931 with a much-needed richness of detail. A later review that included the parakeet, that of Duck and Fletcher (1945:91), is short on details; their dates of 1819 for eastern and east-central Oklahoma apparently ought to read 1820, and I cannot trace any source for their record of 1838 at Goose Neck Bend of the Arkansas River.

Eastern and east-central Oklahoma.—C. B. R. Kennerly (1859:21), reporting upon birds collected by the Whipple group of the Pacific Railroad Survey along the 35th Parallel, listed a specimen collected by H. B. Möllhausen at Fort Smith, Arkansas, very close to the eastern boundary of Oklahoma. The specimen, in the U.S. National Museum, is undated, but since Lt. Whipple's expedition did not arrive at Fort Smith until 2 July and departed in mid-July 1853, it seems probable that it can be dated fairly precisely. Kennerly's report makes it appear that the expedition did not see the parakeet during its trek across Oklahoma: at least no specimens were taken. However, Möllhausen (1853, 1:17) himself describes idyllic camp scenes on Poteau Creek on the Arkansas-Oklahoma state line near Fort Smith with ". . . the chatter of the parrots on the nearest trees"; and a few days afterwards, in late July, he described vividly his impressions of San Bois Creek, south of the Arkansas River in Haskell County, Oklahoma (ibid.:45): to the sights and sounds of many birds ". . . the parrot, climbing from twig to twig, puts

in from time to time a few careless observations." It is worth recording that that loquacious, impressionable German naturalist made no further mention of parakeets in the trip across Oklahoma in the valley of the Canadian River (the river being at that time of year dried to a very low level).

Parakeets must have been common in the Fort Smith area, for Bendire personally saw large flocks there throughout the year 1860, and he remembered that "in the vicinity of Fort Smith, Arkansas, during the fall and winter of 1860-61," he "frequently saw flocks of these birds in osage orange trees . . . , biting off the fruit and feeding on the tender buds. . . ." Farmers commonly shot them for damaging Indian corn and fruit (Bendire, 1895: 1-2).

In the central part of eastern Oklahoma, several rivers come together, creating, as will appear from descriptions left by explorers, what must in primeval times have been ideal conditions for parakeets.

Edwin James, participant in Maj. Long's expedition to the Rocky Mountains in 1819-20, recorded that Long's group, having just descended the Canadian River the full length of Oklahoma (in the mistaken assumption that they were on the Red River), apparently first saw parakeets at the mouth of Sand (or Topofki) Creek, in present Pontotoc County. The Canadian consisted of disconnected pools, but on 1 September 1820, James (1905, 16:164) remarked that they were now surrounded by "the sycamore, the aesculus, the mistletoe, and the paroquet," which had been so conspicuous in the deep forests of the Ohio and Mississippi river valleys. On 5 September, in Pittsburgh County, James (*ibid.*:172) recorded the first Ivory-billed Woodpecker; the Pileated Woodpecker had been seen more than a hundred miles upstream; turkeys were numerous and "the paroquet, chuck-wills-widow, wood-robin, mocking bird, and many other small birds, filled the woods with life and music." The records of Ridgway (1916:148) and of Duck and Fletcher (1945:91) for "Falls of Canadian River," "Shawnee Hills," and "Canadian River at Gaines Creek" [= South Fork], all listed as 1819, undoubtedly stem from a misdating of James's Canadian River reports, which properly belong to 1820.

In the autumn of 1832, America's urbane and gentlemanly essayist, Washington Irving, took a surprisingly long and careful look at the West in an overland tour from Independence, Missouri, traveling into Indian Territory as far as present Oklahoma City and Norman; he later went eastward by way of steamboat down the Arkansas. That lively observer not only recorded parakeets in Kansas, as will be noted, but also saw them among what were obviously to him the romantic scenes of the vicinity of Fort Gibson (Muskegee County). Irving (1944:112) and his party left Fort Gibson and encamped on the Arkansas River a few miles upriver from the Fort on the night

of 10 October: "Encampment of rangers in circular grove—rich bottom—high trees . . . trees tinted with autumn—tinkling of bells—men making messes at fires—some shooting at mark with rifles—parrots flying chattering through trees."

On 11 October (*ibid.*:115) they were beyond the last settler on the Arkansas near Choska, Wagoner County: ". . . Stopped about noon in rich bottom, tall trees, fine *range* of Pea vines, for the horses to repose and feed for an hour—flock of paroquets—beautiful transparency of the varied autumnal leaves with the sun shining through them. . . ."

There is unfortunately more of the autumnal haze than of parakeets in the finished "Tour" that came from these vivid notes. Irving's party journeyed farther to the westward before returning to Fort Gibson, but notes covering the crucial period of late October, when Irving was in central Oklahoma, have not survived. Very raw weather began in early November and, despite very good descriptions of birds and scenery, Irving's notes recorded nothing more on parakeets.

More than ten years later, J. W. Abert, a remarkable naturalist engaged with the Topographical Engineers of the U.S. Army, descended the valley of the Canadian River. He first recorded parakeets in Muskogee County, in the angle between the Canadian and Arkansas Rivers on 19 October 1845 (Abert, 1846:72): "After a long march through misty low lands, where sycamore trees seemed to arch the heavens, and gaudy paroquets were circling round with rapid flight and screaming loudly among their lofty branches, we forced our way through the tangled undergrowth of spice-wood and smilax, and at length reached the banks of the Canadian just as the last rays of the sun were disappearing" (on the west side of the stream, some 18 miles from its mouth).

The next day, the party was at Webber's Falls, on the west bank of the Arkansas, Muskogee County (*ibid.*:73): "The paroquets . . . , were very abundant, and numerous flocks of them were constantly darting round, describing large circles through the topmost branches of the tall trees. . . . Mr. Riely [a Cherokee Indian settled there] tells me that their flesh is very pleasant to taste, and is frequently sought for by the inhabitants of the neighborhood."

Eliza Johnston (1957:480) noted in her diary that an officer had sent to her young daughter a "paroquet" which he shot at their camp on Gaines Creek, a tributary of the Canadian River in Pittsburgh County. The date was 6 December 1855; in their long trek from near St. Louis, overland to Texas, that was the only mention of parakeets.

Although a precise date cannot be supplied (perhaps the record may be referred to the 1850's), Mrs. Ella Robinson, a Cherokee Indian born on the

Arkansas River near Muskogee in 1847, reported that many varieties of fruit trees (apples, pears, plums, and cherries) flourished after being brought from the East. Although orchards were said to have escaped pests that later proved so troublesome, the apple crop was sometimes bothered by parakeets (Foreman, 1929:367, 369): “. . . In the autumn small green and red parakeets came in huge flocks, making a deafening noise with their raucous voices. They would settle down for the night on the apple trees and literally strip the trees of every bit of fruit. They generally departed the next morning although a few sometimes lingered a short time before going further south.”

Except for Mrs. Robinson's undated record just cited, I know of no records in the period of 1856 to 1874 for this area, but there were once two parakeet specimens in the Goss collection of the Kansas State Historical Society, Topeka, that Nathaniel Goss collected (according to Nice, 1931:101) on the Neosho (= Grand) River (therefore, likely Muskogee County or vicinity), 21 October 1875. (Of these specimens, a male and a female, the male has now disappeared.)

Dramatic events occurred in the late winter of 1832 as Daniel Hector Talbot, adventurer and erratic naturalist of Sioux City, Iowa, descended the Arkansas River by boat. Talbot left Sioux City 10 February and returned there on 5 April. He and his companions went from the region of present Muskogee to Little Rock, Arkansas (T. C. Stephens, 1944; letter of J. H. Ennis, 23 November 1962). The greatest slaughter of western parakeets on record occurred, and the whole affair was hounded by misfortune. Talbot apparently took few notes on the parakeets: his diary cannot now be located, although it was available to T. C. Stephens for his biographical study just cited; Talbot left his bird collection which contained at least 25 parakeets (P. A. DuMont, letter, 1 November 1962) to the State University of Iowa, and that institution later allowed much of the collection (the parakeets at least) to be dispersed, without keeping records of the recipients or of the specimens disposed of; secondary recipients in some cases later lost the data, if they had ever received them.

A catalog of the Talbot specimens is attempted here, complicated though it is. It must be kept in mind that labels may have been added later in some instances; at any rate, it is certain that “the mouth of Grand River,” “Fort Gibson,” “Gibson,” “Cherokee Nation,” and “Verdigris River” probably all mean about the same thing in this instance; Muskogee County is probably meant.

It is not clear precisely when Talbot's party reached Indian Territory, but at least four specimens are known that bear the label “Mouth of Grand River,” and the date of 17 February (The University of Michigan Museum of Zoology has three specimens, two unsexed and one female; the Davenport (Iowa) Museum of Natural History has one,

sex unknown, that has been reported, without doubt incorrectly, as state of Missouri). To this it may be possible to add one female at the Museum of Comparative Zoology, Harvard University, without date; the total figure tallies, at least, with the note copied by T. C. Stephens from Talbot's diary (Ennis, letter): "Feb. 17. Friday. After breakfast Talbot took gun and went on a bird collecting trip. Collected about 30 specimens of birds during day, including five Carolina Parakeets on Verdigris River." Obviously, the labels were written with a free hand, as far as locality is concerned.

Another specimen, a female at the Chicago Natural History Museum, is dated 20 February but is indicated to have come from the mouth of the Grand River, a total of six from that locality.

On 18 February (according to the notes now held by Ennis) one of Talbot's companions, Miller, shot three parakeets. There is no record that any of these survived to become skins. It is not quite clear where the party was, but if the specimen of 20 February is properly dated, they must have been in the same area as on 17 February.

At any rate, there are records alleged for nearby Fort Gibson (or just Gibson), Muskogee County, as follows: the Museum of Comparative Zoology has one male and one female dated 21 February; the State University of Iowa has one female dated 20 February; and the American Museum of Natural History has two males dated 20 and 21 February. In addition to these, M. M. Nice (letter, 8 July 1961) has furnished me with data on two males taken at Fort Gibson, 20 and 21 February, and these I have been unable to trace. The Fort Gibson total: seven specimens.

In addition to these specimens, the Talbot collection originally included birds collected on dates that could not have applied to Talbot's trip, although they were probably collected for him, perhaps by someone with whom he had become acquainted on his tour.

To 31 May 1882 are assigned three specimens: one male in the Koelz collection at The University of Michigan Museum of Zoology; one female at the Denver Natural History Museum; and one male (Nice, letter, 8 July 1961) which I have not yet been able to locate. As to locality, they are said to be from the Choctaw Nation: an area of considerable extent that could mean any part of present Oklahoma south of the Arkansas-Canadian Rivers and west approximately to the eastern borders of Pontotoc and Johnston Counties. It seems more likely that they came from that part of the Nation bordering the Arkansas River: that is, Sequoyah or Haskell and Le Flore Counties.

The second date, still later in the year, is that of 1 July. Here belong a total of eight specimens: one skin of unknown sex at The University of Michigan; one male at the Museum of Comparative Zoology; two males at the Denver Natural History Museum; one female and two of unknown sex at the State University of Iowa; and one male and one female (Mrs. Nice's letter) that I have not yet traced.

It must be pointed out that there are two specimens (one at the Davenport Natural History Museum; one at Coe College, Cedar Rapids, Iowa—formerly two at the latter place, but one has vanished) for which the present owners have no information: for various reasons, they are assumed to be from the Talbot collection. The American Museum of Natural History has also one specimen, sex unknown, merely labeled 1882, Talbot collection.

In summary, I have 31 specimens that may be attributed to the Talbot collection, supposing there to be no overlap of references; the weak point is my supposition that four specimens with full data listed by Mrs. Nice are different from the specimens without full data that I have variously listed.

A field report of Loring (J. Alden?) from Redland, Sequoyah County,

April 1897 had it that there the parakeet "was very common at one time, but I was told that none have been seen in 15 years. Said to have fed extensively on 'cockleburs'" (FWS file). The suggested date of 1882 for a last sighting is a reasonable one, since it matches that of Talbot's raid.

Talbot apparently did not, however, get all the parakeets. H. K. Coale (1894:222), during what he called a flying trip through Oklahoma and Texas, was told by Capt. Vinton, then stationed in Texas, that he had seen "a flock of green Parrots with yellow heads at Fort Gibson, Ind. Terr., in 1886. They lit in a grove near the fort and staid fully twenty minutes. No shot gun being handy they were not molested."

Note that the date here is 1886, but Hasbrouck (1891:377) had just earlier reported what appears to have been the same information, relayed to him by A. W. Butler, who got it from Coale: "an army officer stationed at Fort Gibson, saw and recognized a flock in 1889, which alighted in a tree directly over the spot in which he and his men were encamped. This gentlemen [sic] was acquainted with the birds in their Florida haunts, . . ." I have no way of knowing which is the correct date, but Ridgway (1916:148), in following Hasbrouck, set the fashion of considering 1889 as the last sight record for Oklahoma.

Northern Oklahoma.—It may be of interest to look at central-northern Oklahoma as a region somewhat separate from the more central and eastern part of the state, even though the great rivers of the two areas eventually merge.

The earliest report that I find is that of Thomas Say, naturalist in Captain Bell's part of the Long expedition: Bell had descended the Arkansas from La Junta, Colorado, in the summer of 1820, and the first mention of parakeets was in western Osage County, Oklahoma (James, 1905, 16:254): the party sought refuge from the midday heat of 24 August in a strip of timberland on the banks that rose steep and high near the mouth of a large, clear stream (apparently they had just crossed Bitter Apple Creek). "A flock of paroquets flew over our heads, uttering their loud note, with their usual loquacity." A few miles farther east on 25 August (ibid.:256), they saw another flock of parakeets. It seems pretty obvious that parakeets were common there on the Arkansas, and it is surprising that they had not been seen and commented upon farther upstream; the bias of journalists may be to blame.

The status of the parakeets over the years that followed the Long expedition is not clear, but it was noted early in the present century (Barde, 1912:112) that however hard it was to believe that the "parrot" had once been found in Oklahoma, it "was seen on Hominy Creek, in the Osage country, as late as the early 70's." This is present Osage County, and I have been assured by J. J. Mathews, historian of the Osage Tribe (letter, 7 September 1961), that

he long ago saw parakeet feathers decorating pieces "like ancient bandeaus, worn by self-fancying chieftains, but having no religious significance, I feel sure." "The paroquets, . . . were indigenous," Mathews continues. "I know this, since my father saw them some time between 1872 and perhaps 1890. They came to the old fields and ate cockleburs." It is interesting to note that the Osages (who were removed to northern Oklahoma after being forced from southwestern Missouri and adjacent areas of Kansas during the first half of the last century) have words, apparently nearly identical, for both parrot and parakeet (La Flesche, 1932:211, 302).

Red River and the south.—There are several records for this area, one a female specimen in the U.S. National Museum collected by Edward Palmer at Boggy Depot, Atoka County, 1 July 1867. Boggy Depot was in the old Choctaw Nation, and Miss Muriel H. Wright, editor of *The Chronicles of Oklahoma*, reports to me (letter, 8 January 1963) that her father, the late Dr. E. N. Wright, told her of the parakeets that "came in large flocks and ate apples and pears in the orchard at his home [at Boggy Depot]. This must have been about 1870 because the orchard was planted about 1867. . . . The bird was described to me as a comparatively small bird with green feathers and long tail, and looked like a parrot. Their cry was shrill and screechy like a scream."

A little to the eastward, in Choctaw County, D. C. Harrison of the Geological Survey was stationed at Spencer Academy in 1880; according to Hasbrouck (1891:377), "he found the birds very abundant, describing them as appearing in large flocks like Blackbirds, and on his return brought six specimens with him as mementos of the trip." (His specimens are not now extant.)

The parakeet appears to have survived at least a few years past Harrison's date of 1880 in the Caddo district of Bryan County, in the Red River valley just north of Denison, Texas. W. W. Cooke (1914:480) spent the period August 1883 to April 1884 at Caddo and of parakeets wrote that a "sharp lookout was kept for it every time that the timbered districts were visited, but none were seen. A stuffed one was still preserved that had been shot near Caddo several years previous. In 1882 a large flock was seen about 18 miles from Caddo; other smaller flocks were reported from time to time, the last being January 15, 1884 on the Blue River about eight miles from Caddo. They were, of course, resident." Cooke's migration report (1888:124) merely stated that a "few are still found around Caddo"; and his notes summarized in Fish and Wildlife Service files list only the flocks of 1882 and January 1884; and with the information is the notation "both reported," which I interpret as meaning that he never saw the species personally while at Caddo.

The references for Bowie and Fannin Counties, Texas, already cited, are of significance to this region.

Western Oklahoma.—The term “west” refers to the western half of the state, exclusive of the Panhandle. Cooke’s vague statement (1838:124) that “in the middle and western parts they are almost as numerous as ever” stands unconfirmed for the most part. Duck and Fletcher (1945:91) state that the species was recorded in Roger Mills County in 1853; whether this is the date of a publication unknown to me or whether it may refer to some published diary, as yet unchecked, of a member of the Whipple expedition of 1853 is not yet clarified.

Edward Palmer, who sent a specimen from Boggy Depot (see above), apparently did not take the species at the Kiowa Agency, 17 miles southwest of Fort Cobb, Caddo County, 14 March to 27 June 1867 (Nice, 1931:41, 101), although the U. S. National Museum has a specimen collected by C. S. McCarthy or his companion at Fort Cobb 26 April 1860. (This was one of four taken by McCarthy’s party [Nice, *ibid.*:40, 102]; the other three were apparently exchanged by the National Museum—one was once in the collection of Canon H. B. Tristram [1839] of Durham University, Newcastle upon Tyne, mislabeled as from Fort “Colt,” but Tristram’s collection cannot now be traced.)

While Palmer did not take specimens at the Kiowa Agency, it may be noted that the Kiowa Indians do have a word for parrot (Harrington, 1928:224); whether this refers to imported parrots or to parakeets cannot be said, although the latter is not an impossibility, for the Kiowas were found originally in contiguous parts of Oklahoma, Kansas, and Colorado, and they went to a reservation in southwestern Oklahoma in 1868 (Swanton, 1952:295).

One remaining ethnozoological item may be cited. Miss Muriel N. Wright writes describing a beautiful fan of Cheyenne Indian origin (in the Wickmiller Collection in the Oklahoma State Historical Museum) that appears to be made of parakeet feathers. The Cheyenne-Arapaho Reservation, Miss Wright informs me, was in the midwestern part of Oklahoma, in the region extending south to the Washita River and east to the city of Kingfisher.

Nice (1931:102) records that Army surgeon Rodney Glisan did not include the parakeet in his list of birds of the vicinity of Fort Arbuckle, on Wild Horse Creek in Murray County, where he was stationed in 1850–56. As Mrs. Nice reports, the specimens from Fort Cobb in 1860 remain the most conclusive evidence for the bird’s presence in the western half of Oklahoma.

Seasonal summary for Oklahoma.—There is little information on primeval numbers of the parakeet in Oklahoma. Breeding has not been recorded, and by far most convincing records of considerable flocks of birds are from the eastern parts of the Red, Canadian, and Arkansas river valleys. I find no

specific citations of the parakeet in March, June, and November, although Bendire said they were present throughout the year. For December, January, and February, there is one "flock-sighting" report each, but I here lump all of Talbot's February specimens into one sighting. April and May have one sighting each. Besides certain reports of damage to orchards (indicating the presence of the birds in late summer and autumn), there are reports for July, August, September, and October of three, two, two, and five birds. Whether this merely reflects a greater prevalence of recorders at that season is not known. The last sight record seems to be 1886.

KANSAS

General observations.—N. S. Goss (1891:315–316), a pioneer Kansas ornithologist, gave the history of the parakeet as "Formerly quite a common resident in the eastern portion of the State, but as the settlements increased along the timbered streams—their natural home—they rapidly disappeared, and for several years have ceased to be a resident, or even a visitant." Goss had apparently kept parakeets as pets, and mentioned their powerful bills with which they bit furniture; they would not eat corn except when forced to do so (cf. Bendire's observations, earlier mentioned; perhaps Goss only tried dried corn). The source of his pets is not known, but he never saw the eggs in nature.

The later status of the parakeet, however, is still uncertain, despite Goss's statement that it was completely extirpated. Major Shufeldt (1900:254) saw a single individual "in a cornfield in the eastern part of the State of Kansas," in the 1880's. (It was about 1884, according to a later report by Shufeldt [1920?].) Snow (1872:5) considered the species as "formerly abundant in the woods of Eastern Kansas; now seen occasionally in districts thinly settled." By the turn of the century, David Lantz (1899:257) listed the species as extinct; later ornithologists followed suit (Bunker, 1913:148; Long, 1940:444; Tordoff, 1956:329) without adding to general knowledge.

The Missouri Valley of Kansas.—The details of references to the parakeet in the Missouri River valley have been given in the account of the species in Missouri (McKinley, 1960:277–281); observations include those of Lewis and Clark in June 1804; Prince Paul Wilhelm, July 1823; Prince Maximilian of Wied, April 1833; Count Arese, August 1837; J. K. Townsend, April 1834; Sir C. A. Murray, summer 1834; and Audubon and E. Harris in May 1843.

J. T. Irving's account (1955:25) of early August 1833 leaves no doubt that parakeets were common at Fort Leavenworth; as his group strolled through the forest which skirted the garrison and overhung the Missouri, their eyes "would be caught by the dazzling plumage of the little parroquets, as they whirled through the branches of the trees." Audubon, also, found them still

plentiful a decade later, and in his ascent of the Missouri in a steamboat in 1843 killed a substantial number of specimens, of which six unsexed individuals still exist (one in the American Museum of Natural History and five in the Academy of Natural Sciences of Philadelphia) (de Schauensee, 1941:294; Street, 1948:170, 182).

Lt. J. H. Carleton (1943:34) evidently saw parakeets along the Missouri in August 1843. for he mentioned that other birds began to enliven the scene as his party reached the broken prairie region of the Big Blue.

A little over a decade later, F. V. Hayden (1862:154) alleged that the parakeet was "Very abundant . . . along the thickly wooded bottoms as far up the Missouri as Fort Leavenworth, possibly as high as the mouth of the Platte," but preserved no specimens or precise observations to prove his point, except for several birds collected at what was then called Bald Island, Nebraska, north of Kansas. Coues (1874:296) added significantly that Hayden found the parakeet higher up the Missouri than he (Coues) had ever been able to see it; Coues, a great traveler in the West, had never seen it on the Missouri River at all nor anywhere in Kansas. However, Coues failed to cite some evidence that was surely available to him, and E. L. Berthoud (1887:10) recalled that in 1855-56 he had found parakeets "by no means uncommon" near Fort Leavenworth.

Otto Widmann (1907:115) related that H. C. Masters, an early settler, found "hundreds of Paroquets in the Missouri River bottom" when he settled at Iatan, Platte County, Missouri, in the early fifties; and, Widmann continued, J. R. Meade, a great Kansas pioneer, found "the beautiful scenery was varied by flocks of gaily-feathered Paroquets, chattering in the tree-tops." as he rode the wagon trail from Leavenworth to Lawrence in the spring of 1859.

H. Harris (1919:270) recorded a specimen that Bryant had taken near Kansas City in 1894 (this specimen has been stolen and no precise data exist for it); and in August 1904 a specimen was shot—but was too badly damaged to be preserved—by Wirt Remsburg near Atchison, Kansas (Widmann, 1907:116). The Remsburgs appear to have been interested in natural history, so theirs may be an acceptable record. Harris also recorded an observation by naturalist B. F. Bush of a lone parakeet that he watched for a time in the Courtney Bottoms near Kansas City in 1912, perhaps an escaped cage bird (American Ornithologists' Union, 1957:267). It is interesting to note that St. Benedict's College, Atchison, Kansas, has in its Department of Biology an unlabeled specimen of the parakeet that is reputed to have come from Platte County, Missouri, about the turn of the century (E. W. Dehner, letter, 22 September 1960).

The Southeast and the Arkansas drainage in Kansas.—When Washington

Irving was on his journey to the Indian Nations (see above) in the fall of 1832, he traveled overland from Independence through southeastern Kansas. On 3 October, when his party was probably on Labette Creek, Neosho County, near the present site of St. Paul, Irving noted (Irving, 1944:100): “. . . arrived at a grove on the banks of stream & encamp— . . . —wood entangled with rich underwood—grape vines—pea vines, &c. Fine trees—flights of Perroquets—” And he mentioned (ibid.:102) “screaming of flights of parrots” the next day, when probably on Bachelor Creek, not far from Parsons.

In May 1840, Tixier had seen parakeets in Bates County, Missouri; there, in the “prairie points”—strips of woodland following streams into prairie—he had seen (Tixier, 1940:106): “In the woods huge flocks of parrots . . . , uttering discordant cries.”

In more central parts of Kansas, but still in the Arkansas River basin, J. W. Abert saw parakeets on the Cottonwood Fork at Council Grove, Morris County. It was 24 February 1847 and “there was much snow on the ground, and the Kansas river was blocked with ice” (Abert, 1832:59). The party had come up the Arkansas on the Santa Fe Trail, having been battered for many days by a fearful storm; mules, oxen, wild animals froze to death. In that hard weather, the party pressed on to Council Grove (Abert, 1848:128): “Here we found grateful shelter in that noble grove whose huge walnut trees raise their limbs aloft, . . . , while their lower boughs were stretched over us to shield us from the pitiless pelting of the storm. Paroquettes were sweeping rapidly in large circuits among the topmost branches of the ancient denizens of the forest, and their screams shrill and grating echoed through the lofty arches of boughs, . . .”

The next reference to the parakeet in this region is the significant nesting report of Goss (1886:28), who stated that “in the spring of 1858 a small flock reared their young in a large hollow limb of a giant sycamore tree, on the banks of the Neosho River, near Neosho Falls” (Woodson County).

There is in the Museum of State Teachers College of Emporia, a specimen of parrot-like bird supposedly collected in Lyon County in 1890, once considered to be a parakeet (and so listed by Clarke et al., 1958:180, and by Johnston, 1960:29): the exact history of this specimen is not known to me, but it is not a native Carolina parakeet (D. F. Parmelee, various letters).

Valley of the Kansas River.—In October–November 1833, J. T. Irving camped in the valley of the Kansas River near Topeka (J. T. Irving, 1955: 231): “. . . a flock of screaming parroquets came whirling through the trees; . . . They . . . alighted upon a dead tree directly above, casting side-looks down upon my roast, and from the joyous chattering that they kept up, no doubt were congratulating each other, upon having called, just in time to be

invited to breakfast." He fired at them, and "the flock whirled off, though I could hear their voices raised in a clamorous outcry . . . long after they had disappeared among the trees."

Lt. Abert (Emory, 1848:389-390) saw flocks of parakeets "circling over head, screaming and darting amid the tall walnut and sycamore trees" at the mouth of Wakaroose River, northeastern Douglas County, on the night of 29-30 June 1846. The situation was, despite the mosquitoes, almost unbelievably congenial compared to what they met in the same region (on the north bank of the Kansas, Leavenworth County) 1 March 1847 (Abert, 1848:130, 1882:59). On the latter date, on their way toward Fort Leavenworth, with their rations short and the river packed with ice, they saw the sun rise with a cheering brightness that they had not seen during many weeks of hard travel: "There was a majesty in the lofty groves which now surrounded us, . . . ; and there was music even in the scream of the parroquette that swept over our heads; there was a charm in everything, for we now really felt that our trials were at an end."

Probably in the year 1848 Dr. W. A. Hammond, then stationed with the Army at Fort Riley (Geary County), sent to the Smithsonian Institution bird specimens that included the parakeet (Hume, 1942:178). Ridgway (1916:148) apparently referred to this record when he listed Fort Riley "1857" as one of the definite localities for the species in Kansas—in this, he merely followed Baird et al. (1858:68), who listed a specimen which was sent to W. Couper in 1860 (P. S. Humphrey, letter, 14 May 1963).

S. D. Dyer's daughter, who arrived on the Big Blue River in Riley County in 1853, reported later that in addition to game of all kinds there were ". . . lots of wild parroquets when we first went there, but they soon left" (Anon., 1929:24).

In the period of September-October 1854, the Rev. C. B. Boynton and T. B. Mason rode from Fort Riley to Council Grove, crossing the Kansas River on a ferry (they called it the "Smoky Hill River"). After crossing the river, presumably in Geary County (Boynton and Mason, 1855:114-115), "we entered at once the fine grove of timber on its eastern bank, about two miles in width, as we thought, . . . It was the merriest and finest woodland scene that we had found in Kansas. The trees were of great size, tall and thrifty, while rank vines and shrubbery of various kinds showed the exuberant fertility of the soil." One can see the calculating fingers rubbed together! But a finer side showed also and the diarist mused about the New England countryside and its Blue Jays: ". . . while a flock of paroquets, chattering above us, reminded me that I was not in New England."

Max Greene (1856:105-106), mail carrier on the overland trip toward Santa Fe, recorded that (as must commonly have occurred) as they passed up

the brimming, clear Wakaroose (Douglas–Osage Counties), amid the groves of walnut and cottonwood trees, the kingfisher added his alto to “the concert of chattering paroquets,” while the fairest bird of the prairies, the Swallow-tailed Kite, swept the high sky in graceful circles. E. L. Berthoud (1837:10) apparently found parakeets to be common on the Kansas River as far west as Ellsworth (Ellsworth County) in 1855–56 and recalled that “As late as 1865 I saw a flock on the Smoky Hill three miles above Ft. Ellsworth”—this central Kansas record for what is essentially the Great Plains branch of the Kansas River being seemingly the westernmost report of this species for the state. (Note that Berthoud had reported [Coues, 1877] that the species “was abundant in Kansas in 1865–67, since which year I have seen but few, on Smoky Hill and Republican Forks,” but this rather inexact statement is not entirely substantiated in his more formal account just quoted.) Yet, so far had things changed that J. A. Allen could find no late reports of the parakeet in the Leavenworth and Topeka areas in 1871 (Allen, 1872:130). David Lantz, who was a resident at Manhattan 1878 to 1904, had apparently never seen the parakeet at all, although he had been told they were formerly “common in the heavy timber along the Blue and Kansas rivers” (FWS file).

Doubtless, reports of the parakeet in northern Kansas are to birds seen along tributaries of the Kansas River that flow from the northward. Heinrich Lienhard, marching for California in May 1846, saw parakeets on Big Blue River in northern Kansas (Lienhard, 1961:21). Lienhard was attracted by the loud screaming of green birds in the rather wide wooded strip that bordered the stream: “They were green parrots, the first I had ever seen wild, and the only ones I have ever come across in the United States.” In what must have been the same area (but definitely assignable to Marshall County in this case), William Kelly’s party shot and ate the abundant wild ducks and parakeets in late April 1849 (Kelly, 1851, 1:78).

There seem to be no reports on the bird’s possible presence in western and northwestern Kansas generally. By the time of J. A. Allen’s visit in 1871, at least, there was no information extant on it at Fort Hays.

Seasonal summary for Kansas.—That parakeets did not shun cold is indicated by Abert’s observations of late February and early March; there are, however, no reports for the species in Kansas during November, December, January, and early February. For the “spring” season and the spring months of April, May, and June, there are ten records; for “summer” and July and August, six records; I find no records specifically mentioning September, but one record is for October and two are for “autumn.” Whether one ought to consider the parakeet permanently resident in Kansas or, rather, a very hardy and erratic visitant (with one nesting report), cannot be settled from present evidence.

COLORADO

The checkered history of the parakeet in Colorado, undocumented by a single specimen of the species, began with what seems an acceptable report by E. L. Berthoud of Golden, Colorado, to Elliott Coues in 1876 (Coues, 1877) that: "I saw the Carolina Parrot, at this place (lat. $39^{\circ} 45'$; long. $105^{\circ} 8'$) and at Denver, on the S. Platte, in 1860-61, and on the Little Thompson River, Col., in 1862. . . . I have also seen it near old Fort Lyon, on the Arkansas River." Berthoud (1887:10) later expanded this account somewhat and added what seems to be a very late date of 1877: "In 1860-61 it was seen by me in Jefferson County, repeatedly, in small flocks along Vasquez Fork of Platte river, on Bear creek, St. Vrain [a creek that runs into the South Platte River after crossing Boulder County, just north of Jefferson County], etc. In 1863-4 it was not uncommon on the Arkansas and Huerfano. A few years later it seems to have disappeared, and we did not see one until 1877, when two or three were noticed near Longmont [Boulder County] in a wheat field. Since that time not one has been seen by us in Central Colorado."

Fort Lyon is in Bent County, southeastern Colorado, and on the great Arkansas River which, as has been seen, had many parakeets farther downstream, although there are no reports for the species in adjoining western and southwestern parts of Kansas. Berthoud indicates that the species was found along the Arkansas as far west as the Huerfano River, which flows into the Arkansas in Pueblo County in south-central Colorado.

Golden, however, is in Jefferson County, far into the north-central part of the state; Denver lies just to the eastward; and the Little Thompson, which originates in Rocky Mountain National Park and traverses most of Larimer County to flow into the South Platte, is even more northerly and westerly than Golden. One presumes that the birds must have reached that region by ascending the Platte River, which, of course, does not seem impossible, as there are records of the birds a considerable distance up the Platte.

Drew (1885:17), in a paper on altitudes and birds, merely cited Coues and gave no altitudes on the parakeet; Morrison (1889:67) said that the species was "formerly found in eastern part of the state, but there are no late records," without citing authority; Hasbrouck (1891:378) gave the Coues-Berthoud records of 1877 as the only ones known from Colorado (he obviously had not seen Berthoud's booklet of 1887), and as "the most western record for the species."

It is a little strange that our knowledge of the parakeet in Colorado should rest upon the unelaborated testimony of one observer, but there the matter would doubtless have stayed if Elliott Coues had not uncritically

identified a palpably unidentifiable bird from Zebulon Pike's southwestern journals as a parakeet (Pike, 1895, 2:474). Pike (1810:178), in a diary entry for 25 December 1806, said merely: "Caught a bird of a new species, having made a trap for him." A footnote, presumably added later, expanded the meager information: "This bird was of a green color, almost the size of a quail, and had a small tuft on its head like a pheasant, and was of the carnivorous species; it differed from any bird we ever saw in the United States. We kept him with us in a small wicker cage, feeding him on meat until I left the interpreter on the Arkansaw, with whom I left it. We at one time, took a companion of the same species and put them in the same cage, when the first resident never ceased attacking the stranger until he killed him." Coues simply ran the text and footnote together and supplied an identification (Pike, 1895, 2:474); Hart and Hulbert (Pike, 1932:149) include the basic sentence only—not the footnote—but bracket in the word "parakeet" to identify the species! Pike was at the time near Brown Canyon on the Arkansas River, a few miles above Salida, Chaffee County.

Cooke (1897-1900:81, 152, 162) at first knew only of the Berthoud records as given in Coues (1877), but a later installment of his study of Colorado birds added Pike's allusion on the authority of Coues. The last edition of Coues's great ornithology (1903:616) cited the Pike record of 1806 but not that of Berthoud. W. L. Sclater (1912:215-216) was perceptive enough to realize that the bird of Pike was not a parakeet at all but reckless enough to guess that it might be the Long-crested Jay (a subspecies of Steller's Jay); and A. M. Bailey kindly writes me (letter, 21 January 1963) that Aiken and Warren in their publication on the birds of El Paso County in 1914 took Pike's record to be the first reference to the Roadrunner in Colorado. Oddly, Ridgway (1916:148) accepted both the Berthoud (Coues, 1877) and the Pike reports as valid, although he dated the latter as 1807 in one place. Bergtold (1928:112) and Bent (1940:11) did not credit Pike's account. It needs to be noted that the fifth edition of the American Ornithologists' Union Check-list (1957:267) does not credit any of the Colorado records; Berthoud's work (1837) was not known to the persons making the decision to reverse former stands of the Check-list Committee (A. M. Bailey, recent letter, A. Wetmore, letter, 31 May 1963).

ACKNOWLEDGMENTS

To A. H. Wright's pioneer work (1912) I owe a debt that citations do not discharge, for I have rechecked all his many sources; G. M. Sutton deserves to be remembered for suggesting that this report be written at this time; Margaret M. Nice has my gratitude for recent aid and for having originally written so well on the parakeet in Oklahoma. To the late Paul Hahn I cannot adequately record my personal and professional thanks. I once began a survey of extant specimens of the parakeet but soon discovered that Mr.

Hahn had accumulated far more records than I should ever have been able to find. For the opportunity to check his files, I am grateful not only to him but also to J. L. Baillie, with whom Mr. Hahn was associated at the Royal Ontario Museum. I am equally indebted to the Frank M. Chapman Memorial Fund of the American Museum of Natural History for funds that made possible the visit to Toronto. The same financial aid enabled me to visit libraries in Toronto, Montreal, and Ann Arbor, and to check unpublished records at the Patuxent Research Refuge of the U.S. Fish and Wildlife Service. A. O. Gross of Bowdoin College made his private library available, and I have had valuable help from the Van Tyne Memorial Library of the Wilson Ornithological Society. A. W. Schorger read a preliminary draft of the manuscript and gave me several important references. I wish to thank a host of unnamed museum curators who have patiently searched out for me the data that in some cases they had not supplied to Mr. Hahn.

SUMMARY

This paper summarizes information from various sources on the Carolina Parakeet in Texas, Oklahoma, Kansas, and Colorado. Although the species may have persisted in Texas until the 1890's, there are few satisfactory records for the state. The four specimens extant are either mislabeled or without precise date or locality. Parakeets were present in Oklahoma, with records of some sort assignable to eight months of the year. There are no definite breeding records but specimens are known from southwestern, southern, and eastern Oklahoma, the last being taken in 1882. The last sight record was 1886. Kansas records for the parakeet span most of the months from late February through October, with one breeding report and an abundance of sight records for the eastern half of the state. The only specimens extant are those taken along the Missouri River by Audubon in 1843. Records become scarce after the 1850's although a parakeet was killed, but not preserved, in 1904. No specimens substantiate the presence of the parakeet in Colorado. The only possibly valid sight records of the bird in that state are those of Berthoud, who claimed to have seen the parakeet in central Colorado in the Platte watershed as late as 1877.

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BIOLOGY DEPARTMENT, LAKE ERIE COLLEGE, PAINESVILLE, OHIO, 7 JUNE 1963

NEW LIFE MEMBER

Professor Merrill Wood, of State College, Pennsylvania, and from 1959 to 1963 Treasurer of The Wilson Ornithological Society, has become a Life Member of the Society. Mr. Wood is currently Associate Professor of Zoology at Pennsylvania State University, the institution from which he holds both his B.S. and M.S. degrees. An enthusiastic bird-bander, he is currently serving as President of the Eastern Bird-banding Association, and is also a member of all other bird-banding associations, as well as the American Ornithologists' Union, and the Cooper Ornithological Society. Professor Wood is the author of numerous short articles in *The Auk*, *The Wilson Bulletin*, and *EBBA News*, as well as a Pennsylvania State University Bulletin on "Birds of Central Pennsylvania." Professor Wood has two married children and one grandson. His hobbies include photography, gardening, and stamp collecting.

GENERAL NOTES

Brown-headed Cowbird fledged in Barn Swallow nest.—On 28 June 1960, I found a nest of the Barn Swallow (*Hirundo rustica*) near Berkley, Oakland County, Michigan, under a concrete bridge about 6 feet above the water. The nest was adherent to the vertical face of the concrete, within 2 or 3 inches of the connecting horizontal floor of the bridge and 7 feet back from the direct sunlight. The nest contained 2 young Barn Swallows, about 7 or 8 days old, and 1 cowbird (*Molothrus ater*) of about the same age. The cowbird appeared to be nearly ready to fledge and was much more alert than the two young swallows. It was being fed by both host adults. All three young were banded. No further observations were made.

In a search of the literature, I have found no documented record of parasitic young being found in the nest of this swallow. Friedmann (1963. *U.S. Natl. Mus. Bull.*, 233:59–60) lists five instances of cowbird eggs in the nests of barn swallows.—WALTER P. NICKELL, *Cranbrook Institute of Science, Bloomfield Hills, Michigan, 14 October 1963.*

The effects of probable frostbite on the feet of Mourning Doves wintering in southern Michigan.—For several years, in trapping and later in netting Mourning Doves (*Zenaidura macroura*) for banding, I have been aware of quite pronounced foot defects in many individual birds. In some cases one or two toes on each foot have lacked toenails; in others all toenails were missing; in still others the toes were abbreviated to at least the second joint.

It is a well-known fact that the feet and legs of Mourning Doves are more fleshy and hence more vulnerable to the severities of northern winters than are those of any other species of bird normally wintering in the latitude of southern Michigan. I believe that the foot defects observed are the result of frostbite. This conclusion has been reinforced during the last two winters (1961–62 and 1962–63) when there was more than the usual amount of subzero temperatures. I believe that an individual surviving two or more severe winters may lose all of its toes (Fig. 1) until only stubs remain and that an



FIG. 1. Drawn from life by Betty Odle, 12 July 1963, Bloomfield Hills, Mich.

individual surviving perhaps only one winter shows the effects of frostbite more or less as shown in Fig. 2. These figures were drawn by Betty Odle from the feet of two living birds netted and banded on 12 July 1963 and 17 August 1963, respectively. Both birds appeared to be in good health and both had apparently adapted to their defects, although it is hard to see how the bird shown in Fig. 1 could have perched or walked in a normal fashion. Mourning Doves are known to roost in the fall and winter in thick groves of

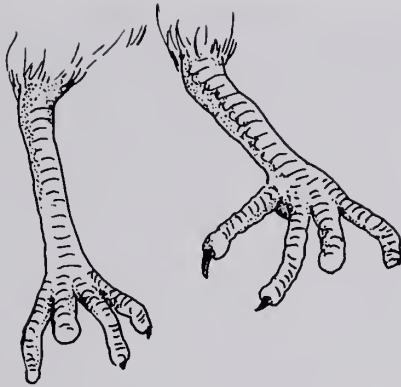


FIG. 2. Drawn from life by Betty Odle, 17 August 1963, Bloomfield Hills, Mich.

conifers, so it is conceivable that perching could have been managed quite well in these overlapping branches, which would easily support the body of the bird.

A comparable case in a mammal is that of the Virginia opossum (*Didelphis virginiana*) which extended its range into Michigan about 1900. This was around the time that Mourning Doves began to be noticed wintering here in any numbers. Most mammalogists recognize that the almost hairless tail and ears of the opossum frequently suffer severe frostbite and abbreviation after a hard winter in southern Michigan.—WALTER P. NICKELL, *Cranbrook Institute of Science, Bloomfield Hills, Michigan, 14 October 1963.*

Nesting association of Pileated Woodpecker and Yellow-shafted Flicker in a utility pole.—An interesting example of interspecific tolerance was exemplified by the nesting in close proximity of a pair of Yellow-shafted Flickers (*Colaptes auratus*) and Pileated Woodpeckers (*Dryocopus pileatus*) in a utility pole. This 52-foot-high, creosote-treated, western red cedar utility pole structure was one of a pair erected in 1947 on the Pennsylvania Electric Company power line, 4½ miles west of Ridgway and ½ mile north of the Clarion River, Elk County, Pennsylvania. The flicker nest, containing 5 eggs, was located at a height of 28 feet above the ground. On 5 May, 1962 at 12:00 M, 2 flickers were observed perched on the cross arm of the pole, pecking and calling. An incubating Pileated Woodpecker on the nest in this pole did not react to this flicker disturbance. An adult flicker was observed leaving the hole at 4:30 PM on 29 May 1962 as the pole was approached prior to examination of the nest contents.

The pileated nest on 9 June 1962 contained three nestlings (2 females and 1 male) estimated to be 12 days of age based on Hoyt's (1944. *Auk*, 61:376-384) age classification. This nest was located 4 feet above the flicker nest hole at 32 feet on the same side of the pole. Both nest entrances faced upslope in a northerly direction.

Kilham (1959. *Condor*, 61:377-387) has observed intraspecific territorial defense by Pileated Woodpeckers. Hoyt (1957. *Ecology*, 38:246-256) reported strife between a nesting pileated and a flicker. However Hoyt (1948. *Auk*, 65:188-196) observed flicker and pileated nests near Ithaca in 1939 on opposite sides of the same nesting stump. No territorial defense or aggressive behavior was observed between a pair of nesting flickers and Pileated Woodpeckers in this study.—SANFORD D. SCHEMNITZ, *School of Forestry, Pennsylvania State University, University Park, Pennsylvania (now at School of Forestry, University of Maine, Orono, Maine), 8 August 1963.*



FIG. 1. An 11-day-old cowbird in nest of Black-throated Blue Warbler. Photographed in Charlevoix County, Michigan, 1 July 1943.

Brown-headed Cowbird fledged in nest of Black-throated Blue Warbler.—On 1 July 1943 I found a nest of the Black-throated Blue Warbler (*Dendroica caerulescens*) at Camp Sherwood, on Walloon Lake, Charlevoix County, Michigan. This nest was at a height of 13 inches in the vertical fork of a sapling sugar maple (*Acer saccharum*) beside a path. In the nest were a Cowbird (*Molothrus ater*) about two days old, a cowbird egg, and one egg of the warbler. A total of nine observations was made through 10 July, when the cowbird fluttered away from the nest into a bush nearby, leaving the two unhatched eggs. Both male and female warblers fed the young interloper. Either one or the other or both hosts were present at all observations and permitted me to approach within 5 feet of them before taking flight. I photographed the nest and the then 11-day-old cowbird on 9 July, the day before the parasite left the nest.

Although Friedmann (1963. *U.S. Nat. Mus. Bull.*, 233:100–101) lists 10 records of Brown-headed Cowbird parasitism on this species, only one of these indicated that the hosts had raised a young parasite in the nest. Hathaway (1913. *Auk*, 30:557), the observer mentioned by Friedmann, saw a female Black-throated Blue Warbler feeding a young cowbird out of the nest near Burrillville, Rhode Island, 26 June 1910.—WALTER P. NICKELL, *Cranbrook Institute of Science, Bloomfield Hills, Michigan, 14 October 1963.*

***Tanagra trinitatis* on Tobago, West Indies.**—The small South American tanager *Tanagra trinitatis* is described by Herklots (1961. "The Birds of Trinidad and Tobago") as occurring rather rarely in Trinidad with not even sight records from the neighboring island of Tobago. We were pleasantly surprised to encounter a male bird on Tobago on 22 February 1963.

The location was near the summit of the Main Ridge of the island where the road from Roxborough across the island to Bloody Bay cuts through the rain forest. We were

at an elevation of 1,400 feet on a woodcutter's path emerging from the forest which at this area had been cut back a few hundred feet from the road. It had been raining gently a few minutes before. The bird flew in to a sapling about 15 feet away and remained in good view for 15 to 20 seconds before flying off along the forest edge. The light was excellent, the bird was in fine plumage and we had ample opportunity to look him over.

To check upon the adequacy of the Herklots descriptions and illustrations one of us examined the skins at the American Museum of Natural History, New York, through the courtesy of Dr. Dean Amadon. There was no possibility of confusion with the related *Tanagra violacea* and we are certain of the identification. Incidentally, Herklots indicates both species as being similar in size; actually, *violacea* is larger by one-fourth.

The authority for the established range of *T. trinitatis* is apparently Hellmayr (1936. Catalogue of the Birds of the Americas and the Adjacent Islands, vol. XIII, Part IX), who states: "Range—Island of Trinidad; northern Venezuela south to the Orinoco Basin, west to the eastern base of the eastern Andes of Colombia." Dr. R. W. Storer has very kindly made available the presently considered range as given in the preliminary manuscript for the unpublished tanager section of Peters' Check-List of Birds of the World, viz., "Northern Colombia, northern Venezuela south to western Bolivia and extreme northwestern Amazonas, and the island of Trinidad."

The water barrier between Trinidad and Tobago is only about 20 miles across, but the trade winds blow rather steadily from Tobago toward Trinidad, apparently increasing the effectiveness of the separation.—NORMAN B. PILLING, 3 Cherry Lane, Westfield, New Jersey, AND ROBERT W. TROWERN, 42 Van Dusen Boulevard, Toronto 18, Ontario, 17 August 1963.

Renesting of a wild pheasant hen.—This paper reports on the establishment of two nests in one breeding season by a wild Ring-necked Pheasant (*Phasianus colchicus*) hen near Sibley, in east-central Illinois. Wild pheasants generally are assumed to renest if the initial nest is destroyed or abandoned but there has been, however, no direct evidence for this phenomenon in wild pheasants. Renesting reported by Errington and Hamerstrom (1937. *J. Wildl. Mgmt.*, 1:3–20), Linder, Lyon, and Agee (1960. *Trans. 25th N. A. Wildlife and Nat. Resources Conf.*, 214–229), Robertson (1958. *Ill. Dept. Cons. Tech. Bull.*, No. 1), and Stokes (1954. *Ontario Dept. of Lands and Forests Tech. Bull., Wildlife Ser.*, No. 4) was based on (1) finding more pheasant nests per unit of land area than adult hens observed on the same area in the early spring, and (2) the higher percentages of hens with broods in the summer than the percentages of all nests that were successful. Seubert (1952. *Trans. 17th N. A. Wildlife Conf.*, 305–329) and Muhlbach (1954. Unpublished M.S. Thesis, Ohio State Univ.) demonstrated that game-farm pheasants in an enclosure established more than one nest during a breeding season when initial nests were destroyed.

A pheasant hen trapped by the nightlighting technique (Labisky, 1959. *Ill. Nat. Hist. Survey Biol. Notes*, No. 40) on 26 September 1962, was marked with a green plastic backtag and released in the field where trapped. The same area, a 20-acre hayfield, was being searched for pheasant nests on 6 June 1963, when the marked hen was observed sitting on a nest.

Two attempts were made, on 8 and 10 June, to capture the hen on the nest for determination of the bird's weight, but she flushed on both occasions. On 11 June, the hen was absent from the nest and one of nine eggs had been destroyed by a mammal. Large blood vessels in the shell membrane and chick feathers indicated the destroyed egg had been in an advanced stage of incubation. On 12 June, the hen again was absent

from the nest. The eggs were collected by the observer and examined; two eggs, which had been destroyed by a mammal, showed signs of advanced incubation, one intact egg had been incubated for 10 days, and 4 intact eggs for 19 days. All embryos were dead. One egg was missing from the clutch.

The hen was found nesting 304 yards south and 168 yards west of the first nest site on 10 July 1963, in a soybean field, and was observed on the nest 15, 19, and 22 July. When the nest was checked on 25 July, it contained one egg that had hatched about 23 July and six eggs that, upon being opened, appeared to be infertile.—JOHN E. WARNOCK AND G. BLAIR JOSELYN, *Section of Wildlife Research, Illinois Natural History Survey, Urbana, Illinois, 16 September 1963.*

Albinism in the Scissor-tailed Flycatcher.—Berger (1956, *Auk*, 73:137-138) states that there are few published records of albinism in the family Tyrannidae. He then gives these records and describes in detail an albino Trail's Flycatcher that he found in Michigan. To this small list of species (Eastern Kingbird, Eastern Wood Pewee, Eastern Phoebe, Trail's Flycatcher) may be added the Scissor-tailed Flycatcher (*Muscivora forficata*).

On 10 July 1961, Mr. and Mrs. John Taylor reported seeing a white flycatcher near Mead, Oklahoma. Later that same day T. R. Linton and I accompanied Taylor to the area in which the bird had been seen. After about one hour's search we found and collected it.

The specimen was a female with a fully ossified skull, but without a distinct brood patch or enlarged ovary. It apparently was adult, for in addition to its ossified skull, its culmen and tarsal measurements were larger than those given by Ridgway (1907, *Bull. U.S. Nat. Mus.*, no. 50, part IV, pp. i-vi, 973) for adult females; it was undergoing a body molt (probably postnuptial); its rectrices and remiges were much worn or broken: It appeared to be adept at catching insects.

The feet were pinkish white, and the beak was white, but the eyes were dark as in the Trail's Flycatcher and some of the other species listed by Berger. The plumage is entirely white except for the following feathers or areas: all but the outer one or two primary coverts on both wings are normally colored as are the second and third primaries of both wings; the fourth and fifth pairs of rectrices are also normally colored; the left second rectrix (a newly molted feather) is black subterminally with a narrow white tip; a single upper tail covert on the left side is tipped with black; the crown patch, a few feathers on the mantle, and the axillars are nearest to a pale orange yellow (color chart of the "Handbook of North American Birds").

The specimen is no. 5248 in the University of Oklahoma Museum of Zoology.—J. DAVID LIGON, *Department of Biology, University of Florida, Gainesville, Florida, 5 July 1963.* (Present address: *Department of Zoology, University of Michigan, Ann Arbor, Michigan*)

Sight record of the Glossy Ibis for the Bass Islands, Lake Erie, Ohio.—On 26 June 1963, an adult Glossy Ibis (*Plegadis falcinellus*) was seen in a Black-crowned Night Heron (*Nycticorax nycticorax*) rookery on North Bass Island, Ottawa County, Ohio. The bird was sighted by Putnam and Maxwell flying over the marsh at a distance of 50 meters. It made two passes, providing a good chance for identification with 7 × 35 binoculars. A pair of Glossy Ibis was spotted on 5 July 1963 over the same marsh by Maxwell and Tilley. The birds have not been seen on subsequent trips to the marsh. No previous record for this species in Ottawa County, Ohio, can be found in the literature.—LOREN PUTNAM, GEORGE MAXWELL, AND STEPHEN TILLEY, *Franz Theodore Stone Laboratory, The Ohio State University, Put-in-Bay, Ohio, 15 August 1963.*

Whimbrel: first specimens for Kansas.—On 22 May 1963, at Cheyenne Bottoms, Barton County, Kansas, H. A. Stephens, Larry Darling, and I saw two Whimbrels (*Numenius phaeopus*) standing side by side in shallow water among spike rushes. Marvin D. Schwilling of the Kansas Forestry, Fish and Game Commission, joined us in pursuit of the birds and through combined efforts we collected them—the first specimens for the state. Both proved to be males (testes: left 14.0×10.0 mm, right 11.0×9.0 ; and 12.0×9.0 , 12.0×10.0 , respectively).

The species had been seen at Cheyenne Bottoms several times earlier in 1963. Stephens noted a single bird on 24 April and two birds together on 30 April. Schwilling noted two birds together and a single bird, on 13 May. Stephens and I saw a flock of 11 birds on 17 May; on the 18th we watched a single bird rise from the ground and join five more in a northerly flight. Other sight records for the state, though few in number, date back 70 or more years (N. S. Goss, 1891. History of the Birds of Kansas, G. W. Crane & Co., Topeka). The species can be rightly called an uncommon transient in Kansas. The two specimens are in the Biology Department Museum at Kansas State Teachers College, Emporia.

These observations were made as part of joint research studies being conducted by the University of Oklahoma and Kansas State Teachers College, and financed by the National Institutes of Health (Project AI 05232-01).—DAVID F. PARMELEE, *Biology Department, Kansas State Teachers College, Emporia, Kansas, 15 August 1963.*

ORNITHOLOGICAL NEWS

The Treasurer of the Society, C. Chandler Ross, reports a most gratifying response to the appeal for new Life Memberships which accompanied the 1964 dues notices. Thirty-five persons responded affirmatively and the Society's Life Members now number 235.

The National Science Foundation announces that the next closing date for receipt of proposals for basic research in the Life Sciences is 1 May 1964. Proposals received prior to that time will be reviewed at the summer meetings of the Foundation's advisory panels, and disposition will be made approximately four months following the closing date. Proposals received after 1 May will be reviewed following the fall closing date of 15 September 1964.

Inquiries should be addressed to the National Science Foundation, Washington, D.C. 20550.

The interest and competence of WOS members extends beyond the field of ornithology as evidenced by two recent books. Andrew J. Berger of the University of Michigan, and a member of the *Bulletin* Editorial Advisory Board, has just published a book "Elementary Human Anatomy" (John Wiley & Sons, 1964) and Allen H. Benton of The State University of New York, Fredonia, New York is co-author of "Keys to the Vertebrates of the Northeastern States" (Burgess Publishing Company, 1964).

A sum of \$670.00 is available in the *Josselyn Van Tyne Memorial Fund* for research grants in 1964. Any student of birds is invited to apply. Young men and women just starting their careers or others not eligible for government grants are particularly encouraged to apply.

Applicants should prepare a brief but comprehensive description of their research project specifying the objectives and proposed plan of procedure. Particulars of the type and amount of financial assistance needed must be indicated. A brief statement of the applicant's ornithological background should be appended. Letters of recommendation from one or more recognized ornithologists would be helpful.

Applications should be submitted not later than 1 April 1964 to the Chairman of the A.O.U. Research Committee, John T. Emlen, Department of Zoology, University of Wisconsin, Madison, Wisconsin.

It is with deep regret that we learn of the death of Dr. Arthur A. Allen, on 17 January 1964, at his home in Ithaca, New York. Dr. Allen, who was known to all American ornithologists as a teacher, writer, and photographer, had been a member of the Wilson Society since 1914.

ORNITHOLOGICAL LITERATURE

AN INTRODUCTION TO ORNITHOLOGY. By George J. Wallace. The Macmillan Company, New York, 1963: xiii + 491 pp., 205 figs. \$8.95.

The first edition of Wallace's widely used text has been completely revised, but it remains unaltered in aim: the college or university undergraduate course in introductory ornithology. In 1955, when the first edition was published, it had little competition. Now there are a number of books in the field, but examination shows them to range from those oversimplified and thus somewhat inaccurate through those entirely adequate but of length unsuited to a single course to texts which are too advanced for the first college course.

Publishing delays held the book up until 1963. Actual content revision ceased, to judge from the "Literature Cited" section, in early 1961. There are only nine 1961 citations. That the author kept his material as up to date as possible is indicated by the fact that almost half of the citations are from the period 1957-61.

This book is divided into two parts. The first part consists of 14 chapters with 384 pages; the second part is of three chapters and 50 pages. For teaching, Part I could be easily adapted to either a quarter or a semester. The first chapter surveys the history and current status of bird study, and includes sections which give recognition to such facets of ornithology as daily lists, annual lists, life lists, and the Christmas Count. These are activities which are too often dismissed humorously as "bird golf." Since these are the very activities which frequently lead young, and not-so-young, people into a lifetime of professional ornithological work, it is pleasant to find them carefully and sympathetically described.

Following this introductory chapter, the bird is treated in terms of its characteristics, origin, and classification; external features and their adaptations; internal features and their functioning; locomotion; sense organs and endocrines; and behavior. The chapters on locomotion and on behavior are new; the others are thorough revisions of similar chapters of the first edition.

The next four chapters are devoted to the annual cycle and migration. The importance of the annual cycle in the bird is stressed by the length of these chapters. When the first edition was published, there was some question raised as to the necessity for a separate chapter on migration, the argument being that as it is an integral part of the annual cycle it should be treated in the appropriate places. Wallace has continued to maintain a separate chapter, in which he treats migration *as* migration: problems of origin, regulation, orientation, and mechanics. Insofar as migratory behavior is directly involved in other aspects of the annual cycle, it is treated in the appropriate places. There is little duplication.

Part I concludes with three chapters on the distribution of birds, their food habits, and their economic relations. It is unfortunate that the material on conservation and management so very logically fits at the end of this section of the book, where it will normally be skimmed due to the lack of time that occurs at the end of every course. The material in it, on land use, drainage, pollution, and pesticides, as well as the practical information on feeding, housing, and attracting birds, is precisely the material that students will most frequently be questioned about in their private or public lives as citizens, parents, and teachers. It is also unfortunate that considerations, perhaps of space limitation, or perhaps the author's own judgment of how much he should intrude himself into his text, prevented a fuller and more dramatic account of the DDT studies in which Dr. Wallace has been so deeply involved in Michigan.

Part II could as easily have been treated as an appendix. Its three chapters are: a classification of orders and families of birds of the world, following Wetmore, but with citations to other arrangements; a chapter of ornithological methods; and finally a chapter devoted to ornithological societies and journals. In the classification, distinguishing characteristics are given for all nonpasserine families, and for all North American passerine families. The material on methods includes field identification, by sight or sound, as well as brief accounts of skin preparation, field studies, and banding. Incidentally, Blake's manual on field preparation of study skins is available, Wallace's statement to the contrary. The Chicago Natural History Museum Bookstore carries it.

A few errors should be pointed out. Most are typographical, such as the reference to Whitaker, 1957b, with no 1957a listed. Apparently an item was dropped. In the legend for Figure 67, p. 113, "glinding flight" is not a new type of flight, but rather is something which should have been caught in proof. More serious is the error in Figure 45, p. 76. Here the same sort of structure is labeled both as narrow red fiber and as capillary. The indicator line from the label "capillary" is misdirected. In the original *Auk* article the structures were not labeled.

Most of the errors have resulted from the complete newness of the book. It is not simply a corrected copy of the first edition. There is one place where I wish Dr. Wallace had revised the first edition. On page 163 he has continued to give a map of a hypothetical set of territories, in conjunction with his exposition of territoriality. There has been enough published on territory in birds so that he easily could have found just as simple and a more meaningful *real* example of territoriality.

These minor criticisms aside, here is an excellent textbook of elementary ornithology, attractively presented, that is well worth consideration by anyone who is teaching such a course. The book would also make an excellent and useful addition to the library of any amateur who has a serious interest in birds.—ORMSBY ANNAN.

THE BIRDS. By Roger Tory Peterson and the Editors of *Life*. Time Inc., New York, 1963: 8½ × 11 in., 192 pp., 192 illustrations, 64 in color. \$3.95.

With all the bird books that have been published in recent years, this new *Life* Nature Library volume on "The Birds" succeeds in handling the subject in still a somewhat different manner. Brief though the treatment is of the varied topics discussed, the writers have done well at hitting the pertinent high points and have brought the subject treatments well up to date. The most outstanding feature of the volume is, as one might expect from a *Life* magazine publication, the illustrations. It is obvious that no expense or effort has been spared in securing top-ranking photographs, diagrams, paintings, and marginal sketches to illustrate the discussions. The art work of Roger Tory Peterson, of course, does much to maintain this high standard of illustration, but his photographic skill as well as his writing ability also shows up in a distinguished manner.

The rather unusual coverage in this volume appears in the chapter headings: From Archeopteryx to Sparrow, What it Takes to Fly, Birds as Food Gatherers, How Many Birds?, The Riddle of Migration, How Birds Communicate, From Egg to Adult, and Toward a Balance with Man. These treatments, of course, do not pretend to constitute a textbook but the book is a good example of today's tendency to digest and condense subjects for the casual reader, a reader perhaps who has neither the time nor the depth of interest to spend long hours delving into the subject. The format follows that of previous volumes in the series. Each chapter begins with a text taking up about half the space devoted to the subject and credited to the authorship of Roger Tory Peterson.

The latter half, under an appropriate subheading, includes the illustrations with often whole paragraphs of explanatory titles authored by members of the editorial staff of *Life* magazine. The text is set in a narrow type bed, leaving space for the numerous well-designed and executed explanatory drawings in the wide margins. All the illustrations are carefully credited to individuals in a condensed half page. Acknowledgments on the same page include a host of authorities whose help was enlisted in compiling the book. An index of nearly five, four-column pages gives an excellent coverage of the materials, with italics referring to illustrations. A bibliography on another four-column page includes 72 references classified into subjects including several 1962-63 references. These seem well selected for the use of the readers for whom this book is intended.

In a digest of broad fields of information such as this nearly every reviewer will probably point out omissions that appear important to him. In his discussions of pesticides' effects on birds, editor Peterson fails to mention Rachel Carson's book "Silent Spring." Although I find Miss Carson's book expressing some exaggerations and distortions, I still consider that this book holds a leading position in arousing the public to the seriousness of this problem and deserved a mention. I note that its 1962 publication date predates some of the references in the bibliography.

I have scrutinized both the text and illustrations for errors and find them nearly flawless. However, on page 38 in the drawings of the grebe foot the right-hand figure (c) fails to show the broad structure of the leg as well as the foot as viewed from the side, an important detail in explaining the efficient form of this superb swimming organ. Also credit for the very good penguin photograph on page 93 was overlooked.

The last chapter, "Toward a Balance with Man," touches on numerous subjects such as primitive man's use of bird feathers as decorations, domestication of poultry, hunting of game birds, disease transmission by birds, and others not ordinarily mentioned in most bird books. The fourth chapter, "How Many Birds," also stresses total populations and numbers of species more than do most bird books.

From ordinary photographic standards certain illustrations might be considered unacceptable. One of these, the Fairy Tern on the cover, I feel is well chosen for the purpose. One excellent photographer commented that he would have thrown away the tern shot on page 32, but as an effective suggestion of rapid flight to introduce the chapter on "What It Takes to Fly" it serves beautifully. Particularly striking photographs in the volume are: the Starlings on pages 30 and 31, the flying flamingo pattern on pages 96 and 97, the warbler-cuckoo (although I feel the "warbler" should have been further identified) on page 153, and the drumming Ruffed Grouse on page 119. Several should be commended for showing actions particularly difficult to photograph: the Bobwhite in flight on page 49; the pelican catching a fish under water on page 67; the woodpecker's tongue inside of the bark of a tree on page 68.

My feeling is that this book will be very effective in drawing the casual reader into a better understanding of the interesting and complex nature of ornithological study and may very well succeed in adding many readers to the rapidly growing fraternity of serious bird watchers.—W. J. BRECKENRIDGE.

NOTES ON THE BIRDS OF GREAT SMOKY MOUNTAINS NATIONAL PARK. By Arthur Stupka. University of Tennessee Press, Knoxville, 1963: 8½ × 5½ in., vii + 242 pp. \$3.00 (paperbound).

Within the limitations of its geographic scope, it is difficult to avoid unrestrained praise for this checklist. At the very outset the author enumerated the kinds of information to

be presented, then stuck doggedly and faithfully to his task. The nine points of coverage include status in the Park area, altitudinal range, migration dates, nesting data, quantitative data from Christmas and breeding-bird counts, and ceilometer kills at the nearby Knoxville airport. References to subspecies appear as footnotes.

Also found in the Introduction are descriptions of the area, its climate, and its flora, as well as an account of its ornithological history. Records specifically cited in the species accounts are, in many cases, credible sight records of observers mentioned in the historical account. The accounts were also based, however, on more than 500 collected specimens, most of which predated the establishment of the Park.

In the discussion of the flora, it is heartening to find a top-notch field man with experience in a critical area referring without apology to life zones. The presence of a Canadian Zone in the Great Smoky Mountains is substantiated not only by the breeding of the Saw-whet Owl, Red-breasted Nuthatch, Brown Creeper, Winter Wren, and other boreal species, but also by the fact that at the higher altitudes "59% of the woody plants are made up of northern species" (Cain, 1930).

Although I could find no reference to the total number of species recorded in the Park, it was a distinct surprise to one familiar with its almost complete lack of open water to learn that 46 species of water birds had been seen there, including four species of geese. The accounts of some water birds (e.g., Laughing Gull and Sooty Tern) make fascinating reading, as do most of the species accounts for that matter.

Other valuable bits of information are contained in the Appendixes. There are ten pages of specific localities and their altitudes; three pages giving full names of contributors who are mentioned in the text; a list of 179 references cited in the text; and a list of the common and scientific names of all plants mentioned in the text. The Species Index includes both common names and scientific binomials of birds, as well as the scientific names of their families. No omissions were noted.

In consideration of the wealth of valuable information so masterfully presented, it is picayune to mention minor flaws or any omissions which some may consider unjustified. Those who would like the above features combined with a field guide will learn in the first sentence of the Introduction that this is not such a book. True errors are few and far between. One which should be pointed out concerns the extension of breeding range of Traill's Flycatcher into Tennessee in 1958 "southward from West Virginia, Maryland, and eastern Pennsylvania." Although this statement was correctly attributed to the AOU *Check-list* (1957), the breeding of this species in Virginia was reported in *The Auk* in 1947 and in North Carolina, with specimen support (loc. cit.) in 1958. Even this minor *lapsus*, however, was concerned with extralimital records. There are far too few such errors to detract materially from the general excellence of the work.—HENRY M. STEVENSON.

THE HAWKING OF JAPAN: The History and Development of Japanese Falconry. By E. W. Jameson, Jr. Published at Davis, California, by the author, 1962: 7 × 10½ in., [xii] + 97 pp., decorative chap. headings, 19 figs., 10 pls. (5 col.), front. (col.). \$15.00.

What we know of falconry as practiced in past centuries is dependent on those rare scholars who, familiar with the sport, have a flair for working with unfamiliar languages and a dedication to searching among "forgotten" archives. One such person was Dr. Casey A. Wood. I can think of no greater labor of love than his translation of "De Arte Venandi cum Avibus" by Frederick II of Hohenstaufen, published under the title "The Art of Falconry" by Stanford University Press in 1943. Perusing this 637-page volume

I never cease to marvel at the storehouse of knowledge he made available to us from the Latin, penned in the 13th century.

In a more modest but no less commendable degree Dr. Jameson, Professor of Zoology at the University of California in Davis, has made available to us a knowledge, hitherto unknown in the West, of falconry as practiced in Japan from as far back as 650 bc. His material, obtained from visits with many falconers, observations on their methods and gear, and information from old books and scrolls, is presented in seven chapters: History of Hawking in Japan, The Sporting Hawks of Japan, Housing and Equipment, Methods of Obtaining Hawks, Manning and Training, Consumption, and Daily Care. We find, as we read these chapters, that the Japanese show the same precision and sensitivity in falconry that they do in many other pursuits.

The raptors used in Japanese falconry include the Peregrine Falcon, Pigeon Hawk, and Goshawk, which are among the same species employed by North American and European followers of the sport, the Hobby (*Falco subbuteo*) and Eurasian Sparrow Hawk (*Accipiter nisus*), which are also employed by Europeans, and two additional species unknown to Westerners, namely, the diminutive Besra Sparrow Hawk (*Accipiter virgatus*) and the powerful Hawk-eagle (*Spizaetus nipalensis*). The latter is the largest raptor regularly trained in Japan. Although considered too large and slow to capture birds, it "can kill a hare (*Lepus brachyurus*) with apparently little exertion and trained birds occasionally take foxes, raccoon dogs, and marten."

Dr. Jameson has managed to inject considerable lore about the traits and behavior of the raptors concerned, especially of the Goshawk, which is the classic and most popular hunting hawk in Japan. His text, however, is essentially about falconry for falconers.

The book is artfully designed and printed, attractively and sturdily bound. Admirers of Nipponese paintings will enjoy the hunting scenes (Color Plates 3 and 5), exquisite in tone and delicacy. No doubt this volume will soon be a collector's item, as only 500 copies were printed.—OLIN SEWALL PETTINGILL, JR.

EXOTIC BIRDS: Parrots, Birds of Paradise, and Toucans. Text after François Levaillant (translated by Eric Mosbacher). The Viking Press, Inc., New York, 1963: 11 $\frac{7}{8}$ × 16 in., 16 col. pls. with unnumbered text pages between. \$12.50.

This sumptuous production consists essentially of 16 color plates from the "Histoire Naturelle des Oiseaux," published between 1796 and 1812 by the explorer François Levaillant. Sixteen of the plates are by Jacques Barraband, the other two are by Auguste, about whom, we are told, little is known.

The plates have been handsomely reproduced on heavy, flat-white paper. The subjects themselves, each perched on a pedestal without background, consequently stand out with stark clarity. Since the birds depicted are notable for their bright colors and, in the case of the birds-of-paradise, elaborate plumes, the plates are indeed eye catching, if not spectacular. As in most bird illustrations prior to Audubon, the birds have the stiffness of mounted specimens complete with staring, glass eyes, but this fault fails to detract from their decorative value.

Only to the extent of showing what 16 different kinds of birds look like is the book an ornithological contribution. The text consists for the most part of brief remarks on the birds shown, usually on their form and colors, which are already obvious. The species are designated solely by vernacular names and little, sometimes nothing, is said about distribution. One of the 16 "exotic birds" is none other than our Blue Jay with an eye

as blue as its plumage. Compared to the other 15 birds in the book, the Blue Jay is pitifully somber, even with the colorful eye that it should not have.

I agree with the suggestion on the flyleaf of the jacket that this will be highly regarded by every lover of old prints. No doubt many copies of the book will come into the hands of interior decorators, the plates to be torn out and used to embellish new bank lobbies, motel bedrooms, waiting rooms in dental offices, and so on.—OLIN SEWALL PETTINGILL, JR.

THE WILD DANUBE: Portrait of a River. By Guy Mountfort. Illustrated by Eric Hosking. Houghton Mifflin Company, Boston, 1963: $6\frac{5}{8} \times 9\frac{3}{4}$ in., 207 pp., line drawings by Penelope Gillespie, 56 pls. (130 photos.), front. (col. photo.). \$6.00.

Guy Mountfort, one of Britain's distinguished ornithologists, is an entertaining teller of personal adventures. In "Wild Paradise" he wrote about the three expeditions that he led to the fabulous Cota Donaña in the wilds of southern Spain. Here he gives us another narrative, this time of two more recent expeditions under his leadership to Bulgaria and Hungary. Lying behind the "Iron Curtain," these countries are unfamiliar to most present-day travelers and naturalists from the West; thus, the book is in many respects a revelation.

Both Bulgaria and Hungary have quiet, romantic countrysides, lofty mountains, mirrored lakes, deep forests, and fine marshes, all supporting a rich fauna and flora. But travel is not for the comfort loving since tourism is generally undeveloped and still based on the premise that all men are equal. Visitors from the West are suspect, and if they are so peculiar as to be ornithologists and bird photographers, they are apt to be under surveillance much of the time. Even so, Mountfort and his associates were treated kindly and offered cooperation willingly by fellow naturalists and most other people, particularly those residing in country districts.

In telling his story Mountfort has the knack of interspersing his brisk accounts of ornithological exploits with fascinating notes on the history, geography, and economy of the areas visited, with numerous experiences and problems—humorous or otherwise—in reaching different destinations, and with observations on the people, their way of life, and their political philosophies. "The Wild Danube" should satisfy most anyone interested in birds, people, and adventure in places that are off the beaten path. The generous representation of Eric Hosking's photographs in appropriate places throughout the text adds substantially to the realism of the narrative.

Concluding the book is an appendix listing the birds (by both common and scientific names) noted during the expeditions and giving their status in the regions visited, a selected bibliography, and a good index.—OLIN SEWALL PETTINGILL, JR.

THE SONG OF WILD LAUGHTER. By Jack Couffer. Simon and Schuster, New York, 1963: $6\frac{1}{4} \times 9\frac{1}{4}$ in., 190 pp., many photos. \$5.00.

With the happy combination of professional interests in both biology and the cinema arts, Jack Couffer was ideally qualified as a cameraman for Walt Disney's "True Life Adventure" series. Here he relates some of his experiences while filming for Disney such widely diversified subjects as seals and tortoises in the Galápagos Islands, a dog and a black bear cub in the Canadian Rockies, a trained Golden Eagle and a pet bobcat in the Grand Canyon, bats in a Texas cave, Adélie Penguins in Antarctica, trap-door spiders in a vacant lot in Los Angeles, Chinook salmon in the Columbia River, and gray wolves in Arizona. From an ornithological viewpoint, the highlight of his experiences was find-

ing an albino Adélie Penguin and observing the extremely aggressive behavior shown toward this bird by the other penguins in the colony.

Couffer discovered early in his cinematic career that the eye of an animal "is the point on which to focus, the target of the camera. . . . If the eye alone is sharp, everything else will appear to be in focus. . . . Keep the lens trained and sharp on an animal's eye, and through it he [the animal] will reveal himself. . . . It is the eye which is all-expressive, the key to individuality."

The writing is quick paced and spiced with good humor; descriptions of episodes are not over dramatized. Attention is given mainly to the animals and the author's experience with them. Problems concerning photography and the techniques employed and the successes and failures in meeting the objectives of the camera work are mentioned only now and then. Essentially this is a book about animals, not photography.

Unfortunately the title of the book, taken from the epilogue wherein the author refers to the vocal sounds of the Tasmanian Kookaburra as "the song of wild laughter," gives no clue to the contents of the 10 chapters. The book is liberally illustrated with the author's photographs, all of them fine but, except in four instances, without captions.—
OLIN SEWALL PETTINGILL, JR.

THE LONG-SHADOWED FOREST. By Helen Hoover. Thomas Y. Crowell Company, New York, 1963: 5½ × 8¼ in., [x] + 272 pp., numerous marginal line drawings by Adrian Hoover. \$4.95.

"The Long-Shadowed Forest"—how provocative! My love for the Gunflint Trail in northeastern Minnesota will be enhanced by thinking of its wildness as the long-shadowed forest. That is a spell-binding title.

The book is spell binding too. It is not another "We Took to the Woods"—it is not a chronicle of personal adventure in the wilderness. Neither does it have the mysticism with which Sigurd Olson approaches nature in "Singing Wilderness" and "Listening Point." Rather it is the day-by-day forest, throughout the seasons, seen through Mrs. Hoover's eyes.

And what quick and penetrating eyes she has. Nothing seems to escape them. She sees the great trees and forest animals, but she also notices such minutiae as fungi and lichens, strange insects, tiny plants, snow patterns. Of frost decorations on the lake's ice sheet, she writes that the "frost buds grew—into acres of crocus-like 'flowers,' and finally into frost 'roses' as big as cabbages, their frail petals made of the delicate and ephemeral crystals."

She has evidently read widely and she gives the reader the results of her scientific studies as well as details from her personal experience. Perhaps at times she falls into a school-teacherish vein. But not for long; her enthusiasm and joy in all the aspects of the wilderness save her from that.

What I enjoy most of all in her book is her feeling for color, being a confirmed color addict myself. She is conscious of the most subtle gradations ("The first light reveals the trees and brush as greenish gray shapes, primordial predecessors to themselves"), and of the most minute flashes ("The moths rest with silver-dusted wings against the screen, their eyes reflecting pink and yellow from the tantalizing light of my lamp"). On the other hand, she can *deluge* one with color, as when she writes, "Our trail upon the water lies behind us, gradually turning from turquoise to green. The slanting light is darkening from white to saffron to bronze, and details of the shore stand out in amber-traced clarity. The waves are green now, their patterns and droplets glowing like melted copper."

Mrs. Hoover is an ardent conservationist, of course, and her remarks are all the more effective in that they are scattered throughout the book, not presented as a set plea. She and I share a love for the profound silence this border wilderness once had, and a horror at its disappearance. For she tells of sitting on her shore at dawn to watch the mother-of-pearl mists rising. Suddenly two boats appeared. "QUIET, ISN'T IT?" rang out from the farther boat. "YEAH. AWFUL QUIET," bellowed the steersman of the second.—FLORENCE PAGE JAUQUES.

THE WONDERS OF WILDLIFE: Nature Observed in 280 Pictures. Compiled by Franz A. Roedelberger and Vera I. Groschoff; English version by Mary Phillips and Peter Whitehead. The Viking Press, Inc., New York, 1963: 8 $\frac{5}{8}$ × 9 $\frac{3}{4}$ in., [liv] + 232 pp., 280 photos. (24 col.). \$8.50.

I find it hard to imagine how an album of natural-history photographs, so many in number, could be more superbly produced at such moderate cost than this one, printed in Switzerland. All the color and many of the more striking black-and-white shots are full page; they and practically all the other photographs, regardless of how much of the page they occupy, are bled. The consequent effect is one of greater size and more freedom of the subjects. Had the volume been higher to accommodate larger pictures, I doubt that the pictures could have been more greatly appreciated. As it is, we have a top-notch pictorial work that will fit ordinary bookshelves, will not have to be kept on its side or put in some odd, out-of-the-way place.

The subject matter, mostly European and photographed by Europeans, runs the gamut of wildlife from lowly invertebrates to birds and mammals. Birds are generously represented. The color plates, every one of them, are among the best I have ever seen anywhere. Besides a caption for each picture, there is usually an accompanying brief text pertinent to the subject, intelligently and concisely written, informative, and commendably authoritative.—OLIN SEWALL PETTINGILL, JR.

This issue of *The Wilson Bulletin* was published on 31 March 1964.

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SUGGESTIONS TO AUTHORS

Manuscripts intended for publication in *The Wilson Bulletin* should be neatly type-written, 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.

PLAN TO ATTEND THE 1964 ANNUAL MEETING

The 1964 meeting of The Wilson Ornithological Society will be held from Thursday to Sunday, 30 April to 3 May 1964 at Western Michigan University, Kalamazoo, Michigan. Sponsoring groups are Western Michigan University, Kalamazoo College, Kalamazoo Nature Center, Michigan Audubon Society, and Audubon Society of Kalamazoo. Dr. Richard Brewer is chairman of the Local Committee for Arrangements.

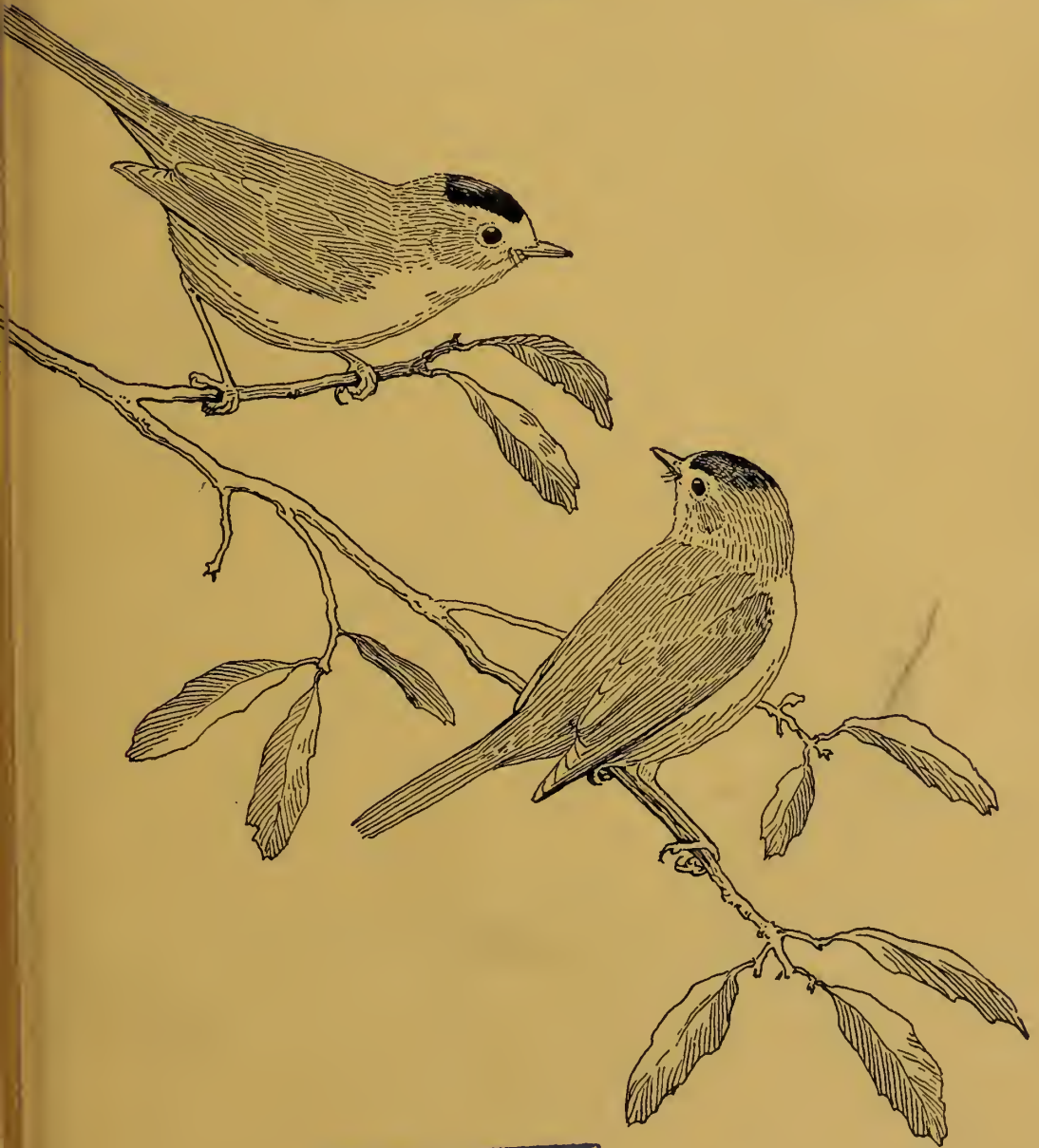
The meeting will open Thursday evening with a reception and a display of bird art at the Kalamazoo Art Center. The papers sessions on Friday and Saturday will include a symposium organized by Dr. Olin S. Pettingill, Jr., on Great Lakes hawk flights. Friday and Saturday morning field trips will concentrate on spring warbler migration, and one of the Sunday trips will be to such ecologically historical areas as the Lake Michigan sand dunes and Warren Woods.

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FOUNDED DECEMBER 3, 1888

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Elected Council Members—Kenneth C. Parkes (term expires 1965); Harvey I. Fisher (term expires 1966); William W. H. Gunn (term expires 1967).

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 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 Museums, 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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Pages 109-208

BALD EAGLES WINTERING IN THE SOUTHERN GULF ISLANDS, BRITISH COLUMBIA	<i>David Hancock</i>	111
ADDITIONAL OBSERVATIONS ON WINTER BALD EAGLE POPULATIONS: INCLUDING REMARKS ON BIOTELEMETRY TECHNIQUES AND IMMATURE PLUMAGES	<i>William E. Southern</i>	121
THE SUMMER BIRDS OF THE TOXAWAY RIVER GORGE OF SOUTHWESTERN NORTH CAROLINA	<i>James F. Parnell and Thomas L. Quay</i>	138
ADDITIONAL RECORDS OF AVIAN EGG TEETH <i>Kenneth C. Parkes and George A. Clark, Jr.</i>		147
NOCTURNAL ROOSTS OF MIGRATING SHOREBIRDS	<i>Jeff Swinebroad</i>	155
THE EVOLUTION OF DIVERSITY IN AVIAN TERRITORIAL SYSTEMS	<i>Jerram L. Brown</i>	160
REPRODUCTIVE DISPLAYS OF THE WARBLING VIREO ...	<i>David W. Dunham</i>	170
JOHN JAMES AUDUBON AND JUVENILE EVENING GROSBEAKS	<i>Benjamin M. Shaub</i>	174
NOTES ON THE DESTRUCTION OF BANDED EVENING GROSBEAKS IN QUEBEC IN 1960	<i>B. M. Shaub</i>	179
GENERAL NOTES		
A ROOSTING AREA OF THE BALD EAGLE IN NORTHERN UTAH ...	<i>John F. Swisher, Jr.</i>	186
UNSEASONABLE RECORD OF GANNET IN NORTH CAROLINA	<i>William H. Adams</i>	187
OBSERVATIONS ON SUN-BATHING IN THE YELLOW-BILLED CUCKOO	<i>Joel Lester Craycraft</i>	187
MIGRATION AND HABITAT OF THE LONG-BILLED DOWITCHER ON THE COAST OF GEORGIA AND SOUTH CAROLINA	<i>Ivan R. Tomkins</i>	188
NEST-SITE SELECTION IN THE AMERICAN REDSTART	<i>Millicent S. Ficken</i>	189
PREDATION UPON FLIGHTLESS DUCKS	<i>Lewis W. Oring</i>	190
ORNITHOLOGICAL NEWS		191
JOSELYN VAN TYNE MEMORIAL LIBRARY		192

SPECIAL REVIEW, <i>Animal Species and Evolution</i> , by Ernst Mayr. Reviewed by <i>Kenneth C. Parkes</i>	193
ORNITHOLOGICAL LITERATURE	204
Richard R. Graber and Jean W. Graber, <i>A Comparative Study of Bird Populations in Illinois, 1906-1909 and 1956-1958</i> , reviewed by William E. Southern; Marston Bates, <i>Animal Worlds</i> , reviewed by Olin Sewall Pettingill, Jr.; Lillian Grace Paca, <i>The Royal Birds</i> , reviewed by Olin Sewall Pettingill, Jr.; Allan W. Eckert, <i>The Great Auk</i> , and Robert Murphy, <i>The Peregrine Falcon</i> , reviewed by Eleanor Rice Pettingill; Owen J. Gromme, <i>Birds of Wisconsin</i> , reviewed by Edward F. Dana.	
PUBLICATION NOTES AND NOTICES	208

BALD EAGLES WINTERING IN THE SOUTHERN GULF ISLANDS, BRITISH COLUMBIA

DAVID HANCOCK

THIS study represents the first attempt to census regularly the wintering Bald Eagles *Haliaeetus leucocephalus* in the southern Gulf Islands, British Columbia. Data were also collected on the feeding and hunting habits of the wintering eagles. In 1961 the National Audubon Society initiated its 5-year Continental Bald Eagle Study. This North American survey was prompted largely by the alarming decrease in numbers of the eastern Bald Eagle in recent years. The studies of Broley (1947), Howell (1962), and others have amply pointed out the plight of this great bird in the eastern United States. More recently Southern (1963) conducted a survey of the Bald Eagles wintering along the Mississippi River in northwestern Illinois. No similar studies have been conducted on the west coast prior to the Continental Bald Eagle project, or to my study.

Murie (1940 and 1959) described the food habits of the eagles of the Aleutian Islands, and Dixon (1909) gives a brief history of the Alaskan birds. Brooks (1922) and Munro (1938) presented a few of their observations on the feeding and hunting habits of Bald Eagles in British Columbia. Less important notes on individual sightings, nestings, and feeding incidents complete the literature on this species on the west coast.

METHOD

Fifteen aerial counts, involving 24 hours and 15 minutes of flying time, were conducted over the area (Fig. 1) from 26 September 1962 to 18 April 1963. In addition, 130 hours were spent on ground observations. The study area (shown in Fig. 1) is encompassed by 48°33' and 48°45' north latitude and 123°30' and 123°15' west longitude. This represents those southern Gulf Islands lying east of the Saanich Peninsula, Vancouver Island, B. C., and west of the United States border. About 50 square miles of land and water were covered. The two-member flight crew consisted of an observer-recorder, and myself as pilot-observer. A two-seater seaplane (Luscombe) was used. The flight speed varied from 75–100 mph. The aircraft was flown around the shoreline of each island at between 75 to 175 feet. In addition, the larger islands, Moresby, Portland, Sidney, Coal, and Piers Islands, were contoured at quarter-mile intervals—at about 100 feet above the treetops. The study transect represented that area extending outward approximately 250 yards from either side of the airplane. Birds were recorded in approximate locations on

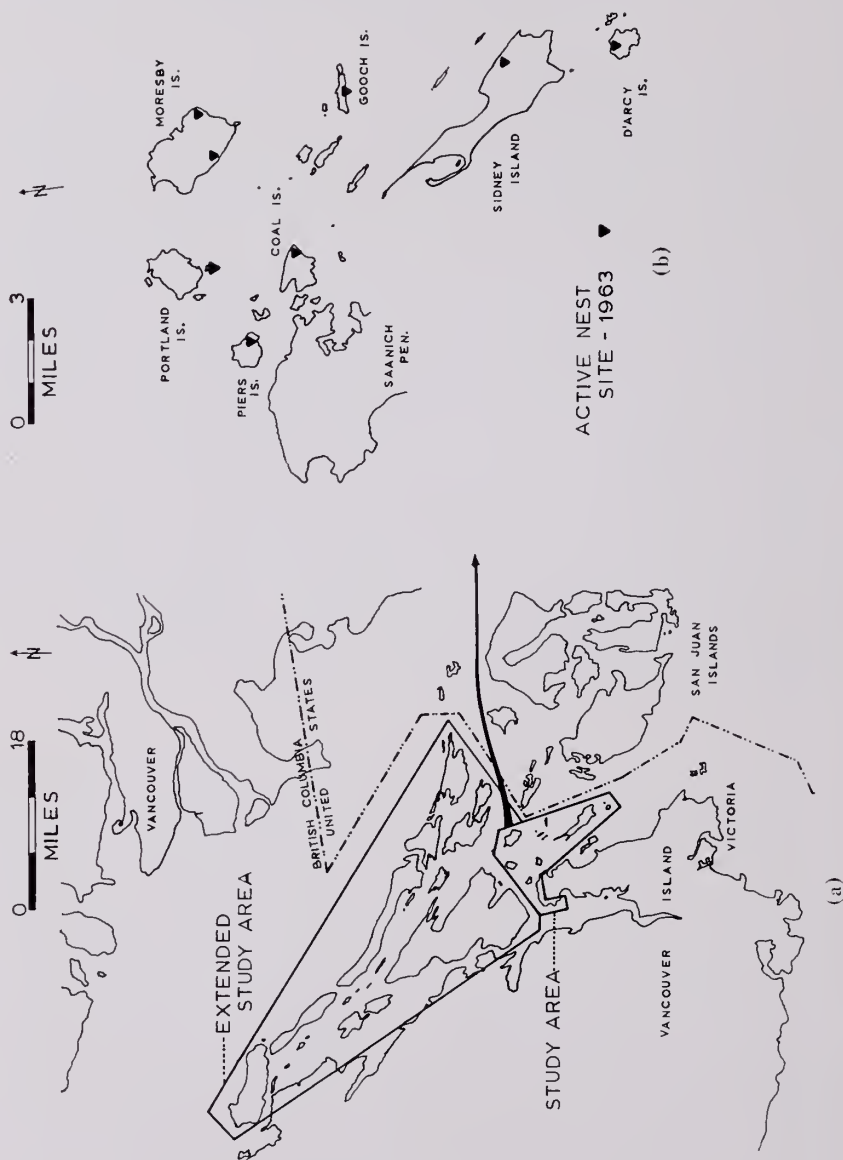


FIG. 1. (a) Map of study areas. (b) Large-scale map of study area showing active nest sites.

work maps, according to age, and whether they were observed sitting or flying.

During February four additional flights (9 hours flying time) were carried out to assess the wintering eagle populations of some of the remaining Gulf Islands. On these flights most of the major shorelines were covered, but many of the small bays and much of the inland area were overlooked. Table 1 lists the major islands covered and gives the actual number of birds seen, along with my estimation of how many birds were actually present. This estimate allows for both the areas that were not flown and for the underestimation due to the difficulty in spotting the birds. This area encompassed about 500 square miles and is referred to as the extended study area. Table 1 also shows the results from a census flight over San Juan Island, U.S.A. My estimate of total birds present in the San Juan group unfortunately is based on very little data. Breeding density and productivity will be dealt with in a later paper.

There is undoubtedly some inaccuracy in determining the age class ratios (adults to immatures). The white head and the black body of the adult birds make their presence more conspicuous than the duller and more mottled immatures. In addition, ground and aerial observations suggest that immatures more often perch in the lower limbs of trees than do the adults, and are thus less easily viewed from the air. It therefore seems likely that more immatures are missed than adults, but that flying adults and flying immatures are spotted with equal ease. Of the birds observed flying, 19 were adults and 26 were immatures. Therefore, if we assume the group of birds observed sitting and the group observed flying are both represented equally by the ratio of adults to immatures in the total population, we can conclude first that adults and immatures represent approximately 40 and 60% of the population respectively. Second, assuming for the moment that the sitting adult population (219) is correct, we would then expect to have observed about 300 sitting immatures. Only 110 sitting immatures were observed. On this basis we can say we observed only about 40% of the immatures present. This line of reasoning has two major drawbacks. First, it assumes that the time spent sitting and flying by each age-group is proportional. Second, it assumes that the adult count is correct, when, in fact, some adults were probably overlooked. This would have made the error even larger. I doubt that the bias is as large as suggested by the above reasoning. Errors due to duplication are considered negligible. As a result of more recent aerial and water counts I have reached the conclusion that my censusing technique for the transect underestimates the adult age-class by not more than 10-15% and the immature class by about 20-35%. While my method underestimates the actual eagle

TABLE 1
PEAK COUNTS AND FORECASTS OF TOTAL BALD EAGLES WINTERING IN THE GULF ISLANDS,
B.C., AND SAN JUAN ISLANDS, WASH. 1962-63*

	Date	Peak counts			Forecasts		
		Ad.	Imm.	Total	Ad.	Imm.	Total
GULF ISLANDS, B.C.							
Study area	12 Feb.	29	33	62	33	45	78
Saltspring	9-16 Feb.	10	5	15	25	20	45
Prevost	9 Feb.	8	1	9	13	8	21
North Pender	20 Feb.	4	1	5	10	8	18
South Pender	20 Feb.	2	0	2	4	4	8
Saturna	20 Feb.	11	6	17	22	20	42
Mayne	20 Feb.	8	5	13	13	12	25
Galiano	20 Feb.	19	6	25	31	20	51
Kuper	-	-	-	-	7	7	14
Thetis	-	-	-	-	8	8	16
Valdes	-	-	-	-	10	10	20
Gabriola	-	-	-	-	10	10	20
Approximate total of estimated wintering population:					175	175	350
Population density \cong 0.7 Bald Eagle per square mile							
SAN JUAN ISLANDS, WASH., U.S.A.							
San Juan	7 Feb.	22	13	35	30	30	60
Remaining islands	7 Feb.	-	-	-	50	50	100
Approximate total of estimated wintering population:					75	75	150

* Totals are given for each major island and this includes the small nearby islands.

population, the relative seasonal changes in abundance are reliable since the censusing technique has remained constant throughout the study.

SEASONAL MOVEMENTS

The change in abundance is shown by Fig. 2. Several population movement patterns have become apparent. At the onset of the project, on 26 September 1962, no eagles were present in the study area. The first bird was observed in the area by Darcy Goyette (pers. comm.) at Piers Island on 21 October. My count of 24 October found nine adults present. A local naturalist, Jack Todd (pers. comm.), spent from 12-18 October on Sidney Island and did not see an eagle. Therefore, I feel that the date of the eagles' arrival on the study area is about the third week in October. Not only were the first birds to arrive adults, but these adults in many cases appeared paired and were located in the vicinity of nest sites. It is my opinion that the first birds to arrive on the "winter territory" were the breeding adults of that territory. During the months of November and December the eagle population remained relatively stable (10-17 adults and 0-2 immatures). The eight nest sites

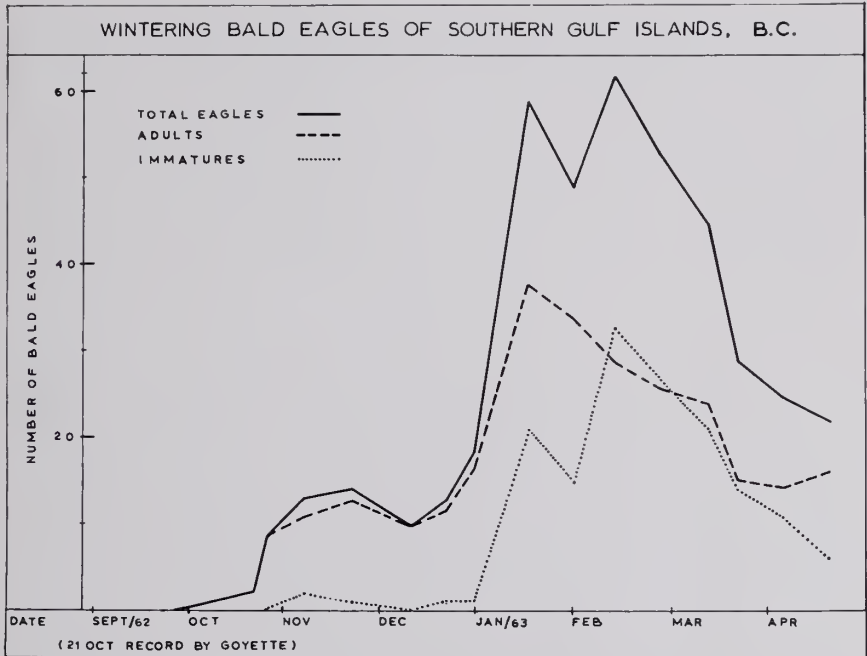


FIG. 2. Wintering Bald Eagles of Southern Gulf Islands, B. C.

known in the study area could nearly account for all these adult birds. It might be pointed out that in most cases it was the presence of the adult birds near the nests that made the nests conspicuous.

Between 31 December 1962 and 16 January 1963, the population increased from 18 to 59 birds. This new group of birds was composed nearly equally of adults and immatures. This high population of birds was maintained in the study area from the first of January until the latter part of February, after which a steady decline in numbers was noted.

The adult segment of the population began to decline after the middle of January. The maximum count of 38 adults was made on 16 January. On 14 March only 24 adults were seen. After this date all the adults present on the study area (the number varying between 14 and 16) can again be accounted for by assuming they are the breeding birds of the eight active nests of the area censused (Fig. 1b).

The population changes of the immature age-class varied only slightly from those of the adults. The arrival of the immatures on the study area probably coincides with that of the first adults, although the first birds were not actually noted on the study area until 7 November. From zero to two birds were noted

between November and December. On 16 January, 21 immatures were seen—this increase coincides with the period of the adult increase. Between 16 January and 14 March the count of immature eagles varied between 15 and 33, the latter count being on 12 February. The large variation in number is probably partially attributable to the difficulty in detecting the immature birds. Daily movements and congregations around temporary food supplies also contribute to the variation in such a small study area. From the last week of March on into the summer the population of immatures gradually declined. Six immatures were present on 18 April.

DISCUSSION

While this study has provided the ground work for a more advanced population study of the Bald Eagle and has outlined the population changes that have occurred in a 50-square-mile area in the southern Gulf Islands during the winter months, little knowledge has been gained which will help interpret the changes observed. While much has been learned about the migratory habits of the southern Bald Eagle through efforts of the late C. L. Broley, no similar work has been done on the northern Bald Eagle. Robbins (1960), in a summary of western Bald Eagle band returns, pointed that there are insufficient data available to determine migratory patterns. Alaskan returns have all been winter recoveries of locally banded birds. Two California recoveries were of birds banded as nestlings in Yellowstone National Park, Wyoming, and Great Slave Lake, N.W.T. Therefore, direction and extent of migrations are largely conjecture at present.

Winter concentrations of Bald Eagles are reported from the Klamath Basin and Snake River Plains and are known by this study to occur in the coastal archipelago of Washington and British Columbia. Whether coastal birds are moving inland or whether the Klamath concentration is due to an accumulation of northern interior birds remains to be seen, though the latter seems more reasonable. The changes observed by Southern (1963) in his study of eagles wintering in northwestern Illinois show a striking parallel to those I encountered. However, the buildup and subsequent decline of adult Illinois birds occurred about 3 weeks in advance of that of the West Coast birds.

POPULATION DENSITY

On the date of the highest count, 12 February, the population density was one bird per 0.81 square mile of island and water area for the 50 square miles of study area. There are several reasons why the density found on the small area does not, nor should, agree with that found on the remaining 500 square miles of archipelago which had only 1 bird per 3.37 square miles. First, only part of the extended study area was actually censused and therefore only

a fraction of the birds were counted. Second, the smaller area is composed of many small islands which have a proportionately longer shoreline than many of the larger islands in the extended area. Few eagles are found at distances greater than 400 yards from the sea, with most birds being within 50 yards of it. The few exceptions were birds feeding on sheep or deer carcasses, or birds soaring or presumably just landed after riding updrafts to the higher inland centers of the island. Another factor which works to upset the rather regular distribution of the Bald Eagle is the periodic change in local abundance of food supply. For example, Sidney and Moresby Islands both had temporarily high concentrations of eagles associated with sheep carcasses. Once the carcasses were consumed the eagles dispersed. On the other hand, San Juan Island regularly supports a large wintering eagle population. This island is unique in that rabbits, in addition to sheep, are important food items.

The general picture that emerges is that the entire Gulf Islands and the northern San Juan Islands support a relatively high density of Bald Eagles throughout the winter and early spring months. The density is probably in excess of one bird every 2 square miles over the whole area. The age-class ratio changes markedly with the season. Since the British Columbia coast is relatively uninhabited and since the Bald Eagle is present in the area in fairly high numbers, it seems reasonable to suppose that this study is being conducted on a relatively healthy and stable population. Sprunt (1961) has suggested that it would be interesting to compare age-class ratios of a healthy population to that population which exists in the eastern and southern United States. Such a comparison poses many problems. One must know more about the migratory patterns of the different age-classes. When Florida birds are breeding the northern birds are on winter range. Since the age-class structure of the West Coast birds varies so markedly both temporally and spatially and since an even larger geographic variation in age ratios was noted by Southern (1963) in Illinois, it seems pointless to place much value on this comparison at this time. The same argument holds true for a comparison of my peak January count with that of the Audubon January census which probably censuses the United States eagle population during its maximum period. The decreased productivity of the Bald Eagle in the United States in recent years should be reflected by a low immature to adult ratio. An average of the 1961 and 1962 January Audubon counts yields a ratio of about 27 immatures to 73 adults. My West Coast count of 16 January 1963, gives an immature to adult ratio of about 36 to 64 respectively. My peak count on 12 February gives the ratio as 53 to 47. It must be remembered that my immature class is probably low due to the differential age bias in counting. This comparison, if valid, suggests that the United States population is declining. However, a quantitative measure of this decline is not possible with the data available.

FOOD

The most prominent food item in the diet of the wintering eagles in the 50-square-mile study area is dead sheep. All of the larger concentrations of eagles were associated with sheep carcasses. For example, on 27 February 14 adults and 15 immatures were observed perched around one 200-acre field containing three partially eaten sheep carcasses. Usually only one bird would feed at a time while two or three more would be perched on nearby rocks and fence posts. Over the past 6 years the local sheep rancher and myself have spent hundreds of hours observing these eagles from blinds. Never once have we witnessed an attack or attempted attack by an eagle on young lambs or on ewes giving birth. The accusation by some of the farmers that the eagles are killing sheep seems completely unfounded and is probably based upon observations of eagles feeding on already dead sheep. I have seen eagles fly not more than 6 feet above a ewe giving birth and the eagles showed no sign of aggressiveness nor the ewe of fright. However, once the ewe and her lamb had withdrawn a few yards from the area an eagle would come down to gorge upon the afterbirth. The conservation-minded sheep rancher considers these scavengers an asset, not a threat.

In areas where there were no sheep carcasses the eagles were more evenly dispersed. This even distribution is probably an adaptation whereby maximum density can be supported by a passive exploitation of the environment. Observations over the past 6 years suggest that a major proportion of the Bald Eagle's hunting is done from a perch. Suitable perches usually overlook several miles of shoreline. Either the prey makes itself conspicuous to the eagle, as in the case of schooling fish or ducks swimming by, or the sea exposes the food on the beaches. Eagles are highly opportunistic, like most raptors, and readily congregate where food is in surplus. Some hunting is also carried out from soaring flights. While sheep constitute a major food item in some localities, fish caught live and found dead appear to be the normal diet. Crustacean shells are sometimes found in the castings.

At Sidney Island Lagoon, a favourite shooting area, several adult and immature eagles regularly hunted waterfowl. On 22 January 300 widgeon and teal were flushed out of the shallow water by the airplane. Immediately one adult and two immature eagles were observed attacking a crippled widgeon. Seventeen passes were made in rapid succession by the three eagles and each time the widgeon dove to safety, creating considerable spray. When the eagles tired and returned to perches the widgeon swam from the shallow (18 inches deep) to deeper water. This pattern of activity was repeated several times throughout the winter, with usually three or four eagles working simultaneously at one duck. I witnessed 85 passes at crippled waterfowl and never once saw an eagle make a successful strike. However, the speed with which

the eagles approach their prey suggests that such attacks might occasionally be successful. No eagle was observed attacking a healthy duck.

The Gulf Islands also support a large population of wintering Peregrine Falcons (*Falco peregrinus pealii*). On 20 January, again at Sidney Lagoon, I saw an adult female peregrine catch a female Bufflehead and carry it to a log on the sand spit. No sooner had she landed than she was forced into the air by an attacking immature Bald Eagle. While the falcon was attempting to drive away the eagle the duck returned to the water and swam off.

The San Juan Islands represent a unique situation in that feral rabbits form an important food item. Both abundance of food species, and previous experience or preference, would appear largely to determine what is eaten. In some areas, eagles, presumably the same birds, were often seen hunting waterfowl. In other areas waterfowl were left and only fish taken. For example, the pair of adult eagles wintering and breeding on Discovery Island regularly capture Glaucous-winged Gulls. This prey species is abundant throughout the whole region but is regularly captured only by a few eagles.

SUMMARY

1. Twice-monthly aerial surveys have been conducted over 50 square miles of the southern Gulf Islands, British Columbia, between 26 September 1962 and 18 April 1963.
2. The first birds arrived on the study area about the third week of October.
3. The adults that arrived between October and the end of December are thought to represent those adults which breed within the area. Few immatures were present during this period.
4. During the first 2 weeks of January the eagle population nearly tripled—this new group being composed equally of adults and immatures.
5. The adult population declined after the middle of January. The immature population increased until the middle of February, after which it declined.
6. Factors affecting the accuracy of the aerial censusing techniques are discussed.
7. Nine additional hours of surveys over an extended area (500 sq mi) yielded a density of one bird per 3.37 square miles. The actual wintering density during peak population in February, is probably just under one bird per square mile over the entire Gulf Island area. The small study area yielded a density of one bird per 0.81 square mile for the peak population on 12 February.
8. Eagles are generally perched within 50 yards of the sea, and their distribution along the coast is quite regular. Clumping was associated regularly with congregations of eagles around sheep carcasses.
9. Dead sheep constitute a major food item for the wintering eagles on several of the Gulf and San Juan Islands. Throughout most of the Gulf Islands, however, fish appear to be the major food item. Few birds are captured.

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DEPARTMENT OF ZOOLOGY, THE UNIVERSITY OF BRITISH COLUMBIA, VANCOUVER
8, BRITISH COLUMBIA, 30 OCTOBER 1963

ADDITIONAL OBSERVATIONS ON WINTER BALD EAGLE POPULATIONS: INCLUDING REMARKS ON BIOTELEMETRY TECHNIQUES AND IMMATURE PLUMAGES

WILLIAM E. SOUTHERN

BETWEEN 29 September 1962 and 9 April 1963, my assistants and I spent 850 hours obtaining new as well as supplemental data on the Bald Eagles (*Haliaeetus leucocephalus*) wintering near Savanna, Illinois. The study area as delineated previously (Southern, 1963), was used again this year and, in general, the objectives were the same: to record behavior, live-trap, color-mark, and determine the movements of Bald Eagles during winter and early spring. I also spent considerable time studying the plumage patterns of immature eagles and attempted to categorize them into age-groups. In addition to color-marking eagles, I attached miniature transmitters to some and followed their movements with radio-tracking equipment.

This study was supported by a grant from the Frank M. Chapman Memorial Fund (American Museum of Natural History). Northern Illinois University provided a research vehicle. Field assistance was given by D. Jean Ridinger and Robert Cecich. Gary D. Schnell prepared the three figures used in the paper. Warrant Officer Ira Meyers and Captain W. Bowers arranged for us to conduct our research on the United States Army Savanna Depot.

POPULATIONS AND FLUCTUATIONS

This year I started field work earlier (29 September) and recorded the first Bald Eagles on 21 October. More immatures than adults were present until 15 December. The indication was that immatures, particularly first-year birds, moved southward earlier than adults. They either concentrated at waterfowl wintering areas (e.g., Horseshoe Lake Refuge) and other suitable feeding sites or dispersed and fed over a larger area. The number of immatures increased again during February and early March. Fewer immatures were observed in spring than in fall and it appeared that northbound birds were not necessarily the ones observed at Savanna during the fall. More 3-, 4-, and 5-year-old birds were recorded during late winter and early spring (see Fig. 1).

Figure 2 presents the population fluctuations of adult and immature Bald Eagles during the 1962-63 winter. Our census methods were the same this year as last. One indication that we obtained an authentic picture of the number of eagles in our area was given when Alexander Sprunt, IV, carried out an aerial census of the Mississippi River population on 3 February. He

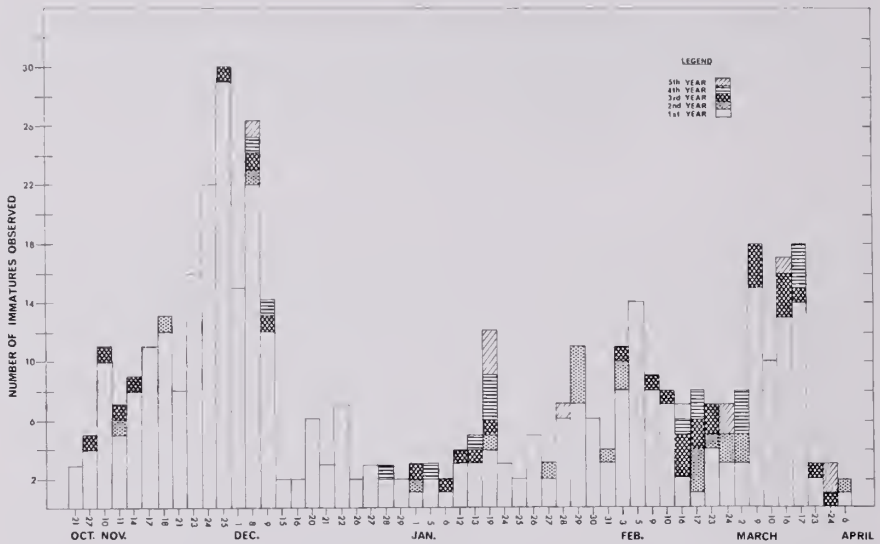


FIG. 1. Fluctuations in immature Bald Eagle population by age-groups during the winter of 1962-63.

reported a population of 158 in our area, 12 of which were immatures, while our ground count for that day was 156, 11 of which were immatures. The counts were made at about the same time and I saw Sprunt's plane pass over.

Two new localities, in addition to the four reported last year, had eagle concentrations. Both were along small sloughs; one resulted from spring seepage and the other from a swifter flow of water. Shad concentrated at each site at some time during the winter and attracted eagles. The winter was severe with a low of -32°F recorded in the area. Prolonged periods of subzero temperatures were recorded and the high for one day was -19°F . Nevertheless, the open areas in the river and backwaters maintained their size. Fluctuations in ice conditions occurred but not necessarily during the periods of extreme cold as might be expected.

FOOD AND FEEDING HABITS

As during last year small Gizzard Shad supplied the major portion of the eagle's diet. They appeared in small numbers by 28 December, became abundant by 13 January, and remained abundant, at least at one or two areas, until 23 February when shad, except for a few dead ones, were scarce.

Besides feeding on shad in the methods referred to previously (Southern, 1963:46) the eagles occasionally fed on other fish when available. During

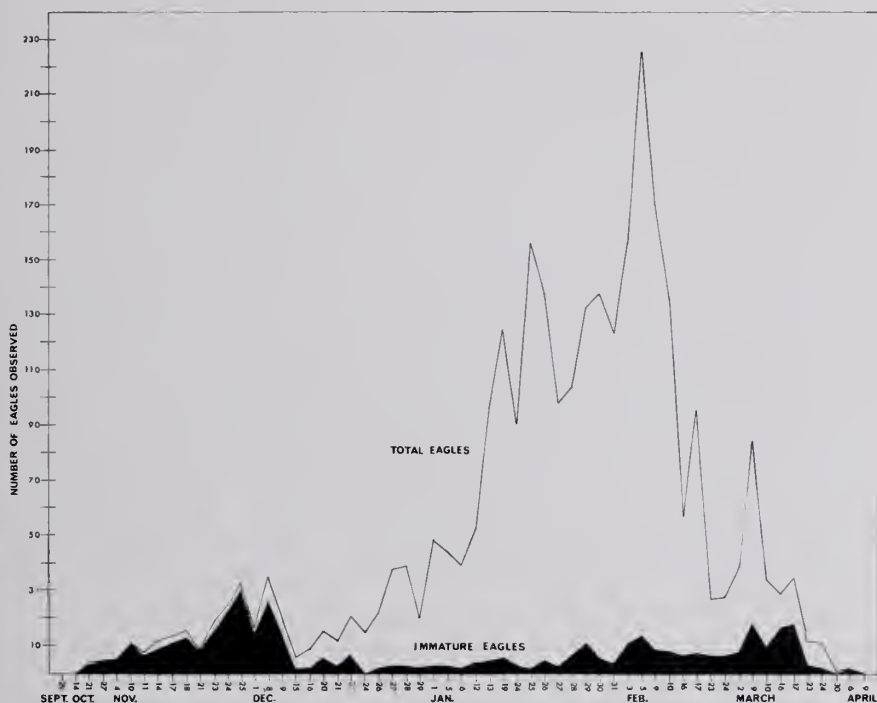


FIG. 2. Population fluctuations of adult and immature Bald Eagles during the winter of 1962-63.

mid-January about 200 fish representing 11 species were trapped in shallow water at Burning Ground Slough (Site 4, Fig. 1, of Southern, op. cit.:43). Eagles fed on several species of fish but appeared hesitant to feed on species larger than shad. Eagles fed most readily on fresh fish but occasionally consumed frozen ones. Twice we watched eagles capturing fish after commercial fishermen pulled their nets. During the fall (24 and 25 November) fishermen pulled their nets near North Point Island (Site 2, Fig. 1, *ibid.*). Each time they returned to the water a number of White Bass (*Roccus chrysops*), some of which were apparently injured and remained near the surface. Gulls were attracted first, but after the fishermen left an adult eagle arrived and shortly thereafter six immatures appeared. They circled the water, swooped down, and picked up fish weighing about 2 or 3 pounds. Successful birds carried the fish to a perch far from the other birds before eating it. Two birds carried their catch across the river to the Iowa side. The adult and each of two immatures ate three fish in about 30 minutes. The next day the nets were pulled again and four eagles were attracted. Later activities of the fishermen

failed to attract eagles. The feeding activities of crows sometimes attracted eagles to a feeding site. Occasionally eagles chased crows from such sites before feeding, but it was not uncommon to find eagles and crows feeding at the same open hole.

We witnessed the attempts of seven eagles, all immatures (three color-marked), trying to capture a female Mallard (*Anas platyrhynchos*). The duck was in a small open hole under a fallen tree. The eagles hopped about among the branches, occasionally fell into the water, and attempted in every fashion to get at the duck. All attempts failed and after about 50 minutes the last eagle departed. During the ordeal the Mallard swam about and occasionally quacked or flapped her wings. After this observation we tried live and dead Mallards as trap bait, but the eagles were not attracted to them.

On 18 December at Horseshoe Lake near Cairo, Illinois we counted 38 eagles of which 29 were immatures. We observed adults and immatures feeding on dead ducks and geese. Groups of eagles moved from one area of goose concentration to another and consumed dead birds. Generally one or two eagles started the feeding activity, and then others gradually moved into the area. New arrivals perched high in cypress trees (*Taxodium*) and slowly worked into the feeding area. Nineteen eagles were concentrated in one area, but all did not feed on one animal. No fewer than six dead birds were consumed at this locality. The eagles jumped on dead birds that were in the open water and pulled them out onto the ice. Live geese remained in the area although they behaved a little nervously. During our stay we saw numerous dead geese, as well as piles of feathers, evidence of previous eagle feeding activity in the fields and on the ice. Most, if not all, of the dead waterfowl resulted from hunting activities bordering the refuge. Twice we saw crippled geese fly or glide to the refuge and die. After the hunting season the abundance of such food decreased, although the death of some cripples is probably prolonged. So long as dead waterfowl were available the eagles showed no interest in live birds. Most of the lakes in southern Illinois were frozen over and the only open areas at the refuges were those maintained by waterfowl. When the lakes are open fish probably supplement the eagle's diet.

As a result of our observations we placed two traps, each baited with a dead goose, in fields near goose concentrations at the Union County Refuge. Within an hour an adult eagle was at one trap and an immature at the other. Each consumed about half of the goose before we frightened them. Neither bird was captured since each had stood on the carcass while feeding and failed to step on the platform snare beside the bait.

We received several reports from the vicinity of Mt. Carroll and Savanna that eagles (one on each occasion) had fed on dead livestock (chickens and

hogs) dumped in fields by farmers. At the depot we found the remains (hair only) of a fox squirrel (*Sciurus niger*) killed after daybreak in an area of eagle concentration. There were eagle tracks and wing prints on the snow. Since there were no squirrel tracks on the ground, it had apparently been killed and eaten in a tree. It is possible, however, that one of the many Red-shouldered Hawks (*Buteo lineatus*) in the area killed the squirrel.

CENSUS METHODS AND RESULTS

The same census route and procedures were followed this year as last. We censused the population during 60 of the 65 days spent in the area between 29 September 1962 and 10 May 1963. Census results are presented in Fig. 1. There was a noticeable decrease in the number of adults on 16 February 1963; thereafter, although with fluctuations, there was a tendency toward a decline. During early February (beginning 3 February) the immature population became more constant and showed a gradual increase until mid-March when a sharp decline was noted. No eagles were recorded after 6 April. The sharp decline in adults is similar to that witnessed in 1961-62 when there was a sharp drop about 16 February. We assumed that the eagles had either moved north (most likely) or south along the river. However, this was not the case. About the same date, there was also a decrease in eagle numbers to the south at Keokuk, Iowa (Lock and Dam Number 19). We traveled along the river between the two areas and recorded only four eagles. Likewise, there was no noticeable increase in eagles to the north of Savanna along the Mississippi. Such an increase should have been evident since few eagles wintered in that area. The remaining conclusion to be drawn is that the birds dispersed or at least followed a course, other than that along the river, to the north toward the breeding grounds. The increased number of immatures during both years probably indicated a similar movement although it is possible that the immatures followed the river to the north of Savanna.

The fluctuations in eagle numbers (see Fig. 1) were somewhat correlated with the availability of shad, but ice conditions also affected the population. By 15 December most of the main channel was frozen at Savanna and probably farther to the north as well. Soon after this date the number of adult eagles started to increase while the number of immatures decreased. When the ice broke up in the spring (river opened on 23 March) the number of adults had decreased and that of immatures increased. Undoubtedly the departure of adults in mid-February was correlated with the nesting cycle.

My data indicate that the heaviest movements of immatures occurred earlier in the fall and later in the spring than the peak movements of adults.

Although immatures of all ages were observed throughout the winter, a larger proportion of the birds present during early winter (through Decem-

ber) were one year old; later in the winter a larger proportion of older sub-adults was observed (see Fig. 2). The plumage patterns of the various age-groups will be discussed later in this paper.

During both years the peak population occurred during early February. In 1962, on 2 February, 268 eagles were present; in 1963, on 5 February, 225 eagles were present. The fluctuations were similar during both seasons.

ROOSTS

Few additional data were gathered about roosts. Recent data suggest that many, and perhaps most, eagles roosted singly or, at least, in small groups. Several times we flushed single birds from wooded islands bordered by sloughs. The birds were in dense stands of large trees and roosted about halfway down in the crown. Generally the sites we located were near feeding areas since this is where most of our predaylight activity was concentrated. Most birds did not, however, roost in close proximity to their early morning feeding area. It was not uncommon for them to fly long distances, perhaps several miles, and often past other suitable feeding sites to reach a particular area. I am convinced that some eagles frequented particular feeding areas, perches, and loafing areas with more than accidental regularity.

TRAPPING METHODS AND RESULTS

We used similar trapping methods this year as last. Seven immatures were caught in platform snares and two adults in a cannon net. Three of the immatures were captured at one time, one in each of three traps in one area, and the next day four were caught simultaneously in the same three traps. Other immatures were on the beach near the trapped birds and attempted to steal the bait fish. After these occasions this method, for some reason, failed. The eagles would not walk on the traps, and once some birds walked around platforms baited with carp and attempted to pull fish from the nooses. Their talons pierced the fishes' operculum during these attempts. Bait was also taken from three floating fish traps by immatures but none were captured.

The cannon net appeared to be the best method for capturing adults. More than one net is necessary, however. We were constantly plagued by our net covering too small an area or by the fact that our time should have been spent checking a series of nets. A rapid method of firing, such as a radio-firing device, would be helpful. The main reason for failure to capture more eagles (one which could be solved by the radio-firing device) was the extreme wariness of adult eagles while feeding. We had to conceal our detonator about one-quarter mile from the feeding area where the birds would not see us stop. This necessitated setting the net at a location distant, yet visible, from the

road. When we sighted eagles at the net we drove to the detonator and fired the net. Sometimes sight of the slow-moving vehicle disturbed the birds and they left before the net was fired. The maximum number of birds before the net at one time was three. We tried using walkie-talkies but they would not function properly at low temperatures. We also constructed blinds at trap areas, but an observer could withstand the low temperatures for only a few hours.

The weights and measurements for 10 of the eagles we captured are given in Table 1. The sexes were determined by cloacal examination and are questionable.

BIOTELEMETRY AND COLOR-MARKING

The same methods were used to color-mark adult eagles this year as last. Immatures were marked with back-tags constructed from yellow Coverthin (a laminated plastic-nylon upholstery material). Black numerals were painted on the tags with Ramcote paint. The tags were fastened to the bird by means of two straps, one of which was wrapped around the base of each humerus and stapled. The tags were conspicuous and easily observed on flying or perched birds.

In addition to the back-tags, six eagles (four immatures and two adults) were equipped with radio transmitters and tracked electronically. This aspect of our work represents a relatively new procedure in field ornithology and will, therefore, be covered in some detail.

Numerous investigators are involved in the development and application of wildlife-tracking systems. Several, including LeMunyan et al. (1959), Lord et al. (1962, 1963), Marshall (1962), and Cochran et al. (1963) published papers regarding certain aspects of their studies. To my knowledge, no one has published results from tracking wide-ranging birds.

Field biologists have long been plagued with the problems encountered in determining the range of individual animals and the necessity of drawing conclusions from scanty data. A means by which marked individuals could be followed continuously or relocated at will was necessary to alleviate, at least in part, these problems. The radio-tracking system herein discussed is an attempt at a solution. While problems still exist, it is now possible to obtain more accurate data as well as larger quantities of data over a shorter period of time.

I first developed an interest in radio-tracking during 1959. Progress was slow and it was not until my discussions with members of the Illinois Natural History Survey that a workable system evolved. The equipment was tested in the field on Herring (*Larus argentatus*) and Ring-billed Gulls (*L. dela-*

TABLE 1
WEIGHTS AND MEASUREMENTS OF 10 LIVE BALD EAGLES

Band number	Age	Sex	Weight in pounds	Measurements in millimeters					Tarsus	Date captured
				Mamus	Spread wing	Total spread	Tail	Exposed culmen		
528-98106	Adult	male	—	590	—	—	—	—	—	17 Feb. 1962
509-52601	Adult	female	14.5	623	927	2,125 (83.75 in.)	318	116	116	4 Mar. 1962
509-52602	Immature 1st yr	male	8.5	577	825	1,930 (75.5 in.)	343	76	95	10 Nov. 1962
509-52603	Immature 3rd yr	female	11.75	660	940	2,080 (82 in.)	343	89	116	10 Nov. 1962
509-52604	Immature 1st yr	male	9	623	903	2,020 (79.5 in.)	345	89	89	10 Nov. 1962
509-52605	Immature 2nd yr	male	9.9	628	927	2,030 (80 in.)	356	76	89	11 Nov. 1962
509-52606	Immature 1st yr	female	12.75	641	965	2,145 (84.5 in.)	343	76	89	11 Nov. 1962
509-52607	Immature 1st yr	female	11	647	940	2,095 (82.5 in.)	381	89	95	11 Nov. 1962
509-52608	Immature 1st yr	female	10.5	635	940	2,070 (81.5 in.)	324	76	82	11 Nov. 1962
509-52609	Adult	female	12.6	620	929	2,035 (80.25 in.)	330	91	89	5 Jan. 1963

warensis) during the summer of 1962. Further development readied the equipment for use on Bald Eagles in the fall of 1962.

DESCRIPTION OF THE RADIO-TRACKING SYSTEM

Transmitters.—The transmitter circuitry is similar to that described by Cochran and Lord (1963). The 7-inch diameter loop antenna used on eagles was constructed from aluminum wire (number nine) or aluminum tubing (one-quarter inch inside diameter). A Philco T2399 transistor which is very stable during temperature fluctuations, performs uniformly, and has small size was used in most transmitters. Weights of completed eagle transmitters averaged 80 grams. Heavy encapsulation (Epoxy 346 or Silastic RTV 82) was necessary to protect the transmitter parts from the eagles. The cost of components for each transmitter was about \$9.00. Minimum life expectancy was 3 months, but longer life (about one year) is possible by altering battery load or switching to a pulsed signal. The first transmitters included regular mercury cells (E 630) as the power source, but at temperatures below 20 F these transmitters failed to operate properly. Tests in a deep freeze at subzero (down to -30 F) temperatures indicated the batteries were at fault. Alkaline cells were substituted and worked satisfactorily. Later Mallory low-temperature mercury cells were adopted. Characteristics regarding power drain and milliwatt hours/gram are most favorable for mercury cells.

As stated by Cochran and Lord (1963:20), "Building these transmitters is an art, not a science." The reader is referred to their article for instructions. Certain components vary according to the animal's size. The eagle transmitter has a 7-inch diameter wire loop antenna. Resistance values ranged between 68,000 and 390,000 ohms. The tuning capacitor values ranged between 75 and 82 picofarads.

Transmitters were attached to birds by means of a two-strap harness constructed from Coverthin. Each strap encircled the bird's body, one anterior and one posterior to the wings, and was fastened with staples at the back. The transmitters rested against, or under, the feathers of the upper breast. While the bird was aware of the transmitter and occasionally worried it, the radio apparently did not interfere with normal movements or behavior.

Receivers.—The receivers were constructed by Sidney Markusen, of Cloquet, Minnesota. One was a portable, crystal-controlled, battery-operated, transistorized double-conversion superheterodyne. Its sensitivity is such that it will give good bearings with a signal input of less than one-tenth microvolt. The receiver is powered by 10 "C" cells, weighs 6.5 pounds, and is 12 × 7 × 6 inches. A 24-inch hand-held loop (aluminum wire) antenna with a 4-foot coaxial lead was attached to the receiver. The receiver was carried by means of a shoulder strap. It covers 100 kc of the 26-mc band in 20 switched channels with tunable subranges.

The second receiver was a mobile unit constructed from a surplus Army command receiver (BC 453) and converted in a manner similar to that described by Cochran and Lord (1963:15). The range of this receiver was slightly superior to that of the portable model. A hand-held (copper tubing) loop antenna was used with this receiver. The loop on an aluminum pole was mounted on the side of an auto during tracking. Plots were taken from a compass rose included in the mounting.

The location of a transmitter-bearing eagle was determined by plotting the intersects of two or more azimuths obtained as nulls with the loop antennas. Accuracy was within about one degree at a distance of 2 miles. Positions were plotted on aerial photographs

of the area. A transistorized tape recorder and a spring-wound Curtiss Wright strip-chart recorder were used to record signals and variations therein.

FIELD RESULTS FROM RADIO-TRACKING

No differences in behavior between transmitter-bearing eagles and color-marked eagles were noticed at release time. All but one immature flew over the river and landed in the water. The one not doing so was released on a hill farther from the river. It fluttered across the road and remained concealed in tall grass for about 15 minutes. The period of time spent in the water ranged from 15 to 35 minutes. The birds mostly drifted about but exhibited swimming ability when they were once directed toward shore. The birds apparently used simultaneous strokes of wings and legs. The wing strokes were made by partially extended wings being directed forward and then forced back so that the breast was lifted from the water and projected forward. Progress was good and strokes were often repeated at regular intervals. After reaching the shore the birds preened, shook themselves, and soon thereafter headed for a perch higher than the beach such as a stump, log, or tree.

The transmitters continued to emit a somewhat weaker signal of a slightly different frequency while the bird was in the water. Swimming motions also altered the signal in a recognizable way. As a result, forward motion of the wings was recorded. When the bird emerged from the water the signal returned to normal. Flight movements also produced a particular variation in signal. As a result it was possible to determine when an eagle was in flapping flight or soaring. Preening movements and attacks on the transmitter were also detectable by variations in signals.

We successfully followed an eagle at a distance of 28 miles from the receiver but generally the tracking range did not exceed 2 or 3 miles. The location of an eagle perched in a tree or standing on ice could be determined at a maximum distance of about 2 miles. During soaring or flapping flights at various altitudes the range increased significantly. Continuous tracking of an eagle flying at an altitude of approximately 300 feet was possible in one instance. By taking a series of plots, we followed the bird for a distance of about 38 miles before we were stopped by the depot boundary fence. On two occasions immature eagles left our area and flew at least 30 miles north along the river. One of these was Number 15 which was caught by a muskrat trapper. It appeared, therefore, that even though food was abundant in our area, the birds took advantage of suitable thermals and flew to other areas, possibly remained there for a few days, and fed.

One immature was periodically relocated and tracked during a 5-week period. Batteries failed at this time because of low temperatures. On occasion we followed a radio-bearing eagle for an entire day, thus recording its feeding areas, periods of flight, and roosting site.

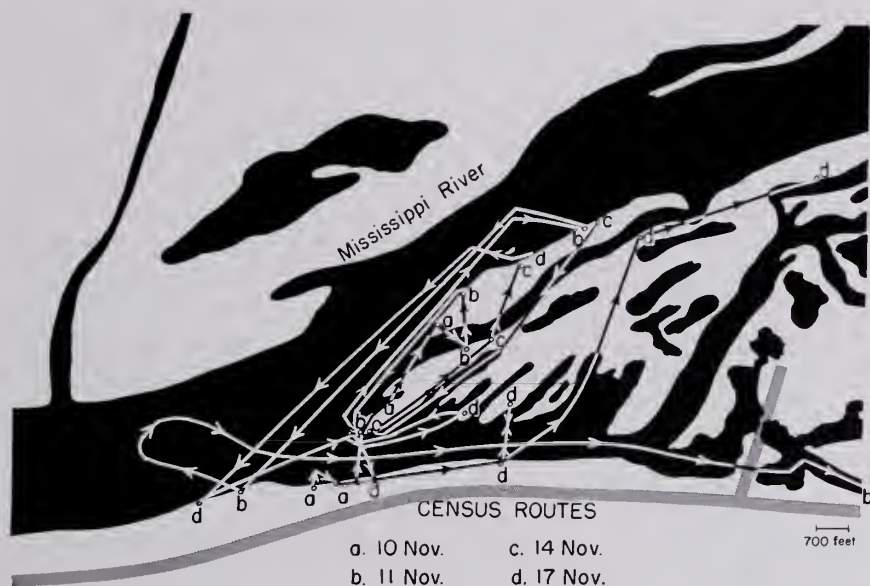


FIG. 3. Movements of Eagle Number 11 during four days of radio-tracking. On the second day the bird left the study area and travelled at least 15 miles north along the river. On 10 Nov. the bird was tracked from 1410 to 1645 hours; on 11 Nov. from 0825 to 1340 when it left the study area; on 14 Nov. from 0745 to 1300; on 17 Nov. from 0715 to 1629.

Between 10 November and 19 December we plotted 118 locations (511 timed fixes at 5-minute intervals) for the four immature Bald Eagles carrying radios. In addition, individuals birds were often tracked continuously for long periods (15 minutes to 4 or 5 hours). The minimum time that lapsed between plots was 5 minutes and sometimes hours or days elapsed before we attempted to locate a particular bird. Usually tracking was done on weekends, and as a result several days were interspersed between tracking periods. This presented a serious problem to successful tracking during this particular study.

Eagle Number 11 was released on 10 November and was tracked periodically through 19 December. The bird was not located on 23 November and only twice thereafter. A total of 200 5-minute positions were taken. On 2 days the bird was followed from daylight until midafternoon, when it left the area. Several times these birds were added to census figures solely on the basis of radio contact. On several occasions we observed transmitter-bearing eagles and their behavior appeared identical to that of "normal" individuals near them. Following are my abbreviated notes describing the movements

of Number 11 on 11 November. Figure 3 illustrates these movements within a part of our study area.

- 0825 Good signal received from roosting site where we left bird last night (west side of island out from R 5.5).
- 1008 Moved to west side of outermost island in R 5.5 area.
- 1040 Flew directly south-southeast to west side of North Point Island which is nearly opposite trap site.
- 1100 Same location.
- 1150 Flying north-northwest in direct flight. Perched directly out from Coast Guard landing on main channel. Signal rather weak. Probably low in trees or on ice.
- 1212 Bird has moved—no signal.
- 1240 Eagle located on east side of river at R 4.5.
- 1255 Took flight about 5 minutes ago and is soaring in a large circular pattern in general area of R 4. Circles take bird about 1.5 miles to the south of us.
- 1258 Soaring to NNW now in a more direct flight. Occasionally circles but in smaller arcs. Flying about parallel to Crooked Slough.
- 1305 Bird moving rapidly to north. Soaring eagle sighted with 10× glasses by directing vision through antenna when null was received. Probably our bird! Good signal with flight variation.
- 1315 Still receiving signal from north. Bird too far away to see with binoculars. Bird about 10 miles north of us.
- 1325 Number 11 is now about 15 miles to our north along river. Still in flight.
- 1330 Lost signal.
- 1640 Tried periodically to pick up Number 11 but no signal received. Bird still outside our area.

Eagle Number 12 was released on 11 November and tracked through 18 November. A total of 128 5-minute locations were obtained.

Eagle Number 15 was tracked between 11 and 25 November. No signals were received on 23 or 24 November. In all, 165 5-minute locations were obtained. The maximum number of locations taken during a single day was 63. We tracked this bird during the morning of 25 November until after 1000 hours. It was one of a group (including Numbers 8 and 14) that attempted to capture a Mallard near the Coast Guard landing (Site 2, Fig. 1, Southern, loc. cit.). We left the area and did not return until 1 December when we failed to relocate this bird. Possibly the bird had already moved north of our area since it was caught in a muskrat trap along the Mississippi River near Galena on 2 December.

We trapped two adults in a cannon net at Burning Ground Slough and attached transmitters to them. The first, Number 16, was captured on 5 January at 1000 hours. It was released at 1200 and flew north from the release point, Coast Guard landing, back to the trap site. At 1210 it flew to an island west of the Burning Ground area and there it remained until 1400 or so. At 1445 we failed to locate it. On 12 January the bird fed during the afternoon at the mouth of the Maquoketa River (Site 1, Fig. 1, Southern, *ibid.*). We did not find it after that date.

The second adult was captured on 26 January. It was released at 1400 hours. We followed it for the remainder of the afternoon. It was not located again.

Three of the back-tagged immature eagles were sighted a total of six times. One, the first bird released (Number 8), was observed with Numbers 14 and 15 (released on 11 November) on 25 November. Number 10 was the only back-tagged eagle observed more than once. It was reported four times within the area after its release on 10 November. During the morning of 8 December it was observed perched in a tree on a small island near the Coast Guard landing. There it remained for about an hour. On 21 December it was found during the early morning on North Point Island and at 0845 it flew south. We observed it near the mouth of the Maquoketa River on 22 and 27 December. It was not reported thereafter. No reports were received from outside the area. One band recovery was reported (immature killed near Galena).

Last year I received two validated reports of color-marked eagles. Thus on the basis of color-marking, I obtained a total of eight reports of eagle locations during 2 years. The value of radio-tracking as a tool in home range studies is obvious—118 locations in about 5 weeks as compared with eight sightings in 2 years.

GENERAL BEHAVIOR

On the basis of radio-tracking and direct observations, it is possible to point out some general patterns of eagle behavior. A condensation of these observations follows: The first eagle usually arrived at a particular feeding site at the first sign of dawn or shortly thereafter. Soon other birds started to appear individually. The arrival of birds at particular sites continued until after sunrise. Usually there was much calling as the birds arrived, particularly in the cases of dawn arrivals. The flight to the area was of the direct, flapping type alternated with only a few short glides. Seldom were birds very active at this early hour, and usually they remained perched in trees near the feeding area. Occasionally a bird circled over the open water, if it had not done so upon arrival, and soon returned to a perch. Once in a while a late arrival landed on the ice near the water. The birds usually started feeding about 20 or 30 minutes after the first birds had arrived. The early morning method of feeding was generally that of flying over the hole and swooping, attempting to take fish with the talons. About this time some birds landed on the ice near the larger open areas (e.g., mouth of the Maquoketa River). Usually the birds on the ice were rather far apart and a number of them were immatures. Occasionally they reached into the water with beak or talons after fish but usually the ice simply served as a landing place after a fishing flight. At smaller holes (e.g., Burning Grounds) the eagles were more

hesitant to get onto the ice, apparently because of limited visibility. Some birds remained perched while others fed. The feeding period extended throughout the day with a few birds always attempting to catch fish. Sometimes a number of eagles concentrated on the ice or along beaches where spring seepage opened the shallow water. Some waded in the water after fish while others remained perched in trees and became startled at the slightest disturbance. At these sites eagles also swooped down after fish, provided the hole was large enough.

Eagles, particularly immatures, were attracted to small holes, wet areas, or patches of slush ice. In such areas they were seen standing or walking about on the ice. Prior to the formation of ice on the river one immature walked about 300 yards along the beach, apparently looking for food. It was not uncommon for an eagle to land 20 or 30 feet from a somewhat hidden feeding area and walk cautiously to it.

About 0900 to 1000 hours, after feeding, some birds left the feeding areas. If it were foggy or snowing the birds generally remained perched and also tended to group together. During such conditions we occasionally found 50 or 60 eagles perched in one cluster of trees near feeding sites. During clear days, particularly when the wind was blowing at about 15 mph, the eagles took to the air and soared about. During afternoons of such days the population was usually low. Temperatures below zero also resulted in the birds' being inactive. They perched low in the trees, rather than on high dead stubs, and remained farther back in the sloughs, behind banks, or in other protected places. During these periods we recorded eagles where they had not been previously.

Once in a while, apparently after wading for food or after falling through the ice, an eagle got on a high perch, and with its back to the sun, spread or drooped its wings, and apparently dried its feathers. Sometimes the eagle panted. This posture suggested that the bird was injured.

After soaring about or feeding during the afternoon the birds gradually left for roosting sites. There was not an obvious flight, but the number visible at a given area slowly decreased. Some remained perched along the census route until almost dark. These birds probably roosted close by on one of the islands.

Insufficient data are available to permit determination of the winter range of individual eagles. I believe, however, that there was a change in the daily population. Some new birds came into the area (or simply returned to it) and others left. Our tracking indicated that the birds ranged over a 3- to 4-mile area for a few days and then possibly wandered outside of the study area (perhaps 30 miles or more). Sometimes they returned after a few days. I doubt that many eagles remained for the entire winter in a given area. Our

records for two eagle flights to the north of our area and a banding return from Galena tend to substantiate my suspicion. The fluctuation in the daily number of individuals representing each age-group further suggests that the birds wander about.

AGE-GROUPS AND PLUMAGES

In each census report we differentiated between the number of adults and immatures at each check station. Striking variations in subadult plumages were noted. As a result I recorded each variation and the number of times I saw it. I noted similarities suggesting a distribution according to age. On the basis of plumage characters I suggest that six age-groups of subadults are distinguishable. My grouping differs somewhat from that of Bent (1938: 326-327). Specimens examined at The University of Michigan Museum of Zoology represented four of the six groups. The plumage patterns, based on the more conspicuous markings, were grouped as follows:

First-year plumage.—Dorsal and ventral sides uniformly dark brown except for an occasional white portion on one or more feathers. Primaries, secondaries, and coverts as dark or darker. Crown sometimes darker than rest of body. Rectrices brown, often with grayish-white varying from a sprinkling to a coverage of about 60% of the central rectrices. Less white visible on dorsal side of tail. Mandibles horn brown. Tarsi yellowish. Iris light brown. UMMZ specimens 91379, 59255, 36916, 113761, 84214. Numbers 59255 and 113761 were birds of known ages, 3 and 4 months, respectively.

Second-year plumage.—Belly and lower breast generally light, tawny brown. Upper breast darker, appearing as a band or bib. Dark brown dorsally in most cases. Occasionally a few white feathers on belly and throat (possibly incoming feathers of third-year plumage). Some white in tail, perhaps more than in first year. Beak and iris brown. Tarsi yellow. UMMZ specimens 47152 and 56479.

Third-year plumage.—Throat with some white; breast brown resulting in an obvious but perhaps narrow band on upper breast. Belly and lower breast whitish to white. Sometimes white area very large, other times small and flecked with brown. Dark brown dorsally except for an occasional white patch or scattered white feathers (may have brown tips). The most common location for a white patch of feathers is between the wings on the back where it resembles a solid white V on a perched bird. Coverts often spotted with white. Crown generally dark brown, sometimes tawny tips to feathers. White may begin to show on sides of head or throat (usually throat first), but crown and nape most often dark. Little yellow at base of mandible; iris brown. UMMZ specimens 36915, 61233, 71862, 107478, 122068.

Fourth-year plumage.—Body primarily brown dorsally. Breast brown; possibly some dull-white on belly. Throat light brown or whitish; sides of head and possibly forehead dull-white; crown and nape often dull-white with brown-tipped feathers (sometimes largely brown). Light superciliary line and occasionally a dark line before and behind eye. Beak showing yellow on proximal one-half. Iris still brownish. UMMZ specimens 74304, 93904, 118574, 122072.

Fifth-year plumage.—Similar to adult plumage but with a sprinkling of brown on most of the white rectrices which may not be visible except with high power binoculars. Generally brown tips on some crown and nape feathers; sometimes entire crown still

brown. Iris yellowish. At a distance, without binoculars, an observer might mistake such a bird for an adult although the head appears somewhat darker.

At some time during development there was a change in the location of brown and white on some contour feathers. During the second and third years the bases were usually brown and the tips white; later they are reversed.

Sixth-year plumage.—Head white but a sprinkle of brown still present on rectrices and occasionally on the nape. This condition possibly persists for some time. Since this plumage pattern is difficult to distinguish in the field from the full adult plumage, birds in this plumage were censused as adults. This variation may simply represent a variation of the fifth-year plumage.

Considerable variation was evident in the third-year plumage. Possibly the birds with a sprinkling of white were second-year birds showing signs of molt. In the spring we noticed a few more birds in this condition. Although we found a few dropped brown contour feathers in the area, there was no indication of a heavy molt. Immatures trapped in the fall were all in fresh plumage.

This grouping of eagles into age-groups served the purpose of providing categories to be used in censusing the population. Although I feel that I viewed the variations with a fair degree of accuracy, there is no guarantee that I am correct. Much more data are necessary from birds of known ages before my grouping can be properly validated.

SUMMARY

Between 29 September 1962 and 9 April 1963, I continued my study of the winter eagle populations in northeastern Illinois. In addition to methods used previously, I introduced radiotelemetry techniques to the eagle research.

Immatures arrived in the area before adults and remained more abundant until mid-December. The adult population increased to 225 by early February. No eagles were present after 6 April.

Gizzard Shad continued to supply the main portion of the eagles' diet. The eagle population fluctuated according to the abundance of shad, with ice conditions, and with the advent of the breeding season. Sometimes eagles fed on fish discarded by commercial fishermen, on dead waterfowl, possibly on dead livestock, and on one occasion attempted to capture a live duck.

Eagles roosted singly or in small groups usually some distance from their feeding sites.

Nine eagles were captured in platform snares and a cannon net. Weights and measurements were taken.

Adult eagles were color-marked with dyes but plastic back-tags were used on immatures. In addition, six birds were equipped with miniature radio transmitters. The transmitter weighed about 80 grams, had a life of about 3 months, and enabled the investigator to follow the bird with radio-tracking equipment. Besides knowing the animal's location I could determine when it was soaring, flapping its wings, or preening. One eagle was tracked periodically for about 5 weeks. Occasionally a bird was tracked from the time it left the roost in the morning until it returned at night. One bird was tracked continuously for a distance of about 38 miles.

During about 5 weeks 118 locations were received by radio-tracking four birds in contrast to eight reports for 12 color-marked birds in 2 years.

Considerable variation was noted in immature plumages. On the basis of my observations and the examination of specimens at The University of Michigan Museum of Zoology I grouped the plumage patterns into six age-groups.

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THE SUMMER BIRDS OF THE TOXAWAY RIVER GORGE OF SOUTHWESTERN NORTH CAROLINA

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THE objectives of this study were to determine the species composition, relative abundance, habitat associations, and altitudinal distribution of the summer bird populations of the Toxaway River Gorge, Transylvania County, North Carolina.

Toxaway Gorge is one of several gorges which dissect the southern face of the Blue Ridge Plateau in southwestern North Carolina. The gorge was formed by the eroding action of the Toxaway River flowing over the Blue Ridge escarpment and down to the upper Piedmont of South Carolina, the river descending vertically 1,900 feet in a linear distance of approximately 6 miles. The depth of the V-shaped gorge from river bottom to ridge tops averages 500 to 600 feet.

Access to the gorge is limited. U. S. Highway 64 crosses its upper end at the 3,000-foot level. Logging roads penetrate the gorge at 1,400 feet and the mouth at 1,100 feet. Access otherwise is by foot over extremely rough, steep terrain.

The summer climate of the gorge region is generally warm and wet. The steep wall of the Blue Ridge escarpment, rising above the foothills of the South Carolina Piedmont, faces the prevailing moist winds and results in heavy summer rainfall. A total of 102 inches of rain was recorded in 1961 at nearby Lake Toxaway; 35.3 inches of this amount fell from 1 June to 31 August. This is slightly above the long-term average but is indicative of the unusually wet climate. Temperatures are moderate in summer, but annual averages are not available for any nearby point. The advance of spring up the full length of the gorge takes about 2 weeks.

The vegetation of the gorge progresses from that of typical Piedmont affinity at the lower end to montane aspects on the higher slopes. The five habitat-type designations used in this report follow those of Cooper (1963) for the same region, as outlined below.

The Pine Flats are of two types. The extensive alluvial pine flat in the mouth of the gorge has been severely altered by man over the past 50 to 60 years. Much of the area has been farmed, some of it until rather recently, and most of the forest has been disturbed. In places succession has progressed only to the sapling pine and blackberry (*Rubus* spp.) stage. Recent logging has also resulted in further opening of the canopy of the pole-sized forest. Virginia pine (*Pinus virginiana*) is dominant, with tulip poplar (*Liriodendron tulipifera*) and white pine (*Pinus strobus*) also present. Alder (*Alnus serrulata*) and willow (*Salix nigra*) grow along the riverbanks. The understory is primarily mountain laurel (*Kalmia latifolia*), with blackberry occurring in dense thickets in the earlier successional stages.

The Pine Flats along the river in the gorge proper are much more limited in extent and are generally more mesic, more mature, and less disturbed. Here a complete canopy of white pine, Virginia pine, hemlock (*Tsuga canadensis*), and tulip poplar is usually present. The main understory species is *Rhododendron maximum*.

The Mixed Mesophytic Cove and Slope Forest begins at the base of the coves and slopes and extends upward for varying distances, depending primarily upon moisture. The canopy may contain as many as 15 to 20 species (Cooper, 1963). Red maple (*Acer rubrum*), sweet birch (*Betula lenta*), beech (*Fagus grandifolia*), basswood (*Tilia heterophylla*), hickories (*Carya* spp.), tulip poplar, and hemlock are most frequently encountered. The shrub layer is generally poorly developed, but local, dense thickets of mountain laurel and rhododendron do occur. A well-developed herbaceous layer is usually present.

The Oak Forests gradually become differentiated from the Mixed Mesophytic type as the sites become drier. The upper slopes and most of the higher ridges are Oak Forest. Scarlet oak (*Quercus coccinea*), white oak (*Quercus alba*), chestnut oak (*Quercus prinus*), and hickories are most abundant in the canopy. Mountain laurel forms a nearly solid understory beneath much of this type.

The Pine Ridges are limited in extent and occur only on the very dry, most exposed ridges. Virginia pine and pitch pine (*Pinus rigida*) are dominant in this type.

It should be noted that, with the exception of the lower parts, the whole gorge area is covered by relatively unbroken forest. Some disturbance due to logging may be found in nearly all types, but generally this is not enough to create any extensive edge effect, except in the heavily disturbed Pine Flats of the gorge mouth.

METHODS

Field work was initiated in late April of 1961, when 2 days were spent in a preliminary survey of the gorge. Full-time research began on 13 June 1961, when the senior author moved into a permanent campsite established by the Highlands Biological Station. The unavoidably late start prevented a complete survey of the nesting period, and many first broods were in the fledgling stage when field work began. The field program was terminated on 22 August 1961. While in the gorge, censuses were conducted from three base elevations. The period 13 June to 1 August was spent primarily in the middle gorge (1,300 to 1,700 feet base elevation) and 2 to 10 August in the lower gorge (1,100 to 1,200 feet base elevation). No campsite was established in the upper gorge (2,600 to 3,000 feet base elevation), but one-day trips were made to this section throughout the summer. The area between 1,800 feet and 2,600 feet was not studied due to the difficulty of reaching this part of the gorge from the base camps. Censuses were conducted at all levels from the river bottom to the ridgetops from each base station.

The census method made use of daily transects of no definite width, each extending through a series of habitat types. Along each transect observations were timed by habitat and altitude to allow expression in birds per hour for each type included. The period of sampling was from daylight until the lessening of morning activity, or about 3 hours. The transect method was chosen

after some experimentation, rather than the more precise method of quadrat analysis, due to the extremely rough, steep terrain and dense shrub layer that was present throughout much of the gorge. The choice of transects as the sampling method necessarily resulted in the use of relative abundance as a measure of the population level rather than absolute abundance (Kendeigh, 1944; Stevenson, 1941).

In addition to the transects, considerable time each day was spent in spot checking. This information was used to help evaluate the overall situation. However, only the data from the specific transects were used in Table 1.

During the study period 42 specimens were collected. These skins have been placed in the collection of the Department of Zoology of North Carolina State College.

Plant names conform to Fernald (1950), and bird names to the American Ornithologists' Union (1957).

RESULTS

The relative abundance of each species in the five major habitats considered is listed in Table 1. Those species not directly associated with any of these habitat types, such as the hawks, the Spotted Sandpiper, the Rough-winged Swallow, and the Kingfisher, are listed in the last column.

We have presented the actual values, in birds per hour, in order to allow direct comparisons with other studies. In view of the differential observability of the various species, the more secretive birds appear less abundant while the obvious ones appear more numerous (Kendeigh, *op. cit.*:74). Also, birds such as hawks are almost certain to be recorded as uncommon or rare, whereas they may actually be present in numbers approaching the carrying capacity of the habitats.

The major portion of the field work for this study was accomplished at altitudes of from 1,200 to 2,000 feet. Thus the results more clearly represent this section of the gorge.

Sixty-four species of birds were recorded. None of these had an abundance rating of over one bird per hour throughout all habitat types. However, the Red-eyed Vireo, the Cardinal, the Carolina Chickadee, the Black-and-white Warbler, and the Tufted Titmouse had values of 0.50 bird per hour or above in all habitat types.

The largest number of species in a single type was 45 in the Pine Flats of the mouth of the gorge. The other habitats each had between 25 and 34 species and were thus relatively similar in species number. A comparison of total abundance between habitats also showed that the Pine Flats of the gorge mouth contained relatively more individuals than did the other types. Both of these abundance conditions appeared to be due to the increased vegetative

TABLE 1
RELATIVE ABUNDANCE OF THE SUMMER BIRDS OF THE MAJOR HABITAT TYPES OF THE
TOXAWAY RIVER GORGE*

Species	Pine Flats in mouth of gorge (20 hr)	Mixed Meso- phytic Coves and Slopes (30 hr)	Oak Forests (19 hr)	Pine Flats in the gorge proper (15 hr)	Pine Ridges (7 hr)	No direct habitat associa- tion
Turkey Vulture	—	—	—	—	—	R (0.05)
Red-tailed Hawk	—	—	—	—	—	U (0.20)
Cooper's Hawk	—	—	—	—	—	R (0.05)
Broad-winged Hawk	—	—	—	—	—	U (0.14)
Ruffed Grouse	—	—	R (0.05)	—	—	—
Spotted Sandpiper	—	—	—	—	—	R (0.05)
Mourning Dove	U (0.15)	—	R (0.05)	—	—	—
Yellow-billed Cuckoo	U (0.50)	U (0.20)	—	—	—	—
Screech Owl	R (0.10)	—	—	U (0.20)	—	—
Barred Owl	R (0.05)	—	—	—	—	—
Whip-poor-will	U (0.25)	—	—	—	—	—
Chimney Swift	—	—	—	—	—	C (0.85)
Ruby-throated Hummingbird	U (0.30)	U (0.13)	U (0.26)	C (0.53)	C (0.53)	—
Belted Kingfisher (1)	—	—	—	—	—	R (0.05)
Yellow-shafted Flicker	R (0.05)	R (0.10)	U (0.32)	—	U (0.14)	—
Pileated Woodpecker	U (0.15)	U (0.30)	U (0.42)	—	—	—
Hairy Woodpecker	U (0.50)	U (0.16)	—	—	U (0.14)	—
Downy Woodpecker (2)	C (0.60)	U (0.37)	U (0.37)	—	U (0.29)	—
Great Crested Flycatcher	R (0.05)	—	—	R (0.06)	—	—
Eastern Phoebe	—	U (0.33)	R (0.05)	U (0.33)	U (0.43)	—
Acadian Flycatcher (1)	R (0.05)	R (0.10)	U (0.32)	—	—	—
Rough-winged Swallow	—	—	—	—	—	C (0.54)
Blue Jay (1)	R (0.05)	C (0.61)	U (0.37)	A (1.13)	C (0.86)	—
Common Raven	—	—	R (0.10)	—	—	—
Common Crow	U (0.20)	R (0.10)	U (0.21)	—	—	—
Carolina Chickadee (1)	A (1.45)	A (1.70)	C (0.89)	A (1.20)	A (1.71)	—
Tufted Titmouse	C (0.60)	C (0.67)	C (0.89)	U (0.47)	C (0.86)	—
White-breasted Nuthatch	—	—	R (0.05)	—	—	—
Carolina Wren	A (1.85)	U (0.43)	U (0.42)	U (0.40)	—	—
Catbird	R (0.05)	—	R (0.05)	—	—	—
Brown Thrasher (1)	C (0.60)	R (0.03)	—	R (0.07)	U (0.14)	—
Robin	R (0.10)	R (0.07)	—	—	U (0.43)	—
Wood Thrush	R (0.05)	U (0.17)	U (0.16)	U (0.16)	C (0.60)	—
Blue-gray Gnatcatcher	U (0.40)	R (0.07)	—	R (0.07)	—	—
Yellow-throated Vireo (1)	R (0.05)	R (0.07)	—	—	—	—

* The numbers in parentheses following the species name refer to the number of individuals collected. The letters in the columns represent assignment of the following ranges of variation, in birds per hour, to the standard relative frequency terms: A = Abundant, greater than 1.01 birds per hour; C = Common, 0.51 to 1.00 bird per hour; U = Uncommon, 0.11 to 0.50 bird per hour; and R = Rare, less than 0.11 bird per hour. The values in parentheses following the letter code are the actual number of birds per hour calculated for each habitat type. The numbers in parentheses immediately below the habitat type designations represent the number of hours upon which the data were calculated. No hours are given for the last column as these were calculated in the habitat types being censused at the time of the observations.

TABLE 1 (Continued)

Species	Pine Flats in mouth of gorge (20 hr)	Mixed Meso- phytic Coves and Slopes (30 hr)	Oak Forests (19 hr)	Pine Flats in the gorge proper (15 hr)	Pine Ridges (7 hr)	No direct habitat association
Solitary Vireo (3)	C (0.55)	U (0.20)	R (0.10)	C (0.87)	—	—
Red-eyed Vireo (2)	A (2.15)	A (2.07)	A (1.79)	C (0.87)	C (0.71)	—
Black-and-white Warbler (2)	U (0.50)	C (0.80)	A (1.32)	A (1.31)	C (0.71)	—
Swainson's Warbler (2)	—	U (0.23)	U (0.26)	C (0.67)	U (0.14)	—
Worm-eating Warbler (5)	U (0.25)	A (1.33)	U (0.47)	C (0.67)	U (0.14)	—
Parula Warbler	U (0.20)	U (0.27)	R (0.11)	U (0.33)	—	—
Black-throated Blue Warbler	R (0.15)	R (0.03)	—	R (0.07)	—	—
Black-throated Green Warbler	U (0.20)	U (0.50)	C (0.53)	U (0.27)	U (0.29)	—
Blackburnian Warbler	—	—	—	R (0.07)	—	—
Yellow-throated Warbler	C (0.65)	R (0.03)	R (0.05)	—	—	—
Chestnut-sided Warbler	—	—	R (0.05)	U (0.13)	U (0.14)	—
Pine Warbler	R (0.05)	—	—	—	—	—
Prairie Warbler (1)	U (0.40)	—	—	—	U (0.29)	—
Ovenbird (1)	U (0.20)	U (0.20)	U (0.31)	U (0.20)	—	—
Louisiana Waterthrush (1)	R (0.05)	U (0.27)	—	C (0.73)	—	—
Kentucky Warbler (1)	—	—	U (0.11)	U (0.27)	U (0.14)	—
Yellow-breasted Chat	U (0.25)	—	—	—	—	—
Hooded Warbler (1)	U (0.25)	C (0.83)	C (0.63)	U (0.27)	U (0.29)	—
Canada Warbler (1)	—	R (0.03)	—	R (0.07)	—	—
American Redstart (1)	R (0.10)	R (0.03)	—	R (0.07)	—	—
Scarlet Tanager (1)	C (0.65)	U (0.37)	C (0.58)	U (0.20)	U (0.43)	—
Summer Tanager	R (0.05)	R (0.03)	—	—	—	—
Cardinal (1)	U (0.25)	U (0.43)	C (0.74)	A (1.67)	C (0.71)	—
Indigo Bunting	U (0.45)	—	U (0.21)	U (0.20)	U (0.14)	—
American Goldfinch	A (1.35)	U (0.37)	—	—	—	—
Rufous-sided Towhee	—	R (0.10)	U (0.11)	—	C (0.71)	—
Chipping Sparrow (1)	C (0.55)	—	—	—	—	—
Field Sparrow	C (0.55)	—	—	—	—	—
Song Sparrow	—	—	—	R (0.07)	—	—
Total species	45	34	33	30	25	8 = 64 total
Total birds per hour	18.55	13.83	12.95	10.47	11.00	species

complexity which resulted in more available niches in the Pine Flats of the gorge mouth.

Most species occurred in more than one of the types. However, only 11 were recorded in all five major types, while 12 were found in only a single type. As calculated from all species ratings in the five habitat types (Table 1), the general relative abundance scores were: rare—30%, uncommon—43%, common—19%, and abundant—8%.

DISCUSSION

The general affinities of the bird life of the Toxaway Gorge were with the upper Piedmont. However, six birds that may be called mountain species (Black-throated Blue Warbler, Swainson's Warbler, Parula Warbler, Black-and-white Warbler, Black-throated Green Warbler, and Scarlet Tanager) were present throughout the gorge. Five additional montane species (Common Raven, Chestnut-sided Warbler, Canada Warbler, Blackburnian Warbler, and Song Sparrow) were recorded at least once, primarily in the upper gorge. In late summer, as postbreeding wandering became evident, observations of the more typically montane species increased. The apparent limitation of some species to the lower gorge appears to have been due to the availability of habitat rather than being a function of altitude as such, since Stevenson (1957) recorded all of these species at considerably higher elevations in regions where their preferred habitat types extended to greater altitudes.

In a study of the summer bird population of the Highlands Plateau, 20 miles west and about 1,000 feet higher in elevation than the highest point in the present study area, Odum (1950) found a generally high population of birds in comparison with similar but drier areas farther north in the Appalachians. He concluded that the high moisture level, by increasing the amount and diversity of the vegetation of the Highlands Plateau, was probably responsible for this increased abundance. This hypothesis should also apply to the Toxaway Gorge area with its high annual rainfall. A direct comparison between the two studies is not possible, but in the oak sere Odum recorded 26 species of birds, whereas in the gorge we recorded 33 species in the Oak Forest. In the Piedmont of Georgia a study showed 24 species nesting in the climax Oak-Hickory type (Johnston and Odum, 1956). This general comparison is indicative of the high number of species inhabiting the Toxaway Gorge area in summer. The abundance of individuals may also be considered as relatively high throughout the gorge.

Several observations were made which seem to deviate significantly from Stevenson's altitudinal records (Stevenson, 1941, 1957). A Canada Warbler was recorded at 2,200 feet, about 1,200 feet lower than recorded by Stevenson, and Black-throated Blue Warblers were found at 1,200 feet, almost 2,000 feet lower than Stevenson's records. Black-throated Green Warblers at 1,200 feet in the Toxaway Gorge were also lower than commonly reported, the lowest published record being 1,600 feet (Odum, 1945). These were all late summer observations, however, and probably most represented postbreeding wanderers rather than nesters.

The status of the Spotted Sandpiper in the gorge was uncertain. It has been

recorded nesting in the North Carolina mountains (Pearson et al., 1959), but all of our observations were in August and may have been of fall migrants.

Perhaps the most significant finding of this survey as regards species presence was the discovery of the Swainson's Warbler as a rather common summer resident throughout the gorge. This bird was known only as a coastal swamp nesting species in the southeast until it was found nesting in the mountains of Georgia in 1950 (Burleigh, 1958). It has also been observed occasionally in summer in the North Carolina mountains (Pearson et al., 1959) and once in the South Carolina mountains, only one-half mile from the North Carolina state line (Schuler, 1962). Stevenson (1941) called it a rare summer resident near Highlands on the basis of two singing males in late June and early July. However, no actual evidence of nesting had been found until Parnell observed an adult Swainson's Warbler feeding two fledgling young in the mouth of a densely vegetated cove at 1,400 feet in the Toxaway Gorge. The young birds were capable of only short flights and appeared to have been out of the nest only one or two days. Singing males were recorded throughout the summer from 1,200 feet up to 2,800 feet, but no nests or subsequent young were found. Two male Swainson's Warblers were collected, and both had the enlarged testes characteristic of breeding birds. Most first broods of this species probably were fledged prior to the 13 June initiation of the field work.

The Toxaway Gorge habitat chosen by the Swainson's Warbler was basically similar to the description given by Burleigh (1958). They showed a preference for dense stands of rhododendron, mountain laurel, and dog hobble (*Leucothoe editorum*) along the narrow river bottom Pine Flats. The Mixed Mesophytic Coves and Slopes and the Oak Forest were utilized to a lesser degree.

The presence of this rather sizable population of Swainson's Warbler in the Toxaway Gorge suggests that this species may also be a common summer resident in the other river gorges that drain the Blue Ridge Plateau. The senior author found the song of this species to be very similar to that of the Louisiana Waterthrush, which was usually found in the same habitats. Confusion between these songs would be very likely by persons familiar with the Louisiana Waterthrush but not with the Swainson's Warbler. Williams (1953) noted a decided similarity between the songs of these two species in the Tryon region of the North Carolina mountains. F. R. Scott noted, in an observation in the Great Smoky Mountains National Park, a Swainson's Warbler song resembling that of an aberrant Louisiana Waterthrush (Stupka, 1963). This problem would be compounded by the retiring habits of the Swainson's Warbler which make it very difficult to see. It is likely that this confusion is partially responsible for the scarcity of records of this species.

Further intensive research is needed to determine the extent and abundance of this poorly known population.

The Worm-eating Warbler was found commonly in the same habitats as the Swainson's Warbler. No nests were located, but two broods of fledglings were observed. This species generally could be found along any brushy ravine, regardless of which more extensive vegetative type it penetrated. Pearson et al. (1959) listed this species as being "locally common" in the mountains of North Carolina, and Burleigh (1958) found it "fairly common" in the Georgia mountains. It was one of the most abundant warblers in the present study area. The presence of both the Worm-eating Warbler and the Swainson's Warbler in sizable populations in very similar habitat conditions provides an excellent opportunity for a comparative study.

SUMMARY

A study of the summer bird populations of the Toxaway River Gorge was conducted in 1961. Altitudes in this deep gorge draining a portion of the Blue Ridge Plateau range from 3,000 feet down to 1,100 feet. The climate is warm and wet. The luxuriant vegetation represents a transition from upper Piedmont affinities to the mixed mesophytic and oak forests of the southern Appalachians.

Timed transects were chosen as the method of censusing the bird population, due to the rough terrain and dense vegetation throughout most of the gorge. This resulted in relative values as the measure of population abundance.

Sixty-four species were recorded in the five major habitat types studied. The Pine Flats of the mouth of the gorge had the largest number of species with 45, the Mixed Mesophytic Slopes and Coves had 34 species, the Oak Forests 33 species, the Pine Flats of the gorge proper 30 species, and the Pine Ridges 25 species. Eight species had no direct habitat associations. Most species occurred in several types. However, 11 were recorded in all five types, while 12 were limited to a single type.

The general affinities of the birds of the gorge were with the upper Piedmont, with some montane species present as nesters and a few others recorded as late summer wanderers. The general abundance levels were considered to be relatively high, both in species and individuals, as determined from the present investigation and in limited comparison with published studies in the Piedmont and mountains.

The Swainson's Warbler was discovered to be a common summer resident of the Toxaway Gorge. This was the first positive record of this species nesting in western North Carolina. This warbler showed a preference for the dense thickets along the narrow river bottom Pine Flats, but it was recorded also in the Mixed Mesophytic Slopes and Cove Forests and the Oak Forests.

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ADDITIONAL RECORDS OF AVIAN EGG TEETH

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IN an admittedly preliminary survey (Clark, 1961), the junior author listed 46 families of birds for which he had found records of the presence in hatchlings or embryos of an egg tooth on the upper mandible. In five additional families (Haematopodidae, Charadriidae, Recurvirostridae, Burhinidae, Bucerotidae), egg teeth or analogous structures had been reported as having been found on the lower jaw only. The 1961 paper was based primarily on an extensive but by no means exhaustive survey of the literature, supplemented by examination of specimens at the Yale Peabody Museum of Natural History.

In connection with a study of early plumages of birds, we have had occasion to handle several hundred additional specimens, both study skins and alcoholics, and have taken advantage of this opportunity to record additional data on egg teeth. The principal collections utilized were those of the American Museum of Natural History (hereinafter abbreviated as AMNH), Chicago Natural History Museum, Carnegie Museum (CM), and Yale Peabody Museum. Parkes examined certain additional specimens in the collections of the United States National Museum (USNM), University of California (both Berkeley and Los Angeles), the California Academy of Sciences, and Cornell University (CU).

Unless otherwise specified, records of egg teeth in the following list are based on specimens examined by one or both of us. Also included are additional literature records, both prior and subsequent to Clark's 1961 paper. Families not previously reported by Clark as having egg teeth on the upper mandible are starred (*): there are 51 such additional family records included in the present paper. Confirmatory records or discussions of families previously reported are given in some cases, especially when only one or two species of large families were definitely known to have egg teeth. The family sequence followed is that of Wetmore (1960).

The large number of families and genera from which egg teeth have now been reported makes it increasingly likely that Gadow (1891) was correct in stating that this structure occurs in the embryos of all birds. The presence and the gross similarity of egg teeth on the upper mandible among such a diversity of families strongly suggests that this structure is homologous throughout the class Aves and thus was presumably present in the common ancestors of living birds. One problem which remains to be studied is the mode of loss of the egg tooth. In some groups it is obviously quickly deciduous; in others it appears to be shed after a longer period; and in still others (notably passerines) it gradually disappears without, apparently, actually falling off. Pycraft

(1900:154) attempted to confine the definition of the true egg tooth to a "detachable" structure, believing that the egg tooth in all "Neognathae" is "detachable, and falls off after [hatching]." He described for the "Palaeognathae" a "non-detachable egg-tooth becoming absorbed after hatching." The latter mode of loss, however, is also found in many "Neognathae," as mentioned above, and Pycraft's separation cannot be upheld.

Negative evidence such as the absence of egg teeth on the culmens of some of the specimens mentioned later must be interpreted with caution. It is entirely possible that the egg tooth may have been lost in some of these during preservation or later handling. Records of absence of an egg tooth in an avian species can be misleading unless adequate series of freshly collected material are available to cover potential individual variations in time of loss of egg tooth, and possible effects of drying or preservation in fluids on the presence and distinctness of the egg tooth.

ANNOTATED LIST

Spheniscidae.—Clark (1961) listed five species of four genera of penguins for which egg teeth had been reported; to these we can now add *Spheniscus demersus*.

*Rheidae.—*Rhea americana*.

*Dromiceidae.—Miranda-Ribeiro (1936) described and figured a 23-day embryo of *Dromaeus* (= *Dromiceius*) *novae-hollandiae* with an egg tooth. We have seen an egg tooth on a downy young emu in the AMNH collection.

*Tinamidae.—Beebe (1925) described the egg tooth and its use during hatching of *Crypturellus variegatus*. A one-day-old chick of *C. soui* (AMNH) shows a pale calcified cap over the whole terminal segment of the bill, of which only a part is raised into a tooth. We have also seen egg teeth in *Rhynchotus rufescens*, *Tinamus major*, and *Nothura maculosa*.

Gaviidae.—The egg tooth has now been recorded in all four species of loons. Clark (1961) had seen only *Gavia immer*; we have now seen egg teeth on study skins of *G. stellata* and *G. arctica* (CM), while Sutton (1963) has described the egg tooth of *G. adamsii*.

Podicipedidae.—Additional species records: *Podiceps dominicus*, *P. auritus*, *P. caspius*, *P. rolland*, *Podilymbus podiceps*. See also Fisher (1961).

*Diomedidae.—We have seen the egg tooth only in *Diomedea bulleri*. Sorensen (in Bailey and Sorensen, 1962:126) describes the egg tooth of a chick of *D. exulans* approximately 4 days old. The egg tooth is visible in several excellent photographs by Dr. Bailey of *D. epomophora* (op. cit.:157, 161, 162). The egg tooth of this species is said to "drop off" during the fourth week posthatching (op. cit.:159) while that of *Phoebetria palpebrata* is said to "remain briefly" (op. cit.:205).

Procellariidae.—Clark (1961) listed a record of an egg tooth in "*Procellaria grisea*," as originally published by Richdale (1945). This is *Puffinus griseus* of the A.O.U. Check-list. In a later paper Richdale (1963:27) reports that the egg tooth of *Puffinus griseus* "disappears" between the ages of 9 and 11 days (based on nine records). We have subsequently seen egg teeth also in *Puffinus auricularis* and *P. lherminieri*. Tickell (1962) reports the egg tooth gone by the tenth day posthatching in *Pachyptila desolata*.

Hydrobatidae.—Additional species: *Oceanodroma leucorhoa*, *O.* (“*Loomelania*”) *melania*, *Halocyptena microsoma*.

*Phaethontidae.—*Phaethon aethereus*, *P. lepturus*, *P. rubricauda*.

*Pelecanidae.—*Pelecanus erythrorhynchos*, *P. occidentalis*.

*Sulidae.—*Sula dactylatra*, *S. leucogaster*, *Morus serrator*, *M. bassanus*. The egg tooth of the Gannet is clearly shown in a plate by Joseph Wolf accompanying a paper by Cunningham (1866), in which the following description appears: “The bill [of the young bird when just hatched] is horn-coloured at the tip, and the upper mandible is provided with a scale, which soon disappears.”

*Anhingidae.—*Anhinga ruja*.

Ardeidae.—Clark (1961) listed egg tooth records only for *Ardea cinerea*. To these we can add *Butorides virescens*, *Florida caerulea*, *Dichromanassa rufescens*, *Egretta* (*Casmerodius*) *alba*, *Egretta* (*Leucophoyx*) *thula*, *Nycticorax nycticorax*, and *Botaurus stellaris* (the latter shown in a photograph in Whitlock, 1953, pl. 35).

*Cochleariidae.—A study skin of a small downy young *Cochlearius cochlearius* (USNM) shows a typical culmen egg tooth.

*Ciconiidae.—The egg tooth in *Mycteria americana* is quite persistent. It is apparent in a large downy young with a culmen length of 82.5 mm (as compared with 30 mm in the youngest available specimen—both USNM).

*Phoenicopteridae.—*Phoeniconaias minor*.

*Cathartidae.—*Cathartes aura*, *Coragyps atratus*.

*Falconidae.—*Falco sparverius*.

*Cracidae.—*Chamaepetes goudotii*, *Ortalis wagleri*, *O. vetula*.

*Tetraonidae.—We have seen egg teeth in *Bonasa umbellus* and *Canachites canadensis*. Examination of several dozen study skins of very young downy grouse of four or five genera (CM) without finding egg teeth suggests that the structure is lost very shortly after hatching in this family, as reported for the Phasianidae (Clark, 1961). A photograph of “day-old” chicks of *Centrocerus urophasianus* (Patterson, 1952) shows what appear to be egg teeth.

*Numididae.—*Guttera* sp.

*Meleagrididae.—Peterson (1963:150, 151) has published photographs of a 23-day embryo and a newly hatched chick of the “turkey,” presumably domestic *Meleagris gallopavo*. The egg tooth is visible in the photographs.

Turnicidae.—A chick of *Turnix suscitator* that could hardly have been more than a day or two out of the egg was purchased from natives by Parkes in Luzon, Philippines, and prepared as a study skin. No egg tooth is visible; under magnification a faint depression can be seen on the culmen at the usual site of the egg tooth, but we have not yet recorded an actual egg tooth in *Turnix*.

*Aramidae.—*Aramus guarauna*.

Rallidae.—Clark (1961) mentioned records of egg teeth on the upper mandible of *Rallus elegans*, *R. limicola*, *Notornis mantelli*, and *Fulica atra*. To these we can now add *Ortygonax rytirhynchos*, *Limnecorax flavirostra*, *Laterallus jamaicensis*, *Porphyriops melanops*, *Gallinula chloropus*, *Porphyryla martinica*, *Porphyrio porphyrio*, *Fulica americana*, *F. ardesiaca*, *F. armillata*, and *F. rufifrons*.

*Heliornithidae.—*Podica senegalensis*; specimen at AMNH seen by Clark through the courtesy of Dr. James P. Chapin.

Otididae.—Clark (1961) listed specific records only for *Afrotis afra*. We can now add *Choriotis kori*, *C. australis*, *Chlamydotis undulata*, and *Houbaropsis bengalensis*.

*Haematopodidae.—Clark (1961) listed for this family only an old record of a “tooth-

like callosity on the lower jaw" of *Haematopus ostralegus*. We have now examined typical egg teeth on the upper mandible of both *H. ostralegus* and *H. palliatus*. Webster (1941) published a photograph of a week-old chick of *H. bachmani* and called attention to the fact that the egg tooth was still visible.

*Charadriidae.—Clark (1961) mentioned only a secondhand report of "a small egg tooth on the anterior end of the lower mandible of *Vanellus vanellus*." Gerber (1939) has published excellent photographs of 12- and 14-day embryos of the latter species which clearly show typical culmen egg teeth on the upper mandible. A study skin of a small downy *Eupoda montana* (CM) shows a very small bump which may be the remains of an egg tooth, as it is not present in a somewhat older chick. One of two very young sibling *Sarciophorus tectus* (CM) shows what appears to be the scar of a recently dehisced egg tooth. These specimens, plus study skins of several species of *Charadrius* preserved within a day or two of hatching and lacking egg teeth, strongly suggests that, as in many Galliformes, the egg tooth is quickly lost in plovers.

Scolopacidae.—As in the Charadriidae, the egg tooth of the upper mandible appears to be lost shortly after hatching in the Scolopacidae. Clark (1961) quoted Romanoff (1960) to the effect that this was true of *Gallinago gallinago* and *Scolopax rusticola*. Clark also cited Wetherbee (1959), who did not find an egg tooth in a newly hatched *Philohela minor*; Wetherbee and Bartlett have since (1962) published a detailed account of the egg teeth and hatching technique of this species. The four woodcock chicks they observed "had egg teeth on both upper and lower jaws. The one on the upper jaw was typical, but the egg tooth of the lower jaw appeared as a rounded, smooth, calcareous deposit only barely raised from the surface of the bill, and was located at the extreme tip of the bill. The teeth were shed between the second and third day after hatching." The latter seems rather late for loss of egg tooth in a scolopacid (see below).

The reported variations in occurrence of egg teeth in the Scolopacidae need further study. Although, as mentioned above, Romanoff (1960) implied that *Gallinago gallinago* possesses a typical egg tooth on the upper mandible (i.e., on the culmen near the tip), an alcoholic specimen of *G. g. delicata* taken from an egg just pipped (CM) shows hardened areas at the tips of both mandibles, but no typical tooth on the culmen. In a reverse discrepancy, Clark (1961) quoted Willink (1899) as having found an egg tooth on the anterior end of the lower jaw of *Numenius* sp. However, Parkes has examined an embryo of *N. tahitiensis* (CU) taken from the egg 3 days before the remainder of the clutch hatched (see Allen and Kyllingstad, 1949). This clearly shows a well-developed egg tooth near the tip of the culmen, but nothing resembling an egg tooth on the lower mandible. That the egg tooth at the upper mandible is ephemeral is suggested by the color photographs published by Allen (1948). In his plate II, the bill tip is visible in three of four newly hatched Bristle-thighed Curlews; in two of these the egg tooth is visible, while in the third only a slight scar appears to be present. In plate III, a single chick of another brood shows no sign of an egg tooth.

Carnegie Museum contains long series of study skins of various sandpipers, many certainly younger than the 2 to 3 days at which the egg tooth is lost in *Philohela* according to Wetherbee and Bartlett (1962). None of these chicks appears to have an egg tooth. A series of eight *Erolia minutilla* in the USNM alcoholic collection, apparently removed from the eggs just prior to hatching, shows typical culmen egg teeth, as well as apparent calcification of the very tip of both mandibles. An alcoholic specimen of *Catoptrophorus semipalmatus* (USNM), stated on the label to be 26 hours old, shows no trace of an egg tooth.

*Recurvirostridae.—Clark (1961) listed only an old record for an egg tooth on the

lower mandible of *Recurvirostra avosetta*. A study skin of a very young *R. americana* (CM) shows a strong culmen egg tooth, absent in another specimen about a day older.

*Burhinidae.—*Burhinus oedicnemus*, *B. senegalensis*, *Esacus recurvirostris*.

*Clareolidae.—*Pluvianus aegypticus*.

*Chionidae.—*Chionis minor*.

*Stercorariidae.—*Stercorarius pomarinus*, *S. parasiticus*, *S. longicaudus*.

*Rynchopidae.—*Rynchops nigra*, *R. flavirostris*.

Cuculidae.—Clark (1961) listed *Centropus* and *Crotophaga*; we have found egg teeth also in *Clamator glandarius*, *Coccyzus erythrophthalmus*, *Saurothera vetula*, *Tapera naevia*, and *Geococcyx californianus*.

Strigidae.—Clark (1961) mentioned only *Nyctea*. We have now seen egg teeth in *Otus asio*, *Micrathene whitneyi*, *Speotyto cunicularia*, and *Asio otus*, as well as additional specimens of *Nyctea scandiaca*. Among the excellent photographs of owls assembled by Bösiger and Faucher (1958), egg teeth can be seen on nestling *Strix aluco*, *Nyctea scandiaca*, *Bubo bubo*, and *Asio flammeus*.

Steatornithidae.—The presence of an egg tooth in *Steatornis caripensis* is suggested by Snow's description (1961) of the young bird emerging from the shell "by cutting a circular cap from the broad end of the egg." This should be confirmed by examination of specimens.

*Aegothelidae.—*Aegotheles cristatus*.

*Caprimulgidae.—*Caprimulgus vociferus*, *Nyctidromus albigollis*.

*Apodidae.—Burckhardt (1954) published line drawings of embryonic *Apus melba* showing protuberances suggestive of egg teeth. Fischer (1958:113) published a photograph of a *Chaetura pelagica* "less than 24 hours old" in which the egg tooth is visible. Occurrence in the Apodidae is confirmed by alcoholic specimens of newly hatched *Collocalia troglodytes* (CM).

*Alcedinidae.—Drawings published by Burckhardt (op. cit.) also suggest presence of an egg tooth in *Alcedo atthis*. We have recorded it on numerous alcoholic specimens of *Megaceryle alcyon*, and a study skin of a fully feathered, stub-tailed young *Halcyon senegalensis*.

*Coraciidae.—*Coracias garrulus*.

*Leptosomatidae.—*Leptosomus discolor*.

*Upupidae.—Skead (1950) reported egg teeth on the upper mandible of newly hatched *Upupa africana*.

*Bucerotidae.—Clark (1961) had no definite records of an upper mandible egg tooth in any hornbill, but has subsequently examined one on an alcoholic specimen of *Tockus alboterminatus* (AMNH).

*Formicariidae.—A stub-tailed young *Rhegmatorhina gymnops* (CM) has a small but clearly developed egg tooth. A young *Thamnophilus dohrnatus* of about the same stage of plumage development has a small pimple, barely visible, remaining, as does a somewhat older *Taraba major* (CM). In a juvenile *Grallaria squamigera* with remiges half grown and rectrices not yet appearing, the egg tooth is small but clear, while in a juvenile *G. erythrotis* only slightly older, there is no trace of an egg tooth. We have as yet seen egg teeth in no other member of the superfamily Furnarioidea of Wetmore.

*Cotingidae.—*Attila spadiceus*, *Tityra semifasciata*, *Rupicola peruviana*. In two study skins of stub-tailed young *Pachyrhynchus polychopterus* (CM), the culmen egg tooth is present, and there is at least a suggestion that the tip of the lower mandible may also have been hardened. It would be of great interest to examine younger specimens in this connection.

*Tyrannidae.—King (1955) states of the egg tooth of *Empidonax traillii*: "This structure is visible throughout nestling life. Its white tip is apparent to the unaided eye until about day 4.5 or 5.5. Because of the heterogonic growth of the bill, it shifts from its initial position on the culmen until, at about twelve days, it appears as a minute tubercle on the hook of the bill. It has thus rotated through 90 degrees." Specimens we have examined suggest that a similar change in position takes place in other tyrant flycatchers and cotingas. Study skins of known or estimated age in AMNH include a 16-day specimen of *Arundinicola leucocephala* and a 19-day (estimated) specimen of the much larger *Pitangus sulphuratus*. In both of these the egg tooth is clearly visible but small. We have also recorded egg teeth in *Tyrannus melancholicus*, *Muscivora tyrannus*, *Sayornis phoebe*, and *Todirostrum cinereum*.

*Alaudidae.—*Lullula arborea*, *Eremophila alpestris*.

*Hirundinidae.—*Hirundo rustica*.

*Dicuridae.—*Dicurus adsimilis*.

*Cracticidae.—*Gymnorhina leuconota*.

*Ptilonorhynchidae.—*Prionodura newtoniana*.

*Paridae.—*Parus atricapillus*, *P. atricristatus*.

*Timaliidae.—*Turdoides bicolor*, *Garrulax pectoralis*.

*Pycnonotidae.—*Pycnonotus cafer*, *P. barbatus*.

*Mimidae.—*Dumetella carolinensis*, *Toxostoma rufum*.

Turdidae.—Clark (1961) listed only a report of "anlagen of egg teeth in both upper and lower jaws in embryos of *Turdus merula*." We have seen egg teeth in preserved specimens of *Turdus libyanus*, *T. albiventris*, *Hylocichla mustelina*, *Catharus guttatus*, and *Pogonochila stellaris*, and study skins of *Saxicola dacotiae* and *Turdus migratorius*.

*Sylviidae.—*Cisticola lais*.

*Prunellidae.—It is always difficult to determine whether preparators have correctly aligned the upper and lower mandibles in study skins. A specimen of *Prunella modularis* (CM), with feathers in the major tracts barely beginning to emerge from their sheaths, has the lower mandible extended beyond the upper, and with a hardened tip. There is also a small egg tooth almost at the tip of the culmen.

*Motacillidae.—*Anthus spinoletta*, *Motacilla grandis*.

Laniidae.—Clark (1961) quoted a record of egg teeth in *Lanius ludovicianus*. We have also seen egg teeth in *L. collaris* and *Tchagra* sp.

*Parulidae.—*Seiurus aurocapillus*.

Ploceidae.—Records of species supplementing the account in Clark (1961) include: *Amblyospiza albifrons*, *Ploceus xanthops*, *P. nigerrimus*, *Lonchura (Spermestes) cucullatus*, and *Estrilda* sp.

Icteridae.—As quoted by Clark (1961), Friedmann (1929) stated that the egg tooth of *Molothrus bonariensis* is no longer very distinct after the fifth day posthatching. A study skin of a nestling of this species (AMNH), the age of which was estimated by the collector to be 12 days, clearly shows a small egg tooth. Two study skins of *Icterus nigrogularis* (AMNH), estimated by the collector to have been 12 and 13 days old, respectively, show not only a well-developed culmen egg tooth, but what appear to be calcified caps to the tips of both mandibles.

*Thraupidae.—A nestling of *Thraupis virens* (AMNH), said by the collector to have been 9 days old, shows a small hut distinct egg tooth. In another skin of this species, stated by the same collector to have been 14 days old, the egg tooth has almost disappeared. An 8-day-old nestling of *Ramphocelus carbo* from the same collection shows no

sign of an egg tooth, while it is present on a stub-tailed young *Piranga olivacea* of unknown age (CM).

Fringillidae.—Clark (1961) listed records for *Geospiza* and *Ammospiza*. We have made no particular search for additional records from this very large and probably composite family, but we have examined specimens with egg teeth from the three major subgroups, as follows: *Spizella passerina* and *Melospiza georgiana* (Emberizinae); *Richmondia cardinalis* and *Pheucticus ludovicianus* (Richmondininae); *Loxia curvirostra* (Carduelinae). Clark (1961) listed a record of another cardueline, the canary (*Serinus canarius*), under Ploceidae, a family with which some authorities place the Carduelinae.

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NOCTURNAL ROOSTS OF MIGRATING SHOREBIRDS

JEFF SWINEBROAD

DURING a series of studies of bird migration in central Ohio from 1952 through 1956, data were collected on shorebird behavior. One persistent feature was the stopover of shorebirds for two or more days, and the assemblage of these birds on a mud flat serving as an overnight roosting area. The data were collected at O'Shaughnessy Reservoir, which is about 15 miles north of Columbus, Ohio. The reservoir is 6.5 miles long and has a maximum width of 0.25 mile. Mud flats are exposed each fall. Because of the open nature of the area and the encircling roads, it was possible to keep track of the small groups of shorebirds in the area as they moved from mud flat to mud flat (Swinebroad, 1960). Light intensity was measured with a Weston light meter model 603, with the photocell lying face up on the mud flat. Measurements were also made of ambient temperature, surface wind direction and speed, degree of cloud cover, frontal activity, and the like, according to accepted procedures.

The small numbers of birds involved (flocks ranged in size from 2 to 20) and the ease of observation made this an ideal place to observe individual behavior. Though observations on small groups of animals are limited in application, they are of some value in building a more comprehensive picture.

The data presented here were collected in August, September, and October of 1952 and 1953 on 139 nights.

Shorebirds which migrate into the area would be noticed first at dawn. Presumably they had flown in just before dawn or alighted sometime during the night. Some of these birds were recognizable for a time because of peculiar stains. A few of these marked individuals remained in the area for at least 2 weeks, while others departed within 24 hours of their arrival. The numbers so involved, although recorded, are not important here. The birds which remained for more than one day would scatter out in small flocks along the shores of the reservoir and spend the daylight hours mostly feeding, preening, and sleeping. Near sunset, the behavior of the flocks changed. The rate of calling increased, flocks would fly up suddenly, circle the mud flat at low altitude, re-align, and then repeat the whole performance a number of times. Interindividual distances would decrease and the rate of calling would increase. Finally the entire group would take off and fly to the mud flat where other flocks were assembling. This evening roosting flight was noted for at least one species every night when observations were made in the area. The data presented in Table 1 indicate relation of the evening flight to light intensity and time of sunset. These data represent those nights when light

TABLE 1
ROOSTING FLIGHTS IN RELATION TO LIGHT INTENSITY

Species	Date	Time of flight*	Light intensity in footcandles	Time in relation to sunset*	Degree of cloud cover‡	No. of birds
Semipalmated Plover	6 Sept. 1952	7:18 PM	2 ft-c	+39 min	0	2
	16 Sept.	6:20	100	-36	0	4
	23 Aug. 1953	7:00	100	-19	3	10
	23 Aug.	7:10	38	-9	3	2
	24 Aug.	6:46	350	-32	0	7
Pectoral Sandpiper	13 Aug. 1952	7:25	25	-8	0	8
	30 Aug.	5:45	60	-82	7	10
	13 Sept.	7:00	4	+6	0	4
	15 Sept.	6:15	250	-26	2	4
	15 Sept.	7:14	5	+33	2	5
	15 Sept.	7:17	-†	+36	2	5
	19 Sept.	6:25	250	-9	7	4
	16 Oct.	6:21	4	+31	0	6
	20 Oct.	5:00	1,000	-45	2	15
	20 Oct.	6:08	4	+23	2	2
	21 Sept. 1953	6:55	-	+23	10	20
	21 Sept.	6:58	-	+26	10	7
	21 Sept.	6:59	-	+27	10	9
	21 Sept.	7:06	-	+34	10	2
Least and Semipalmated Sandpiper	24 Aug. 1952	7:15	5	-2	0	20
	24 Aug.	7:15	5	-2	0	2
	30 Aug.	6:15	100	-52	7	7
	30 Aug.	6:40	60	-27	7	4
	30 Aug.	6:50	60	-17	7	2
	6 Sept.	6:50	60	-6	0	20
	8 Sept.	6:45	50	-8	2	10
	8 Sept.	6:50	50	-3	2	14
	8 Sept.	6:54	50	+1	2	4
	9 Sept.	7:03	20	+12	0	20
	9 Sept.	7:15	2	+26	0	18
	10 Sept.	6:49	55	0	0	4
	10 Sept.	7:15	5	+16	0	14
	12 Sept.	6:50	50	+4	0	2
	12 Sept.	7:17	5	+21	0	9
	22 Aug. 1953	6:30	1,000	-51	1	10
	22 Aug.	7:20	170	-1	1	10
	22 Aug.	7:55	2	+34	1	20
	23 Aug.	7:10	48	+9	3	4
	24 Aug.	6:46	350	+32	0	6
24 Aug.	7:35	5	+17	0	10	
24 Aug.	7:45	-	+24	0	10	

* All local corrected to EST.

‡ In tenths of sky covered.

† Below 1 footcandle.

measurements were made on the mud flats involved. Other observations on other nights were more subjective and are not presented; nevertheless, they are in general agreement as regards time and light intensity.

Other weather variables measured showed no relation to the flight, unless they influenced light intensity, as, for example, did cloud cover, and these data are not included in Table 1.

After dark, individual shorebirds could be detected on the mud flat by picking up their eyeshine with a dim flashlight. With some practice, most of the species could be separated by eyeshine color and intensity. Species apparently remained in distinct groups, yet more or less contiguous with other species. Although measurements of interindividual distances were not feasible, the impression was that birds were rather evenly dispersed over the mud flat, and were not closer than 3 or 4 body lengths to each other. Perhaps there is a nocturnal carry-over of territorial behavior as discussed by Hamilton (1959). In a majority of the nights the birds did not move from the mud flat until some time before dawn. Twice, on nights of full moon, the birds flew to the mud flat roost, then later dispersed outward, resulting in a scattering of flocks about the reservoir much like that of the daytime. In the morning, birds moved out from the roost at such low light intensities that it often took place before the human eye could distinguish species.

The species which demonstrated the preceding behavior were:

- Semipalmated Plover (*Charadrius semipalmatus*)
- Black-bellied Plover (*Squatarola squatarola*)
- Spotted Sandpiper (*Actitis macularia*)
- Greater Yellowlegs (*Totanus melanoleucus*)
- Lesser Yellowlegs (*Totanus flavipes*)
- Pectoral Sandpiper (*Erolia melanotos*)
- Least Sandpiper (*Erolia minutilla*)
- Stilt Sandpiper (*Micropalama himantopus*)
- Semipalmated Sandpiper (*Ereunetes pusillus*)

As Least and Semipalmated Sandpipers often occurred in mixed flocks, or, where separate, showed similar responses in the evening flight, data for these species are combined.

The relation of evening roosting flights to light intensity has been reported by others for other species (for recent example see Haase, 1963). Hamilton (op. cit.) reports on evening flights of Pectoral Sandpipers at Delta, Manitoba, to a mud flat roost where other shorebirds were assembling. He noted also a relation between light intensity and the timing of the flight.

The data are advanced here largely for the purpose of speculation. They are too few and selective to merit statistical treatment. Some hypotheses may

serve as the basis for further investigations and are not proposed as conclusions.

About the same number of flights occurred before as after sunset, so that event in itself does not seem critical. Considering all species, 32 of the 41 roosting flights measured occurred at or under 100 footcandles, regardless of the other environmental variables measured. On clear evenings, for example, 15 of 18 flights started at or below 60 footcandles. Therefore, light intensity at definable low levels seems to be significant in initiating the roosting flight.

That birds respond to dawn and dusk conditions is not a novel observation. These data may have significance, nevertheless, in relating quantitative measurements to the roosting flight behavior pattern. In addition, there may be significant deviations from these data which relate to species or seasonal differences in migratory activity. On several occasions the number of birds of a species decreased sometime between dusk and the following dawn, indicating a departure from the study area. These decreases occurred after all of the species were observed to fly to the mud flat roost. Presumably the birds gathered at the mud flat and subsequently some or all flew out of the area. Unfortunately, the departures of shorebirds could be detected regularly only later in the season when other aspects of the study precluded light measurements. Whether the birds left soon after the roosting flight, or just before dawn, or during the night could not be determined. At any rate, if prior to migration there is a lowering of threshold sensitivity to certain external stimuli, then perhaps premigratory roosting flights would occur at constantly higher light intensities than at other times. This kind of deviation, or something like it, should be looked for as possible indicators of impending migration.

The appearance of a stopover time during migration which involves a nocturnal assemblage of various species at different motivational levels may introduce additional complications to the problem of the initiation of migratory flights. For example, an increase in social activity of one species preceding a migratory flight may be communicated to another in the roost and perhaps facilitate the departure of the second species.

Questions such as the foregoing are better considered by observers situated at small, isolated lakes and ponds, rather than at coastal areas or along large lakes where local movements can obscure migratory departures.

SUMMARY

During the fall of 1952 through 1956 individuals of several species of migrating shorebirds were observed to occupy overnight mud flat roosts during stopover in the study area. The timing of evening flight to the roost seemed to be influenced by light intensity. The timing of the flight might be modified by behavior preceding migration. Deviations

from the expected in the roosting flight may provide the observer with information about premigratory disposition of the flocks and alert him to a period for critical measurements.

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DEPARTMENT OF BIOLOGICAL SCIENCES, DOUGLASS COLLEGE, RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY, 18 OCTOBER 1963

NEW LIFE MEMBER

Dr. Lawrence M. Bartlett, Professor of Zoology at the University of Massachusetts, is a new Life Member of The Wilson Ornithological Society. A graduate of the University of Massachusetts and holder of a Ph.D. degree from Cornell, Dr. Bartlett has been a member of the WOS since 1957. He is a member of the AOU, the Cooper Ornithological Society, American Society of Ichthyologists and Herpetologists, Northeastern Bird-banding Society (currently serving as Vice-President), and other scientific societies. Dr. Bartlett's principal ornithological interests are in anatomy and field studies, and he has published about fifteen scientific papers. His other interests include bird-banding and photography. The picture shows Dr. Bartlett with a young Cedar Waxwing, brought to his office with an injured wing.



THE EVOLUTION OF DIVERSITY IN AVIAN TERRITORIAL SYSTEMS

JERRAM L. BROWN

WHAT are the conditions which facilitate or hinder the evolution of territoriality? No generally accepted solution to this problem has yet been found—perhaps because too specific an answer has been sought for too general a question. Instead, the *diversity* of systems of territorial and other aggressive behavior has come to be well appreciated, as evidenced in recent reviews of territoriality (e.g., Kuroda, 1960; Carpenter, 1958; Hinde, 1956), and the impossibility of providing a specific answer applicable to all types of territoriality is now realized.

Arguments over which are the primary selection pressures leading to certain types of territoriality continue, however, as shown in the recent contributions bearing on the “function” of territoriality by Stenger (1958), Wynne-Edwards (1962), Kalela (1958), Kuroda (1960), Peters (1962), and others.

The present paper offers a new orientation to the problem by presenting a general theory for the evolution of territoriality with special reference to its diversity among species. Since most of the previous theories have already been shown to be untenable or severely limited (see especially Carpenter, 1958; Tinbergen, 1957; and Hinde, 1956, for criticism of them), little attention will be given to them here.

GENERAL THEORY

A theoretical framework for the consideration of some of the mechanisms promoting and limiting the evolution of territorial behavior is outlined in Fig. 1.

Aggressive behavior is generally employed by individuals in the acquisition of goals which tend to *maximize individual survival and reproduction*. Natural selection should favor aggressive behavior within a population when these goals are consistently and easily accessible to individuals through aggression but should not favor it when they are not accessible. For example, when a food supply cannot be feasibly defended, because of its mobility or transient nature, generally no territorial system is evolved to defend it; and the territory, if present, may be restricted only to the nest and the area reachable by the parents on the nest. Such cases are found in colonial sea birds, nomadic and social feeding passerine species, and aerial feeders. In these species the goal of increased or guaranteed food supply is unlikely to be attained through aggression.

On the other hand, if the individual depends for its nesting requirements,

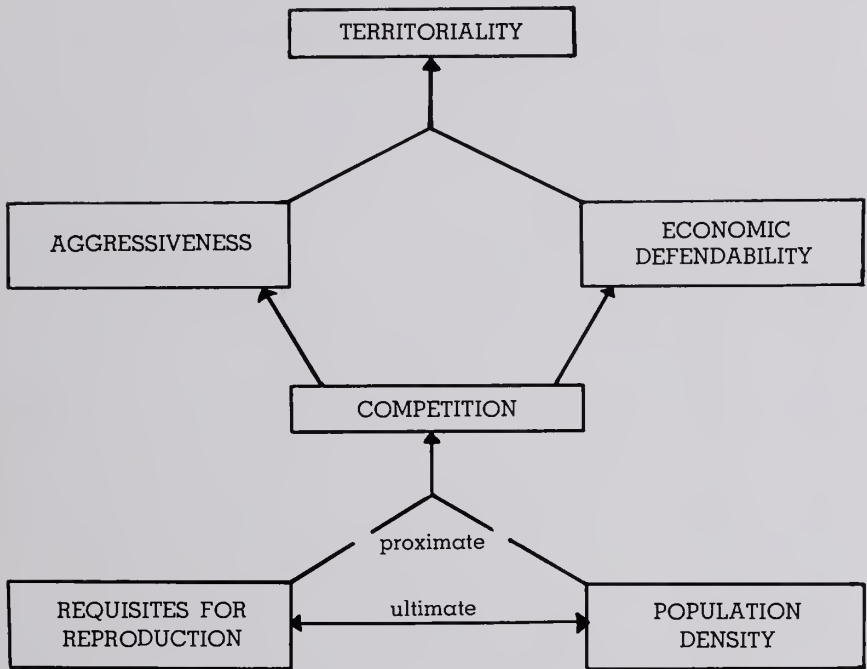


FIG. 1. A general theory of the evolution of diversity in avian intraspecific territorial systems.

food supply, and attraction of a mate on a relatively fixed and well-defined area, then this all-important area is typically defendable and becomes the classical territory. In short, *defendability* of the food supply, mate, mating place, nest, or other requisite for reproduction or survival is one of the most important determinants of the system of territorial behavior which is attained through natural selection. "Defendability" should be conceived in terms of the time and energy budgets of an individual as well as in purely physical terms.

Since intraspecific aggressiveness is primarily a behavioral response to competition for ecological requisites in short supply, *the predominant single factor tending to increase aggressiveness through natural selection should be competition*. Competition, as used in this discussion, may be said to exist when any ecological requisite exists in a quantity less than optimal for the total number of individuals which exploit it. Competition may exist for mates, food, roosting spots, breeding space, or any other necessity for reproduction in short supply. Competition is not necessarily expressed through aggression or threat but it frequently engenders such behavior.

On this logical assumption it follows that the value of site-dependent aggressiveness should tend to be in proportion to the intensity of competition—defendability allowing. The intensity of competition is directly dependent on the density of the population and inversely dependent on the supply of the requisites in question (Fig. 1). It is, consequently, complexly related to productivity, natality, mortality, and to all ecological and species characters affecting them.

Too much aggression in the absence of a short supply of the disputed requisite would eventually be detrimental. Consequently, a balance must be achieved between the positive values of acquired food, mate, nesting area, protection of family, etc., and the negative values of loss of time, energy, and opportunities, and risk of injury. Where this balance may lie in any particular species is influenced by a great variety of factors—to name a few: population density, physiological limitations and susceptibilities of the species, nest construction and site requirements, distance to food from nest, stage of development of young at birth, foraging time necessary to raise young, clutch size, time necessary to protect young, reaction of potential mate to too much or too little aggressiveness, conspicuousness to predators, migration, climate, weather, size of bird, and richness of food supply.

Within the population those *individuals* with the *optimal balance* of the genetic factors working for and against a particular form of aggressiveness would leave the most surviving and reproducing offspring: the type and degree of aggressiveness exhibited by these individuals would become, through natural selection, the norms for the population.

In short, it is argued that the type of territoriality evolved in a species depends on the types of requisites for which competition exists and upon the degree to which they are economically defendable in terms of balance between advantages and disadvantages of such defense to individuals (not the population). The problem for a particular species then becomes that of demonstrating which requisites are in short supply, which are not, and how it is economical for certain ones to be defended and not others.

APPLICATIONS OF THE THEORY

The general applicability of a theory based on competition and economic defendability to species exhibiting diverse types of territoriality may be illustrated with the following examples.

Colonial nesters.—A simple form of territoriality is exhibited by the Brandt's Cormorant (*Phalacrocorax penicillatus*), which was studied by Williams (1942). This species nests along the Pacific Coast of North America on islands and cliffs. At the start of the breeding season males begin giving

an advertising display in a small area a little larger than the size of the future nest; copulation occurs at the nest. The territory consists of the nest and a barren area extending a few feet or more around it. It is used in the attraction of a mate, for copulation, and defense of the family. All food is obtained from the sea under conditions which make the defense of a feeding area completely impractical if not impossible. Consequently, no matter how intense competition for food might be, the evolution of a territory used for feeding would be blocked through lack of defendability. On the other hand, the small area used for mating and family defense is feasibly defendable, and competition for the often limited optimal nesting space probably intensifies the necessity of defense of the nesting territory in this species.

Leks.—For the special evolutionary problems offered by the lek type of social organization the Sage Grouse (*Centrocercus urophasianus*) serves as an example. The data below have been taken from the extensive study by Patterson (1952). Sage Grouse live for most of the year in loose social groups of predominantly one sex. At the start of the breeding season cocks defend small display territories in a communal display area. Within the group of displaying males are a few dominants, each surrounded by a few subordinate "guard cocks." The females come to the display ground for copulation, usually choosing a dominant male. Aggressiveness is important for a male to achieve a dominant position; fighting and birds with blood-stained plumage are commonly seen on the lek. Nesting is performed by the female alone, who generally chooses an area well away from the lek where a richer supply of food, water, and cover exists. After the last egg has hatched the chicks leave the nest and are led by the hen to areas of suitable food and cover sometimes as much as 460 yards away. In summer and fall males and hens which were unsuccessful nesters move to areas of richer food supply, either higher altitudes or crop lands (up to 1 to 5 miles away).

According to the theory outlined here, the form of territoriality evolved in a species is determined primarily by competition and defendability. It is necessary, therefore, to relate the lek system to the environmental requirements of the Sage Grouse and to determine those requisites for which competition does and does not exist and whether or not they are economically defendable. Food, in the opinion of Patterson, was not a limiting factor on his study areas. He wrote, "... environmental deficiencies in the form of food, cover, and water are believed to be practically non-existent as sage grouse decimating factors, once the breeding season has been inaugurated" (p. 139). Consequently, "there seems to be no competition between individuals for the essentials of daily survival such as food, cover, or water" (p. 176). Patterson estimated juvenile mortality as 95% of the total mortality for the population and considered that, "losses to natural enemies probably constitute the

greatest source of juvenile mortality" (p. 139). Although a richer food supply might theoretically allow a higher population density and the occupancy of an increased area of suitable habitat, *for the individuals which are alive during the reproductive period*, food availability apparently does not limit reproduction. Consequently, competition for a food supply for the young in this species appears to be negligible, and any time or energy devoted to intra-specific defense of a food supply would be a net loss to the individuals concerned. The food supply may be considered as physically but not economically defensible under these conditions.

Furthermore, since protection against predators capitalizes on protective coloration and immobility of the precocious young, inconspicuousness of the family is necessary. Defense of an area around the nest would be detrimental by attracting predators, and the absence of the male from the nesting area is advantageous by decreasing conspicuousness of the family, and by reducing the potential prey population there (even if he were protectively colored). Furthermore, since the young do not have to be fed by the parents, the presence of the male is not necessary for that purpose.

Thus freed from the responsibilities of protection and care of nest and young, the males have full freedom of competition for the fertilization of females. To this end have evolved the elaborate and conspicuous plumage and display in the males and the lek system of mate selection. Once evolved, the lek system tends to perpetuate itself through the demonstrated preferential success of the dominant males within the lek (74% of 174 observed matings). Copulations at the periphery of the lek or outside of it are rare.

Summarizing, in the Sage Grouse although a food supply for the young might be physically defensible, it would not be economically defensible by the male during the breeding season because of the absence of competition for food at that season and the importance of predation in reducing productivity. Consequently, no large feeding and breeding territory is maintained by natural selection; competition among males for females has intensified, and, *together with other characteristics of the species and physical environment*, made possible the lek type of social organization. A similar explanation in principle for the evolution of the lek system in the Black and white Manakin (*Manacus manacus*) was given by Snow (1962).

Large territories.—The type of territory in which feeding, mating, and rearing of the young are all carried out together poses the most difficult problem for any theory of the evolution of territoriality, for the evidence is as contradictory as are the opinions of the many authors who have treated the subject. The fact that large territories occur only in species which utilize them for feeding would suggest that this type of territoriality has evolved in response to competition for food. This viewpoint is favored by Stenger

(1958) and Pitelka (pers. comm.) but opposed by Lack (1954) and Hinde (1956).

If this type of territory had evolved and were maintained in response to competition for food for the young, it would first be necessary to show that the nestling and fledgling mortality were commonly and in most populations of the species attributable ultimately to food shortage and only proximately to predation. However, the evidence presented by Lack (1954) on the causes of such mortality in thrushes favors stark predation uncomplicated by food shortage. There is but little reliable evidence bearing directly on this point in other species.

Despite the small amount of actual evidence that competition specifically for a food supply for the young commonly exists during or before the period when the young are being fed, the nature of the evolution of clutch size suggests that food may frequently be in short supply at that time. Clutch size probably tends to be increased through natural selection to the most productive number (in terms of eventual reproduction of the young produced) that the environment allows. Since the environmental limit to productivity in nests not affected by predation or parasitism is probably set primarily by the rate at which food can be brought to the young, it seems possible that competition for food for the young would frequently exist.

Another type of evidence offered in defense of food shortage as the primary cause for the evolution of large territories is the correlation between territory size and food supply. It is generally known that territorial (and nonterritorial) species have denser populations (and usually smaller feeding areas) in habitats where their food supply is better. This has been demonstrated quantitatively by Kluyver (1951) for the Great Tit (*Parus major*) and by Stenger (1958) for the Ovenbird (*Seiurus aurocapillus*). But if territory size is adjustable within limits to the breeding density in these species (as it apparently is), the correlation between territory size and food supply could be wholly a result of the normal habitat preference of the species and not directly related to the evolution of territoriality.

A more universal and easily demonstrable reason for the evolution of this type of territoriality is that it is dependent on competition for the *opportunity to breed*, as determined by ownership of a suitable area (in terms of feeding and nesting habitat). It may be debated whether the food density at the time the young are fed is adequate or not, but there is no question for many species with large territories, that possession of a territory is a prerequisite for the opportunity to mate and begin nesting. Even in a nidifugous species for which food is more than ample for the reproductive effort of all the individuals in any one area (assuming static clutch size), competition for space may result in restriction of the breeding population to those who by their aggres-

siveness are capable of holding a territory in an area of habitat acceptable to both sexes (e.g., certain Parulidae during high densities of spruce budworm, Stewart and Aldrich, 1951; Hensley and Cope, 1951). This would result in restriction of the maximum breeding density to the most aggressive birds. Such restriction has been indicated to occur in tits (Kluyver and L. Tinbergen, 1953; Gibb, 1956), Red-winged Blackbirds (Orians, 1961), Song Sparrows (Tompa, 1962), and strongly suggested to occur in many passerine species by studies of repopulation of artificially depopulated areas (Hensley and Cope, 1951; Stewart and Aldrich, 1951) and numerous other observations on the rapid remating of marked birds upon loss of their mate (e.g., Magpies, Minton, 1958; Shannon, 1958).

It should not be inferred that if the competition is not for food that it must be for mates, for many passerine species with large territories are monogamous with as many females as males in the breeding population.

The aggressiveness necessary to establish a large, exclusive territory may gain relatively little in terms of food, cover, and mates when they are already in adequate supply for the population as a whole; but by mere possession of an opportunity to breed, the territory owners would leave more reproducing offspring than the nonowners. As long as counter selection against aggressiveness were weak, *aggressiveness per se would be maintained in the population merely by the exclusion of less aggressive birds from breeding.*

The fact that the peak of territorial defense in some species (in terms of area and behavior) occurs before the young must be fed and often before the female arrives (e.g., Odum and Kuenzler, 1955) tends to support this idea. The males can afford to devote excess energies to territory defense during the period when they have little else to do but forage for themselves. After the mate arrives there is, of course, a selective advantage to protecting her from other males, but this could be done more efficiently by accompanying her and would not require a territory.

The correlation between large territories and their utilization for feeding might also be explainable on the basis of competition for space in which to breed. If aggressiveness were maintained in the population mainly by the exclusion of less aggressive individuals from breeding, the usage of the territorial space in foraging would be secondary to the fact that an aggressive individual was spending 100% of his time in a discrete area and defending it.

It seems likely that *both* limited food and exclusion by aggressiveness *per se* have been important selective agencies in the evolution of large territories. Under conditions of limited food density and medium to high population densities competition both for food and for space *per se* may be expected to be operative. Under the unusual conditions of high food density and low

population density, neither type of competition would constitute an effective selective force and territory defense would be absent or minimal. If both food density and population density were high, exclusion by aggressiveness would be the primary factor (e.g., Bay-breasted Warbler, *Dendroica castanea*, during outbreaks of the spruce budworm). If food density and population density were low, then defense of the food supply would be the primary factor.

Regardless of whether competition in this specific type of territoriality is for opportunity to breed, food, mate insurance, or some combination of factors, the general theory proposed in this paper would apply. For the object of the competition is not necessarily specified in the general case—only that it be economically defensible.

POPULATION CONTROL

Since territoriality appears in some species to participate in the control of population density (e.g., Kluyver and L. Tinbergen, 1953; Gibb, 1956; Tinbergen, 1957; Orians, 1961; Tompa, 1962), the hypothesis has been advanced (Wynne-Edwards, 1962) that territoriality and much of the ritualized agonistic behavior which characterizes it in many species have evolved to serve as mechanisms of population control. The argument fails primarily because it does not take account of the fact that changes in gene frequency are the result of competitive advantages accruing to individual genotypes rather than to the group as a whole.

It is not sufficient to demonstrate that genetic changes in some individuals in the direction of increased territoriality and efficiency of population control benefit all members of the population *equally*, including those individuals lacking these genetic changes. For, if the benefits of territoriality were equally distributed among all members of the population, then according to the Hardy-Weinberg equation the frequencies of the genes determining the increased territoriality would remain unchanged in successive generation rather than increasing. Consequently, it is impossible to account for the evolution within a population of territoriality, "epideictic displays," and population control on such a basis, notwithstanding the massive documentation assembled by Wynne-Edwards (1962). His proposal does not give a solution to the problem of how individuals in which territoriality is more strongly developed than others in the same population are adaptively superior to them.

The proposal that territoriality in a species may have evolved through extinction of nonterritorial populations and survival of territorial ones (Wynne-Edwards, 1962) is an insufficient explanation for two reasons. In the first place, the proposal does not explain how territoriality evolved in the original territorial populations. Secondly, the magnitude of the differences in

territoriality which occur between local populations of a species and between closely related species make it seem probable that such differences can evolve rapidly within a population in response to local conditions and do not usually require the processes of extinction of whole populations and invasion by others. The vast differences in territoriality exhibited by such closely related pairs of species as the Red-winged and Tricolored Blackbirds (Orians, 1961) and the Scrub and Mexican Jays (Brown, 1963) support this view.

SUMMARY

Recognition of the diversity of systems of territoriality among species has clearly indicated that an understanding of the evolution of territoriality requires a theory which accounts for the diversity according to more general ecological principles than those which have been proposed in the past.

A general theory of territoriality is proposed which depends upon the influence of two primary variables, *competition* and *economic defendability*, and on the adaptive value of aggressiveness under various conditions of these variables. Examples of application of the theory in different types of social systems (colonies, leks, and large territories) are given.

It is suggested that in species with large territories used for both feeding and nesting, territoriality might, under certain conditions, be maintained or selected for in a population merely through the exclusion of less aggressive individuals from the opportunity to breed in a suitable habitat. Such exclusion would, however, be limited by counter-selection pressures when aggressiveness became too detrimental to reproduction.

ACKNOWLEDGMENTS

I wish to thank Drs. W. J. Hamilton III, G. H. Orians, and F. A. Pitelka for arousing and sustaining my interest in territoriality by their ever-stimulating and illuminating discussions of the subject during the period of our common residency at the Museum of Vertebrate Zoology, University of California, Berkeley (1956-60).

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REPRODUCTIVE DISPLAYS OF THE WARBLING VIREO

DAVID W. DUNHAM

THE paucity of information on the ethology of the Vireonidae (Andrew, 1961) renders the following observations worthy of record. They were made through $9 \times$ binoculars at a distance of 8 meters and recorded on a portable tape recorder.

Ithaca, N.Y., 17 May, 1963, 0900 EDT. A chase involving two Warbling Vireos (*Vireo gilvus*) was seen. Loud, short *Squeet* vocalizations were given repeatedly by one of the birds during the chase. One (A) landed in a large tangle of grapevines (*Vitis* sp.) about 70 cm from the ground, at the base of a large elm (*Ulmus americana*). The second bird (B) landed about 40 cm below A on an inclined vine. B spread its tail fully, rhythmically moving its body from side to side with movements of small amplitude (referred to as "weaving" below) while oriented with the head toward A, and while constantly giving soft *Squeets* (Fig. 1A). Bird A remained where it was (Fig. 1B) as B approached very slowly by short hops while remaining in the above attitude. When B had approached to a distance of about 10 cm from A, the tail was closed, the contour plumage of the ventrum was fluffed (but not ruffled), the wings were quivered *very* slightly at their tips (the carpals not being lifted from the body), the same orientation and vocalizations were continued while the mouth was opened wide, exposing the brilliant red lining (Fig. 1C). B continued to advance toward A, "weaving" until they were only about 3 cm apart. Then B continued to move slowly but now to the side of A. By moving to the side B also moved down the vine so that it was now slightly below the level of A. It continued to keep the gape pointed at A, however, by raising the head slightly. A remained where it had landed. The two birds then flew off together. The time from arrival to departure, during which B maintained a display attitude, was about one minute. A few minutes later a similar chase was observed in the same area, with the same loud *Squeets*. Both birds landed on a branch of the same elm tree, about 1.7 meters from the ground and about 10 cm apart. One bird (A) turned toward the other (B) and assumed the second display posture described above, "weaving," vocalizing, and orienting as before. Both birds were stretched in a head-forward position, and as A displayed (Fig. 1D), B struck repeatedly at its open mouth with its own closed bill (Fig. 1E). A then flew off and B flew up into the canopy of the elm and fed on small, green larvae gleaned from the foliage. The second encounter lasted about 15 seconds.

Although these observations were noted out of definite behavioral context, and the sexes of the individuals involved could not be determined, it is probable that this behavior was primarily reproductive. The head coloration of the nondisplaying bird, in both cases, was slightly lighter than that of the displaying bird.

Bent (1950) quotes Audubon's description of two displays in this species, one involving spreading of the wings and tail by the male, and strutting around the female in short circles while uttering a low warble; the other the assumption of a stiffened attitude and moving of the body from side to side. The context of the latter is not clear, nor is it clear whether one or both of the birds displayed.

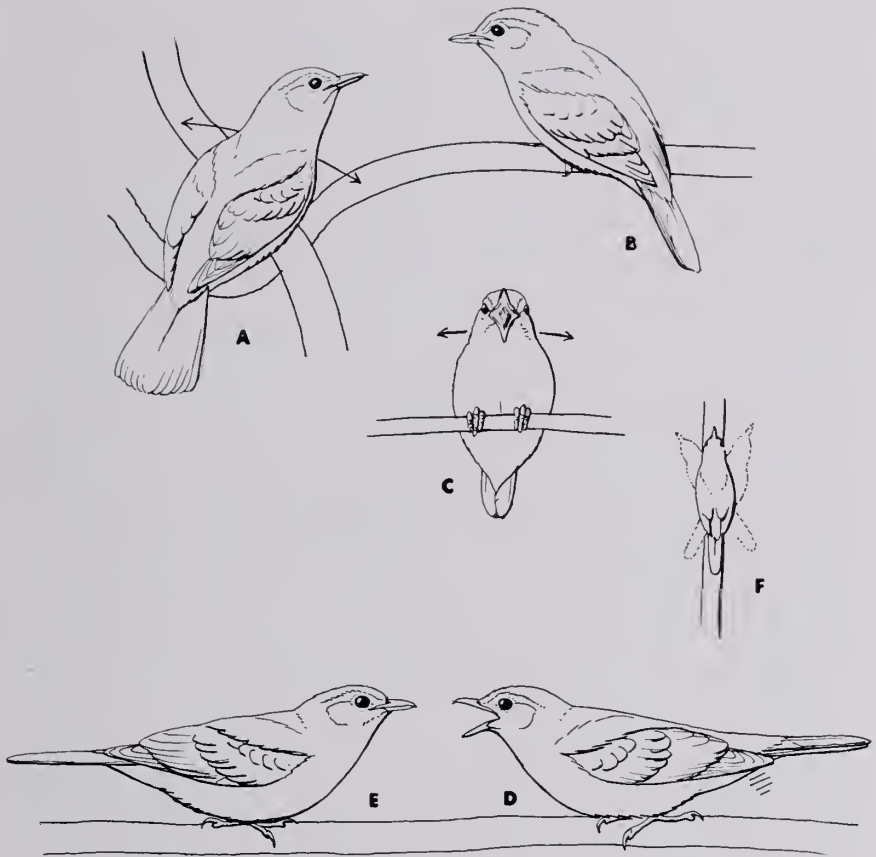


FIG. 1. Displays of *Vireo gilvus*. F is a dorsal view of D, showing lateral movement in "weaving."

Lewis (1921) reports reproductive fighting and chasing in the Philadelphia Vireo (*Vireo philadelphicus*) involving "squeeking" vocalizations. These chases were followed by copulation when the female lifted her tail, after perching, and gave a "mew, mew" call. Reproductive chasing occurs in the Red-eyed Vireo (*Vireo olivaceus*) (Bent, op. cit.; Southern, 1958); at least some of the chases are silent until the very end (Lawrence, 1953). Lawrence notes the approach of the male to the female with tail down and spread, vocalizations, and ruffled throat and crown feathers. These approaches sometimes ended in copulation. Bent (op. cit.) also reports: (1) the male giving a soft "song" while fluffed immediately preceding a reproductive chase; (2) Saunders' observation of a male giving a soft "song" and trembling the wings in front of a female; and (3) the sleeked male at right angles to the

fluffed female. "weaving" while giving soft, squeaky vocalizations. Tyler (1912) reports a similar observation. Southern (op. cit.) describes a soliciting female with wings spread and lowered, body vibrated rapidly, and a series of short chipping calls. Bent (op. cit.) cites Townsend's record of a male Solitary Vireo (*Vireo solitarius*) fluffing the plumage, especially the yellow flank feathers, and "singing" as he ". . . bobs and bows to the female. . . ." Bent cites Rathbun's account of reproductive chasing and fighting in Hutton's Vireo (*Vireo huttoni*). He cites Torrey's report of a fluffed posture, with the tail spread, in the male White-eyed Vireo (*Vireo griseus*) while perched in front of the female, and while repeatedly uttering a three-parted vocalization. The female struck at him with her bill. Nolan (1960) observed chasing, and wing-quivering by both sexes of *griseus*. Skutch (1960) notes reproductive chasing in the Yellow-green Vireo (*Vireo flavoviridis*) as well as a display in which the male sways from side to side with the mouth wide open, uttering low, weak notes, while perched close enough to the female to touch her. Nolan (op. cit.) records reproductive fighting and chasing, during which faint vocalizations were heard, in the Bell's Vireo (*Vireo bellii*). He also notes wing and tail-flicking, tail-flirting (laterally as in bathing), and tail-spreading in male and female *bellii*. Bent (op. cit.) cites a report by Grinnell, Dixon, and Linsdale of the male "singing" near the female with tail spread, twitching the tail while spreading it still more, and sometimes holding it down, nearly vertical.

The following behavior occurs in at least the species listed: reproductive chasing and/or fighting—*gilvus*, *philadelphicus*, *olivaceus*, *huttoni*, *griseus*, *flavoviridis*, and *bellii*; male fluffing some part of the body plumage—*gilvus*, *olivaceus*, *griseus*, and *solitarius*; female fluffing the body plumage—*olivaceus*; male tail-spreading—*gilvus*, *olivaceus*, *griseus*, and *bellii*; female tail-spreading—*bellii*; male "weaving"—*gilvus*, *olivaceus*, and *flavoviridis*; male bobbing—*solitarius*; female striking at displaying male—*gilvus* and *griseus*; male wing-quivering—*gilvus*, *olivaceus*, and *griseus*; female wing-quivering—*griseus*; male wing-spreading—*gilvus*; female wing-spreading—*olivaceus*; male and female lateral tail-twitching—*bellii*; male and female wing and tail-flicking—*bellii*; female body-quivering—*olivaceus*; male displaying gape—*gilvus* and *flavoviridis*.

It would be interesting to know how many species of vireos have brightly colored gapes, and if there is any sexual dichromatism in these parts as there is in the Yellow-breasted Chat (*Icteria virens*) (Ficken and Ficken, 1962). It is also worth noting that *Icteria* has one reproductive display involving ". . . swaying from side to side . . ." (Ficken and Ficken, op. cit.) which resembles the "weaving" found in at least three, and probably other vireos. *Icteria* holds food with its foot (Ficken and Ficken, op. cit.) as does *bellii*,

griseus (Nolan, op. cit.), *olivaceus* (Herrick cited in Nolan, op. cit.), and *solitarius* (Skutch cited in Bent, op. cit.). Further study of the ethology of the vireos and *Icteria* might well serve to clarify the taxonomic position of *Icteria*, which, as the Fickens point out (op. cit.), is clearly not a parulid.

ACKNOWLEDGMENTS

The author is indebted to Drs. W. C. Dilger and R. W. Ficken for critical reading of the manuscript, and to Dr. W. C. Dilger for help with the illustrations. The author was a National Institutes of Health Predoctoral Fellow during the course of this study.

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LABORATORY OF ORNITHOLOGY, CORNELL UNIVERSITY, ITHACA, N.Y., 6 JUNE
1963

JOHN JAMES AUDUBON AND JUVENILE EVENING GROSBEAKS¹

BENJAMIN M. SHAUB

THE brightly colored male Evening Grosbeak (*Hesperiphona vespertina*) and his trim mate, delicately marked in tones of gray with a slight overlay of delicate yellow around the neck and under the wings, have been with us here in New England in considerable numbers for slightly more than a decade and a half. At the Shaub Ornithological Research Station we have been interested in these magnificent birds not only for their vivacious activities at our feeding trays but because, overlooking sporadic invasions, they are such newcomers to our avifauna.

When we first became interested in making a detailed record of this species we went to the Museum of Comparative Zoology at Harvard University where the late James L. Peters placed before us numerous trays of skins. There were the normal plumages of adult males and females with minor variations such as we observe at our feeding stations. Some males were quite dark in overall color, while others were light, with the yellows bright, fully saturated, and vivid. The females likewise varied from light to dark grays. However, there were no specimens then in the Harvard collection designated as males, in other than the adult plumage.

The juvenal plumages of the male and female Evening Grosbeaks were described by Magee (1934), an early bird-bander and student of ornithology, who resided at Sault Ste. Marie, Michigan, from which locality the type specimen was obtained and described. Magee's account fully described the appearance and behavior of the young birds which were observed and trapped at his banding station from 1921-33. He noted that there could be no mistake in distinguishing the sexes, as the wing and tail markings were distinctly those of the adult birds. Magee's descriptions appear to have been unknown to the mass of new "birders" at the time the Evening Grosbeak began the extension of its range on more or less regular schedule in the early 1940's.

The publication of the reprint of Audubon's "Birds of America" (1941) at a very nominal sum has made it possible for most families interested in birds to procure a copy. Consequently, many learn from Plate No. 424 that the immature male Evening Grosbeak has a plumage like that of the adult female. The same information was disclosed on Plate No. 207 of the Royal Octavo edition of 1840-44 (Fig. 1). These illustrations are among the great errors to be found in Audubon's superb paintings. It is, indeed, quite evident

¹ Contribution No. 28 from the Shaub Ornithological Research Station, 159 Elm Street, Northampton, Massachusetts.



FIG. 1. A reproduction of Plate No. 207 of Audubon's "Birds of America" (1841-44). The description of the plate identifies the illustrations as: 1, a male Evening Grosbeak; 2, a female, and 3, a young male. It is this and similar illustrations of Audubon's which have led to the erroneous belief that both sexes in juvenal plumage are similar to or like the adult female.



FIG. 2. Juvenile male Evening Grosbeak photographed on 35-mm Kodachrome at Saranac Lake, N. Y., 3 August 1952. Note the white secondaries, black primaries, and black tail as in the adult male. The body plumage is of a buff color throughout. The bill is a dark horn color.

that he had never seen a juvenile male Evening Grosbeak, and probably none were described prior to the account by Magee (op. cit.). There seems to be some basis for Audubon's speculation that the male's juvenal plumage should resemble that of the adult female. Among other carduelines, the young male Purple Finch (*Carpodacus purpureus*) is indistinguishable from the female; the juvenal plumage of the goldfinch is like the adult female's, and even the brilliant adult male plumage changes to that of the female during the winter months.

The nesting areas of the Evening Grosbeak have not been well defined and are usually in the extensively wooded areas. In the eastern United States young had appeared at only a few places until the last 5 to 10 years, when they were observed at an increasing number of localities (cf. Shaub and Shaub, 1953; Shaub, 1951 and 1958). One of the earliest was at Saranac Lake, New York, where they made their appearance about 1946. In 1949, the writer photographed a juvenile female in this city, on Kodachrome film. This picture, probably the first ever made of a young Evening Grosbeak, was later published (Shaub, 1952) as a monochrome picture. During the summer of 1952, the writer trapped and banded a number of young grosbeaks at the



FIG. 3. Juvenile female Evening Grosbeak photographed on 35-mm Kodachrome at Saranac Lake, N. Y., 3 August 1952. Note the white band across the black outer primaries which is characteristic of the adult female, as well as the patchy white markings on the secondaries. The tips of the tail and tail coverts are white. The overall body color is buffy and is similar to that of the juvenile male.

residence of Greenleaf Chase, 125 Lake Street, Saranac Lake. One of each sex was photographed (Figs. 2 and 3). These illustrations have been published three times previously (Shaub and Shaub, 1953, 1954, 1956). Still, we continue to receive frequent reports of juvenile male Evening Grosbeaks having been seen throughout the winter in flocks with adults. Such reports arise from the mistaken idea that the juvenile plumages of the sexes are like, or similar to, that of the adult female.

We have made numerous attempts to point out that the sexes are clearly and definitely distinguishable while the birds are in juvenal plumage, and that the first winter plumage of both sexes is like the adult. The change from the juvenal to the first winter or adult plumage occurs between the middle of September and the latter part of October (Shaub, 1958). Only one report records the appearance of a juvenile male as late as 26 October. Thus Evening Grosbeaks as they appear during their winter sojourn are readily distinguished as to sex, and immatures or birds of the year are indistinguishable from the adults by the average bird watcher. However, in early October there may be an occasional individual still in the process of molting to the first winter plumage. Males and females in juvenal plumage have the same wing and tail patterns as the respective adults; the body feathers are buff in both sexes, and much alike, the juvenal male lacking the bright yellow frontal band and black crest. In juveniles of both sexes the bill is a dark horn color, which changes to yellowish when the first winter plumage is acquired.

Once an inaccuracy appears in such a book as Audubon's, it is indeed dif-

ficult to erase the error and to establish the truth in subsequent journals of more limited circulation.

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159 ELM STREET, NORTHAMPTON, MASSACHUSETTS, 16 JANUARY 1963

NOTES ON THE DESTRUCTION OF BANDED EVENING GROSBEAKS IN QUEBEC IN 1960¹

B. M. SHAUB

DURING June, July, and August 1959, a total of 94 Evening Grosbeaks (*Hesperiphona vespertina*) were collected in the area about St. Leon le Grande, Rimouski County, Quebec. The statistical data concerning this group as determined from the band numbers removed from the birds were previously reported (Shaub, 1960). After this first episode of wanton shooting, we were of the opinion that such molestations of these fine birds would cease, especially after one or more of the collectors had been reprimanded and fined by the Quebec law enforcement officers. However, early in 1960, we received from the Fish and Wildlife Service another batch of recovery reports, on which data concerning 104 Evening Grosbeaks were detailed, which showed that the collecting activities in the western part of the Gaspé Peninsula had been resumed in June and July 1960.

We decided at that time to make a visit during the latter part of June or early July, obtain a first-hand impression of the area and the layout, and see and study the facilities where the collecting had been carried on by the natives.

On 13 July 1961, we arrived at St. Leon le Grande, and were directed to Mr. Brousseau's residence near Lac Humqui. There we were told that Mr. Brousseau was then at his camp along the West Branch of the Patapedia River, where he is employed as a guard by lessees of fishing rights on the river, which is famous for its Atlantic salmon. As the cabin was nearly 40 miles back in the forest and the roads were scarcely passable for an automobile, we obtained the services of a guide. A new highway is being constructed into this wilderness area, which in due time will emerge at the northeast corner of Maine, to enable motor vehicles to carry out lumber, and to provide a short route to the north shore of the peninsula for tourists and sportsmen. Both the unfinished new road and the old road were extremely rough, but our heavy station wagon negotiated these without incident. The camp is located in the forest with only very small areas of open land.

During our conversation with our host we learned that the American fisherman who precipitated the grosbeak shooting spree in 1959 had told him that the United States Fish and Wildlife Service would pay one dollar for every bird band returned to that office. Mr. Brousseau told us he thought that his "fortune was about to be made"; hence, he and a number of other

¹Contribution No. 29 from the Shaub Ornithological Research Station, 159 Elm Street, Northampton, Massachusetts.

individuals deliberately shot all the banded birds they could during the summer of 1959.

Regarding the collecting of the 104 birds in 1960, Mr. Brousseau said that he had not taken any of this lot, and that all of the bands had been given to him to send to Washington. He is one of the very few Frenchmen in the area who can speak and write English. When asked how the birds were collected, he said that he could "only surmise." Our surmise is that they were shot with a .22 caliber rifle when they visited the several cabins along the river for salt sprinkled on the ground nearby.

The area along the Patapedia River is densely forested, chiefly with spruce and balsam. The stand of trees is usually so dense that it is difficult to traverse the area on foot or by any other means; hence, one would have to spend a great deal of energy trying to search out the nesting sites of the grosbeaks. Our host said he had, at one time, found a nest, and that it was located near the top of one of the rather slender springy conifers.

The next morning we were up at daylight and in the cabin. It was not long before the birds began to come in to the bare area of a couple of square yards near the entrance, just off the large flat stone before the door. Ordinary fine-grained table salt had been sprinkled from a saltcellar and it was for this that



FIG. 1. Group of 15 Evening Grosbeaks photographed early in the morning of 14 July at Brousseau's cabin on the West Branch of the Patapedia River. Birds are picking up minute grains of table salt from the bare ground.

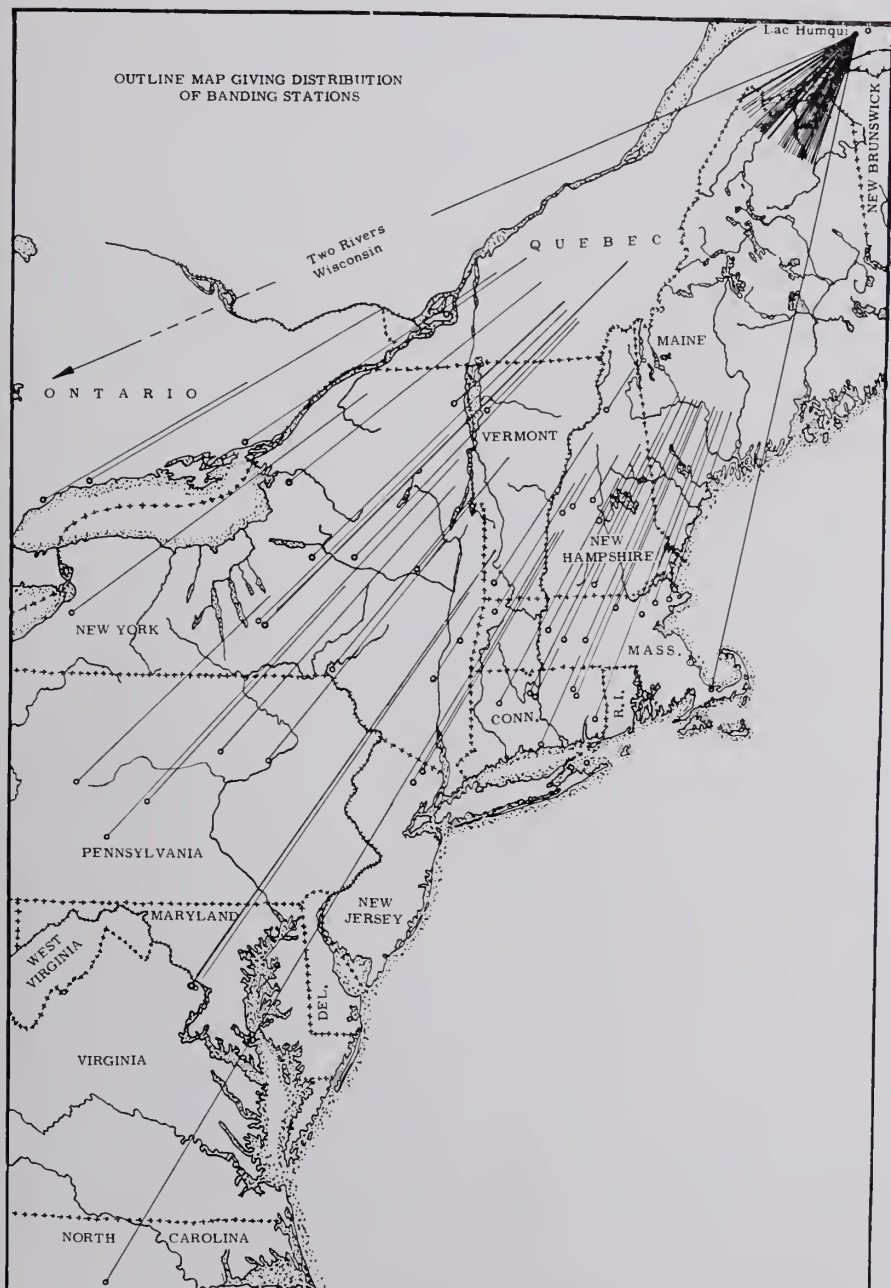


FIG. 2. Map showing site of Lac Humqui, Quebec and the location of the banding stations where the collected Evening Grosbeaks were banded.

the birds came to the area in large numbers. One could sit in the doorway and observe the relatively tame birds while they were picking up the salt, and see easily if a bird was banded. It would have been equally easy to collect the bird with a .22 caliber rifle. The photograph (Fig. 1), taken under adverse conditions, shows 15 grosbeaks in an area not more than 2 feet square. Of the birds in the picture only a third are males, while, of those collected, 71 were males and 33 were females. Other birds that came to this spot while we were present, and not more than 7 feet from the doorsill, were Purple Finches (*Carpodacus purpureus*), American Goldfinches (*Spinus tristis*), and Tree Swallows (*Iridoprocne bicolor*). It is surprising how attentively they will pick up the very small individual grains of salt. This scene was reported to be similar to those at the other places where the two lots of Evening Grosbeaks were collected.

With the data at hand for another group of Evening Grosbeaks during their breeding season, it seems desirable to use the information provided by the sample for a better knowledge of these birds on the Gaspé.

Figure 2 shows the wintering area where the 1960 birds were banded. Since the Middle Atlantic and the New England states account for the great majority of the Evening Grosbeaks banded, similar samples from other areas where the species breeds in numbers might well show a similar distribution.

Figure 3 shows the interval over which the birds were collected and is principally a record of the activities of the collectors.

In Figure 4 we have a rather striking survival chart. To be of the greatest value, such a chart should pertain to a situation where approximately the same number of birds were banded every year, but this would depend largely

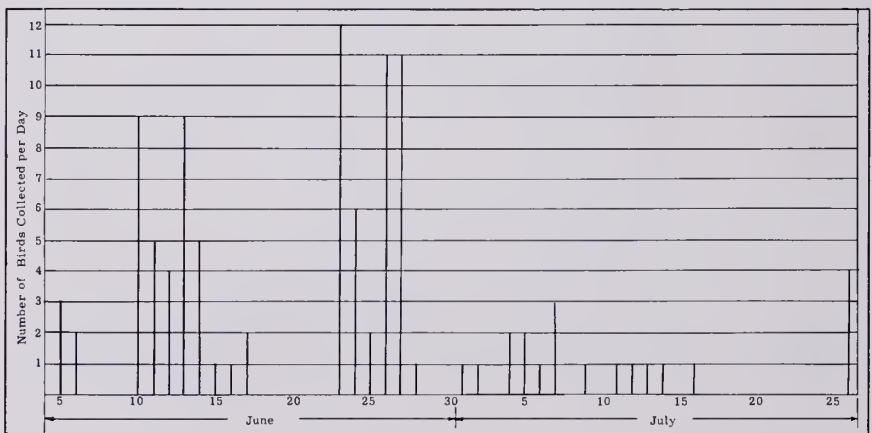


FIG. 3. Diagram showing date and number of Evening Grosbeaks collected from 5 June to 26 July 1960 in the vicinity of Lac Humqui and the Patapedia River area.

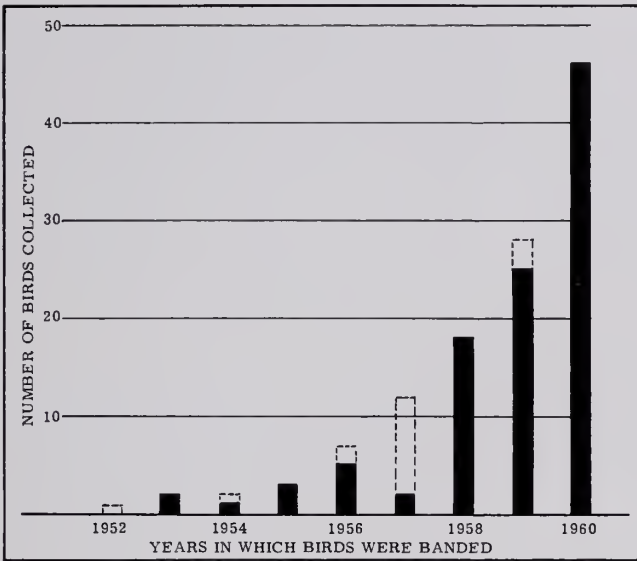


FIG. 4. A survival chart showing the number of birds in the sample plotted against the year they were banded.

upon chance, or upon the concerted action of a large number of people. The banding records show that a much smaller number of individuals of the species were banded in 1957 than in other years, and this shows up clearly in the diagram. The added height of the column (dotted) shows approximately the number of birds banded in 1957 that might have been in the lot. The same situation, to a lesser degree, may pertain to several of the other years. Should one have the opportunity to trap a sufficiently large sample of birds which have been banded each year in equal numbers, over a period longer than the age of the oldest member of the species, and which have become thoroughly mixed after banding (as is the case of the Evening Grosbeak), he would have an excellent set of figures for determining, by extrapolation of the data, the maximum age any individual is likely to reach. For the Evening Grosbeak an age of 10 to 12 years would be the maximum.

The high rate of mortality for the first 2 years is also shown in the diagram, for birds in their adult plumage when banded. With such a high rate of mortality for adults, the rate for fledglings must be astonishingly high for the first five months after leaving the nest.

While one might assume that most of the birds, in their spring migration, journey to the western part of the Gaspé, New Brunswick, and the northeastern part of Maine for their breeding period, nevertheless if one had a sample of

TABLE 1
COMPARISON OF THE NUMBER OF LOCALITIES AND BANDERS, AND OF THE NUMBER
OF BIRDS TAKEN, IN 1959 AND 1960

State or Province	Number of localities		Number of banders		Number of birds	
	1959	1960	1959	1960	1959	1960
Connecticut	5	7	6	7	10	11
Maine	3	1	3	1	4	2
Massachusetts	9	9	11	11	21	16
Michigan	2	0	2	0	2	0
New Hampshire	7	6	7	6	11	6
New Jersey	1	2	1	2	1	2
New York	7	11	7	12	18	32
North Carolina	0	1	0	1	0	1
Ontario	2	4	2	4	2	4
Pennsylvania	6	5	6	5	14	18
Quebec	0	1	0	1	0	1
Rhode Island	1	0	1	0	1	0
Vermont	5	2	6	3	9	6
Virginia	1	2	1	1	1	4
Wisconsin	0	1	0	1	0	1
Totals	49	52	53	55	94	104

the nesting population in the other breeding areas in the eastern part of North America there would probably be a like assemblage of the wintering birds from the same banding area.

Of the 49 banding stations listed in the data for 1959 (see Table 1), 24 stations were not represented in the 1960 reports: 25 stations were listed at both times; 27 stations were added by the new reports. In all, for the two sets of data, 76 stations had banded one or more Evening Grosbeaks which were collected in the Lac Humqui and the Patapedia River areas.

Birds (numbers in parentheses) were listed in the 1960 reports from the following localities: *Connecticut*: Bloomfield (2); Guilford (1); Hartford (3); Ledyard (1); Mansfield (1); Morris (2); Storrs (1). *Maine*: Cumberland Mills (1). *Massachusetts*: Adams (3); Amherst (1); Groton (1); Lexington (2); Paxton (1); Reading (1); Sandwich (1); South Hamilton (1); Ware (5). *New Hampshire*: Bedford (1); Enfield (1); Franklin (1); Lancaster (1); Mascoma (1); New Hampton (1). *New Jersey*: Pompton (1); Ramsey (1). *New York*: Amsterdam (2); Deposit (7); East Chatham (3); Etna (2); Hamburg (3); Herkimer (1); Kingston (1); Oneida (1); Peru (2); Slaterville Springs (1); Watertown (9). *North Carolina*: Rocky Mount (1). *Ontario*: Barriefield (1); Bowmanville (1); Cherrywood (1); Toronto (1). *Pennsylvania*: Berwick (1); Hollidaysburg (2); Proctor (3); State College (10); Sykesville (2). *Quebec*: Montreal (1). *Vermont*: Bennington (2); Burlington (4). *Virginia*: Arlington (1); Dun Loring (3). *Wisconsin*: Two Rivers (1).

The presence of so many Evening Grosbeaks in this remote area during the nesting season offers a superb opportunity for vacationing bird banders to

spend a fortnight or longer banding these birds (see Parks and Parks, 1963). At the same time they could excite an interest among the natives in trapping and banding the birds rather than collecting the banded individuals. It appears from conversations with men in the area that there is a strong tendency to secure the bands in order to learn where the birds were banded and by whom. The same and much additional information would be available to those who would band the birds, and release them, for they would often be trapped by the many banders in the wintering territory. Such a program of banding would add much to our present knowledge.

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159 ELM STREET, NORTHAMPTON, MASSACHUSETTS, 23 JANUARY 1963

NEW LIFE MEMBER



Dr. Mary Juhn (Mrs. Richard M. Fraps), a member of the WOS since 1954, has recently become a Life Member of the Society. The holder of a Ph.D. from the University of Zurich, Dr. Juhn has retired from a professional position involving ornithological research principally dealing with feather development as reflecting aspects of avian endocrinology and general development. She is a member of the AOU, American Society of Zoologists, American Association of Anatomists, Society of Biology and Medicine, American Genetic Association, Sigma Xi, and a Fellow of the AAAS. Her current interests include gardening and conservation.

GENERAL NOTES

A roosting area of the Bald Eagle in northern Utah.—In view of the increased concern being focused on the Bald Eagle (*Haliaeetus leucocephalus*) throughout North America, the following observations from northern Utah may be of interest.

During the years 1962-63, the observer has noticed individual Bald Eagles scattered throughout the Bear River Migratory Bird Refuge, Box Elder Co., Utah. These birds are strictly winter residents and have been observed during the months of January through March by many of the refuge personnel. I have seen them as far south as Zion National Park. Although the origin of these birds is unknown to this writer, it is possible that they come from northern Wyoming, Montana, and Canada.

When watching the eagles on the refuge, I have noticed that they were either sitting on the ice or were soaring high above the marshes. The marsh itself is the basic feeding area, with carrion providing the main item of diet.

On the wintering grounds of the Bald Eagles on the Mississippi River in northern Illinois, and in Florida, the surrounding habitat always includes deciduous or evergreen trees of considerable height, which provide a suitable roosting or nesting niche near the feeding area. The habitat at Bear River delta is composed primarily of salt grasses, alkaline flats, and cattail marshes—with large trees almost nonexistent. Do the birds, then, spend their roosting hours on the ice floes?

East and west of the Bear River marshes, lie the parallel ranges of the Wasatch and Promontory Mountains. These might be capable of providing suitable roosting sites, but potential roosting places would probably be found only at elevations of approximately 5,600 feet or higher. Below this elevation there are many cultivated deciduous trees located approximately 15 to 20 miles out from the refuge feeding area, but possibly because of human encroachment they are not utilized for roosting.

In January 1962, several Bald Eagles were seen flying toward the Wasatch Mountain range apparently with great intent and using a continuous wing flap. The specific area they went to was the Willard Peak, which has an elevation of approximately 9,700 feet.

On 24 February 1963 at 7:30 AM, I climbed up into the Willard Canyon to a height of approximately 6,000 feet before I encountered too much snow to continue. From a high vantage point an adult pair of eagles was seen flying toward the Bear River delta feeding area, riding the high thermal air currents. During the next 7 hours two adult eagles and one immature bird were seen flying about the area at very high elevations. On several occasions Golden Eagles (*Aquila chrysaetos*), breeding birds in the area, were also seen, but no interspecific strife occurred between the two species.

At 3:15 PM on the west fork of the basin of the Willard Canyon, which is about 15.5 nautical miles from Bear River, I began counting the eagles, using 7 × 50 glasses, as they circled very high over the area. The numbers increased until the eagles had almost assumed a gregarious behavior. After a first pair dropped down into a large dead Douglas fir, the others were observed descending, one by one, into this same tree, until nearly every limb was occupied—14 birds being counted in all. The white heads of two other adult birds were also seen in contrast with the evergreen foliage. This roosting area is at an elevation of approximately 7,500 feet. The number of birds counted was 16 adults and 1 immature bird.

On 29 March 1963 the roosting area was almost devoid of eagles. Although the majority of birds had left the feeding and roosting areas, one adult was seen feeding on a dead Coot (*Fulica americana*) in the marshes.

To determine the amount of use the area had received during the winter, on 1 June 1963 I climbed to the trees which had been used for roosting. Eagle pellets were

found to be scattered quite profusely throughout the entire area. Approximately 90% of the pellets found contained duck feathers.

Therefore, it is this writer's opinion that if proper roosting habitat is not available near their feeding grounds, the birds will commute great distances to seek it. In studies of the Bald Eagle of the Midwest (Southern, 1963. *Wilson Bull.*, 75:50) roosting areas were found to be available near the feeding areas along with hunting perches. Here on the Bear River marshes this is not the case and the high mountain passes provide the only suitable roosting places for eagles.—JOHN F. SWISHER, JR., 117 North 10 East, Brigham City, Utah, 28 June 1963.

Unseasonable record of Gannet in North Carolina.—On 23 July 1963, an adult Gannet (*Morus bassanus*) of undetermined sex was found on the ocean side of Shackleford Banks, located 3 miles southeast of Beaufort, Carteret County, North Carolina. This island is one of a series forming the outer banks of the coastline. High and steady winds had prevailed from the ocean for a 3-day period from 18 July through 20 July. The state of decay indicated that the bird had been dead less than a week. Extreme dates for the Gannet in North Carolina are 26 May and 20 August with none recorded during the summer interval according to Wray and Davis (1959, "Birds of North Carolina"). There have been no subsequent published records of the Gannet in North Carolina during this summer interval. The specimen was not banded.—WILLIAM H. ADAMS, *Department of Biology, Tennessee Wesleyan College, Athens, Tennessee, 24 October 1963.*

Observations on sun-bathing in the Yellow-billed Cuckoo.—Published accounts of the behavior of the Yellow-billed Cuckoo (*Coccyzus americanus*) and of sun-bathing in birds are few. It therefore seems noteworthy to record the following observations.

At 0800 hours on 3 August 1963, I was searching for birds near headquarters at Salt Plains National Wildlife Refuge, Jet, Oklahoma. I saw a Yellow-billed Cuckoo alight on a branch, spread and droop its wings, and spread and bend its tail laterally at an 80° angle to the bird's body. The posture was held approximately 3½ minutes. A Mississippi Kite (*Ictinia mississippiensis*) startled the cuckoo and it moved to a nearby branch and preened for 10 minutes. The bird again assumed the above-described posture, but faced the opposite direction; the tail was bent in the same direction as in the first observation. One side of the bird and the tail, which was lowered slightly to expose it fully to the sun, were in direct sunlight. This second posture was held for 5½ minutes. A slight turning of the head was the only movement during the sun-bathing postures. The air temperature at the time of the observations was approximately 80 F.

Gibb (1947. *Brit. Birds*, 40:174) states that the sun-bathing posture "is typically the fluffing out of the body feathers, opening of the wings and fanning the tail. The odd postures at times described may usually be attributed to the bird's inclining its body towards the oblique rays of the sun." Hauser's observations (1957. *Wilson Bull.*, 69:80) indicate that the bill is usually open while sun-bathing. The postures of the cuckoo differed from most sun-bathing postures in the sharp bending of the tail, the closing of the bill, and the absence of fluffed feathers.

I wish to thank Drs. Andrew J. Berger and George Miksch Sutton for their many helpful suggestions and critical reading of the manuscript. This study was financed by a grant (G21630) between the Department of Zoology, University of Oklahoma, and the National Science Foundation.—JOEL LESTER CRACRAFT, *Department of Zoology, University of Oklahoma, Norman, Oklahoma. (Present address: Museum of Zoology, Louisiana State Univ., Baton Rouge, Louisiana) 4 November 1963.*

Migration and habitat of the Long-billed Dowitcher on the coast of Georgia and South Carolina.—A recent study by Jehl (1963. *Wilson Bull.*, 75:250-261) discusses the ratio of the Short-billed Dowitchers (*Limnodromus griseus griseus* and *L. g. hendersoni*) during the autumnal (midsummer) migration, in New Jersey, a welcome addition to our knowledge of these two similar subspecies. It also makes brief mention of the Long-billed Dowitcher (*Limnodromus scolopaceus*).

The purpose of this brief note is to place on record the times of occurrence of *L. scolopaceus* on the coast of Georgia and South Carolina, together with some notes on the habitat, as I have known it for many years along the lower Savannah River.

The Short-billed Dowitchers are abundant on the tidal flats and beaches of the river entrance in spring and fall migrations, and a few may be found at any time of year. They occur in various stages of plumage. In the 1920's and 1930's I collected quite a number, hoping to find the Long-billed Dowitcher in the same habitat. It was some years later that the difference of habitat in the two species came to be understood. Others have recognized this preference, and once understood there is little difficulty in separating the species.

In this region the habitat preferred by *scolopaceus* consists of shallow impounded waters with scant vegetation. In another work (Tomkins, 1958. *Occas. Publ. Ga. Ornith. Soc.* No. 4) this has been called the "borrow-pit" habitat, a term which is neither more nor less satisfactory than such terms of restricted terminology usually are. Of course, such habitat must contain food and, without it, will not retain any birds that may drop in. The Long-bill shares this habitat with a group of scolopacine birds, the Lesser Yellowlegs, White-rumped Sandpiper, Stilt Sandpiper, Pectoral Sandpiper, all species not normally found in the Short-billed Dowitcher domain on the tidal flats and the beaches. Salinity does not seem to be a restrictive factor.

In this region, with abundant rainfall and a fertile substrate, the "borrow-pit" habitat is seldom found naturally, partly because of the lush vegetation, but it usually occurs following some disturbance of the natural conditions by the works of man. A typical place is where soft material dredged from the river has been pumped into an area surrounded by ring dikes, or where small undrained pools are left in the construction of a road. Even in those places vegetation soon takes over, or continued baking by the sun renders it unusable. The only place I have found such habitat formed by natural causes was on Turtle Island, South Carolina, where a tidal flat was flooded after storm winds and seas closed the mouth of the creek that drained it. This pool produced the specimen of *L. scolopaceus* mentioned in Sprunt and Chamberlain (1949. *South Carolina Bird Life*), the only specimen then known from that state.

At several times and places over the years, such islands of habitat have developed, matured, supported considerable numbers of birds at the peak, and then became obsolescent. The largest one was an area of perhaps four or five hundred acres on Hutchinson Island, Georgia, where silt from river dredging was impounded by dikes. Shorebirds were very numerous there at times, when there was sufficient rainfall. At present it is no longer suitable habitat. At the peak in 1958, as many as 200 Long-billed Dowitchers were counted at a time. There was also a high count of 138 Stilt Sandpipers. The area was too great, and the bottom too soft, to get an exact count. Such numbers of these two species have not been reported elsewhere from either state, and usually the sight of only a few is considered noteworthy.

Another small pool, between a roadway and an abandoned railway bed, with a sill that maintained a fairly constant water level between the spring tides that flooded it at times, often attracted a few Long-billed Dowitchers but no Short-bills. Across the road,

a few hundred yards away, the Short-bills were numerous but preferred to move to some bare beach when the tide flooded their feeding grounds.

In summation, the Long-billed Dowitcher has been recorded numerous times within a few miles of the lower Savannah River. In spring it has been seen from 27 March to 2 May, and the postnuptial migration has brought this dowitcher here from mid-August to the end of November. The obvious conclusion is that these birds regularly come through this area but are not likely to be seen unless suitable habitat is available. It is also obvious that field observations do not give a true picture of the numbers that migrate through here.

A happening verifying this view is that reported by Denton and Post (*Oriole*, 27:43-45) which tells of the gathering of certain scolopacine birds for some weeks in artificial pulpmill ponds near Augusta, Georgia, many of them species which are seldom seen in this area away from the coast.—IVAN R. TOMKINS, 1231 East 50th St., Savannah, Georgia, 28 October 1963.

Nest-site selection in the American Redstart.—Nest-site selection has been the subject of surprisingly few studies considering its importance to the reproductive success of the species. The behavioral acts involved in site selection and their sequence are similar in many passerines (e.g., Nethersole-Thompson and Nethersole-Thompson, 1943. *Brit. Birds*, 37:70-74, 88-94, 108-113). I will report here some observations on nest-site selection in the American Redstart (*Setophaga ruticilla*) which were part of a study of the reproductive behavior of this species.

The nest is built at the juncture of three or more small branches, or more uncommonly, in vines. On the few occasions when nests were built on the horizontal limb of a tree they were always placed where several small branches grew upward. A variety of shrubs and trees is utilized. The height of nests in the study area in Ithaca, New York, ranged from about 3 to 35 feet.

The female spends the first day or two after choosing a mate exploring the whole territory and probably learns its approximate boundaries during this time. Then she restricts her activities to certain smaller areas and explores them more thoroughly. During this period she often starts near the base of a small sapling and gradually explores its branches by hopping and flying upward. Next (from a few hours to a day later) she begins standing in a crotch for a few seconds before moving on. Finally site "trying" behavior appears. The female presses her breast down in a crotch, frequently rotating her body while in this position. After she raises her breast the tail is often pressed down. Crotches formed from only two branches are rarely "tried" in this manner, but on one occasion a female "tried" such a crotch and as she turned and pressed downward she toppled forward (probably because of the lack of additional branches), left the site and was never seen to return to it. The only time a female built in a two-pronged crotch, the wind swept the nest away. This bird was probably a first-year female as judged by her late arrival and very dull plumage.

Although male redstarts do not build nests, some try out nest sites during the period that the females are engaged in this activity. The male usually begins trying sites after the female has started. All the sites "tried" by males are those typical of the species and the motor patterns used are the same as the females'. In all of the cases observed (approximately 20) the reaction of the female to seeing her mate trying a site was to approach as soon as he left and then try the same crotch. However, females never built in sites which the males thus "directed" them to.

The inspection of nest sites occurs in bursts. The female often tries five or six in a 10-minute period and then feeds for a while before resuming. She frequently tries as many

as 20 sites before finally bringing nest material to one. It is impossible to predict which crotch will be used for the nest since the bird often builds in one that she tried only infrequently as compared to the others. Although in some individuals the site inspection period lasts 1½ days, in others only a few hours ensue between the first trying of sites and the bringing of nesting material.

After trying a number of sites the female starts tugging at plant fibers. This behavior is usually brief and ineffectual at first and the female soon tries more sites. During the next stage she picks up and drops plant fragments. Finally, a strip is brought to one of the nest sites that has been tried recently (not necessarily the last tried). Although the female may try a few more sites even after she has brought several loads of material to one, there is usually no further trying of sites and nest building commences.

Nest-site selection is a behavioral sequence: there are many separate acts which are more or less dependent on the preceding ones. The usual sequence is: (1) exploration of the whole territory, (2) exploration of specific areas, (3) standing in crotches, (4) site "trying" by performing shaping movements in crotches, (5) tugging at plant material, (6) picking up plant fragments, and (7) carrying them to a site.

The first stages involve primarily visual exploration; later ones, such as shaping, are primarily tactile. Visual "screening" of possible sites eliminates the necessity of "trying" large numbers. Lorenz (Group Processes, N.Y., 1955, p. 188) suggests that the site finally chosen by certain European passerines is one in which there is a maximum of tactile stimulation on all sides. The restart that once tried a two-pronged crotch and fell out subsequently went to species-typical sites. She seemingly underwent an "unsatisfactory" tactile experience and immediately learned to avoid this type of site. The biological significance of rapidly learning to select sites which give the proper tactile sensations seems obvious when we consider that the only female which built in a two-pronged crotch had her nest swept away by a mild wind storm which destroyed no other nests.—MILLICENT S. FICKEN, *Laboratory of Ornithology, Cornell University, Ithaca, New York and Department of Zoology, University of Maryland, College Park, Maryland, 30 December 1963.*

Predation upon flightless ducks.—From 5 June to 29 August 1961, I studied the postbreeding activities of waterfowl at Camas National Wildlife Refuge, Hamer, Idaho. During that time, I did not witness the capture by a predator of any duck capable of flight. On the other hand, several flightless birds were caught by predators. On 6 July, for example, I noticed a flightless drake Mallard (*Anas platyrhynchos*) splashing desperately. I then saw a mink (*Mustela vison*) atop the duck, biting into its neck. A furious struggle took place both above and below the water. The bird's flapping gradually lessened, and finally ceased. The mink and the Mallard submerged for about 15 seconds during which time I saw no struggling. Surprisingly, the duck surfaced and swam off in one direction, the mink in another. The bird appeared to be injured, swimming very slowly and quite low in the water.

On 23 August I saw two adults and a young coyote (*Canus latrans*) walking near a large group of flightless ducks. The pup had an unidentified duckling in its mouth. As my boat approached the flightless gathering, about six American Widgeons (*Mareca americana*) and two Gadwalls (*Anas strepera*) ran onto land directly toward the motionless coyotes. A commotion followed; several ducks reached the water flapping furiously, and the coyotes scampered off with at least one adult duck. The following day I saw a coyote catch another duck in the same manner.—LEWIS W. ORING, *Department of Zoology, University of Oklahoma, Norman, Oklahoma, 22 August 1963.*

ORNITHOLOGICAL NEWS

The Wilson Ornithological Society operated at a loss in 1963. This, together with a large December issue of *The Wilson Bulletin*, an extraordinary number of address plate changes due to zip code, and rising costs in general, presaged a deficit of approximately \$1500 at the end of the current year.

The Executive Council, meeting at Kalamazoo, voted an increase in dues commencing in 1965 to \$5 active, \$10 sustaining and \$150 life. These increases, plus an anticipated increase in endowment income, which will result from the highly gratifying response to appeals for new patrons and life members, augur well for the future financial stability of the Society. They do not, however, remove the 1964 deficit. Council, therefore, authorized your outgoing president to make an appeal to the membership for funds to carry the Society through its present financial squeeze. Such an appeal at the annual meeting resulted in more than half of the anticipated deficit being underwritten. This is a call to those who were not present for your participation. If you can be of assistance, please direct your contributions, which of course are income tax deductible, to the treasurer.—P. B. S.

The Society's reserve supply of some recent issues of *The Wilson Bulletin* is inadequate. The supply of the March 1963 issue is especially critical, but we also need additional copies of the March 1962 issue and the June, September, and December issues of 1963. Members who do not keep all back issues on file will be doing the Society a real and important service by returning any copies of these issues to: The Josselyn Van Tyne Memorial Library, Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

Membership in the Laboratory of Ornithology at Cornell University at Ithaca, New York, is available to all persons interested in supporting its research, educational, and cultural programs. Fees are \$10.00 for Supporting Membership and \$100.00 for Annual Patronship. All members receive the quarterly *Newsletter* and *The Living Bird* while Annual Patrons receive in addition such other publications as phonograph records, record albums, and booklets produced by the Laboratory during the calendar year.

The AOU announces that *The Proceedings of the XIIIth International Ornithological Congress* is now ready for delivery. This is a two-volume work of more than 1,250 pages, bound in hard covers, and illustrated by a colored frontispiece, containing 110 papers presented or read by title at the International Congress held in Ithaca, New York in 1962. The price is \$20.00 (postpaid if remittance accompanies order). Order from: The Treasurer, American Ornithologists' Union, Museum of Zoology, Drawer MU, Louisiana State University, Baton Rouge, Louisiana.

The Asociacion Ornitológica del Plata announces that it is resuming the publication of its journal, *El Hornero*, with William H. Partridge as Editor. The Asociacion extends a cordial invitation to ornithologists interested in the bird fauna of this region and in Neotropical birds in general to join the association and to send in papers for publication in *El Hornero* on any aspects of the study of birds of the Neotropic Region. All papers will be published preferably in Spanish with English summaries. Membership dues per year are: Active Members, \$200 Arg. Pesos (about \$1.50 U.S. dollars), and Sustaining Members, \$400 Arg. Pesos (about \$3 U.S. dollars). *El Hornero* is sent free to all mem-

bers. Send papers and dues to: Asociacion Ornitologica del Plata, Av. Angel Gallardo 470, Buenos Aires, Rep. Argentina.

In conjunction with research concerning the population dynamics and demography of the Eastern Bluebird, Dr. Douglas James, Department of Zoology, University of Arkansas, Fayetteville, Arkansas, would like to know the names and addresses of everyone who has established a number of bluebird nesting boxes, and who are in a position to tell him the number of such boxes used by bluebirds each year. Persons interested in cooperating should contact Dr. James for details and copies of the census form.

JOSELYN VAN TYNE MEMORIAL LIBRARY

The following gifts have been recently received. From:

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| Pierce Brodtkorb—5 journals, 11 reprints | C. Chandler Ross—1 reprint |
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| John P. Hubbard—2 reprints | J. Dan Webster—3 reprints |
| Leon Kelso—2 books, 5 translations, 6 reprints | Wisconsin Society for Ornithology—500 journals & reprints |
| Peter Klopfer—24 reprints | Dale A. Zimmerman—7 reprints |
| Daniel McKinley—1 journal, 18 reprints | George Zug—1 reprint |
| Harold F. Mayfield—4 books, 5 journals, | |

SPECIAL REVIEW

ANIMAL SPECIES AND EVOLUTION. By Ernst Mayr. Belknap Press of Harvard University Press, Cambridge, Massachusetts, 1963: 6¼ × 9¼ in., xiv + 797 pp., numerous figures and tables. \$11.95.

Reviewed by KENNETH C. PARKES

Prior to 1942 the name of Ernst Mayr was relatively little known to biologists other than ornithologists. The latter knew him as the young German who had been brought to New York in 1932 to curate the Whitney-Rothschild collection of birds at the American Museum of Natural History. His major field experience had been in New Guinea and the Solomon Islands, and he was an acknowledged authority on the taxonomy and distribution of the birds of the Pacific Islands. Although most of his publications had been faunal or taxonomic, he had written a few thoughtful papers of a more analytical nature, on speciation and zoogeography (Mayr, 1940, 1941). But the name Ernst Mayr could hardly be said to have been a "household word" among biologists.

This situation changed abruptly in 1942 with the publication by the Columbia University Press of Mayr's "Systematics and the Origin of Species." It immediately became apparent that Ernst Mayr was something more than a mere traditional taxonomist. Reviewers rightly praised Dr. Mayr's ability to draw significant generalizations from his own taxonomic work and that of others; particularly did his command of the literature receive admiring comment. "Systematics" soon took its place among the "classical" works of the emerging synthetic approach to the study of evolution. It was adopted, by this reviewer among others, as a text in university courses.

Praise for Mayr's 1942 book was not unalloyed with criticism. The most frequent adverse comments were those of non-ornithologists, who felt that Mayr relied far too heavily on data from birds; that his generalizations from ornithological data were not necessarily applicable to animals of other groups; and that his examples from non-ornithological sources were not always wisely chosen or correctly interpreted (partly based on personal conversations, but see Hubbs, 1943, and Schmidt, 1943). A more recent critique (Blackwelder, 1962) takes sharp issue with many of Mayr's viewpoints as expressed both in the 1942 book and in later writings.

Whether as a result of these criticisms or as a natural broadening as a biologist which would have taken place in any event, Mayr's interests in the years following 1942, as illustrated by his publications, seem to have expanded greatly. Among his papers we find titles dealing with such diverse topics as genetics and behavior of *Drosophila*, the taxonomy of fossil hominids, and speciation in echinoids. Until he left the American Museum of Natural History for Harvard in 1953, the majority of his papers still dealt with birds, and he wrote two highly useful regional bird guides (one coauthored with Jean Delacour). Increasingly, however, one notes in Mayr's bibliography the appearance of interpretive and synthetic papers. Since 1953, his publications have been overwhelmingly of this nature; scarcely a symposium has been published in the past ten years on evolution, classification, the "species problem," etc., that does not have Mayr listed as co-editor, participating author, or summarizer. His name continued to appear occasionally in the ornithological literature of the last decade, particularly in connection with technical details of nomenclature, and he served as coeditor for volumes 9, 10, and 15 of the Peters' "Check-list of Birds of the World."

All this while we had heard rumors, first of a revised edition of "Systematics and the Origin of Species," and later of a completely new book rather than a rewritten version of the 1942 work. The rumors are rumors no longer, and "Animal Species and Evolution"

is now before us. It is, indeed, a completely new book, and more than twice as long as "Systematics and the Origin of Species."

The present review is appearing rather late, and I do not pretend to have avoided reading other reviews to prevent my being influenced by the opinions of others (although I have not yet, at this writing, read a review by an ornithologist). I have, in fact, eagerly soaked up such opinions. This procedure is virtually mandatory because of the overwhelmingly broad spectrum of Dr. Mayr's intellect, and of his book. Nobody is truly capable of a thoroughly analytical review of Ernst Mayr's book *in toto* except another Ernst Mayr, and such reviewers are rare indeed! In practice, Dr. Mayr's book *can* be reviewed at any of three different levels. The dust jacket bears excerpts from statements by eight world famous biologists, using such terms as "landmark," "definitive," "indispensable," etc. This may be called the "forest" level of reviewing, and some of the post-publication reviews in journals have also been at this level. The latter, however, tend to be at the "trees" level; the reviewers have expressed their admiration of the book as a whole, especially of areas lying outside their own fields of interest. Specialists reading Mayr's book tend to reflect the viewpoint of Gerald W. Johnson writing on I. F. Stone: "He has . . . the merit of tremendous industry. How the man covers so much ground and reads so much dull stuff is beyond my comprehension; but I respect it" (Johnson, 1963). Having acknowledged Mayr's broad coverage, the specialist then goes on to question rather critically Mayr's limning of those trees in the vast forest with which he, the specialist, is best acquainted. This is only to be expected. Loren Eiseley, in response to a criticism of his review of "The Columbia Encyclopedia," wrote ". . . in judging anything so extensive as an encyclopedia, one can only test the accuracy of detail by the examination of areas in which one has some reasonable degree of knowledge" (Eiseley, 1963). For most of us, attempting to review Dr. Mayr's book is not unlike essaying a review of an encyclopedia, save only that the latter is usually the product of many authors rather than one.

If one allows one's impression of "Animal Species and Evolution" to be formed from a synthesis of the criticisms of individual trees and groves, one may at least be permitted some doubts as to the soundness (in this case, the authoritativeness) of the forest as a whole. Given the immense scope of the book, however, this composite impression based on a mosaic of specialists' displeasure with Mayr's treatment of their pet subjects might seem to be somewhat unfair to the author.

There is one more level of reviewing which, to continue the sylvan metaphor, may be called the "twig" level. This involves the scrutiny of details of fact, citations of literature, use of scientific names, etc. Few reviewers have bothered to descend to this level, perhaps for lack of time, perhaps because of a dislike of being thought petty. One commentary which was presented at the "twig" level was that of Alexander (1963), which was answered (I daresay not wholly to Alexander's satisfaction) by Mayr (1963). Dr. Mayr began his reply with the following words: "No one can write a book of 813 pages with 1,800 literature references and numerous generic and specific names quoted on almost every page and not expect to make an occasional mistake. However, I hope that matters are not quite as bad as Dr. Alexander would seem to make them." Let us see. The forest has been adequately covered by reviewers, and specialists of various sorts have had their say about the trees, and a few have examined some twigs. In most of the present review, I shall be writing primarily as a specialist in ornithology, which was Dr. Mayr's original field. I shall pay a good deal of attention to twigs, in the face of a certain amount of unpopularity of this type of reviewing. But, as I shall mention in concluding, I think there is a need for this close examination.

In a synthetic work of this nature, the references to the literature are all-important (as suggested by Dr. Mayr's stressing of the fact that his book contains some 1,800). Checking such references is a tedious editorial task, but a vital one. Reviewers ordinarily expect that this task has been done, and will look up only such references as may catch their eye, either because of an apparent discrepancy, or a wish, unrelated to reviewing *per se*, to learn more about the subject. This is true of all of the literature citations mentioned below; I made no "spot-checks" for accuracy, but looked up only those references which interested me particularly for some reason.

On p. 94 of Mayr's book, in a discussion of seasonal isolation as an isolating mechanism, I encountered the sentence "The five species of *Rana* in eastern North America (Moore 1949) likewise have largely overlapping breeding seasons." Now, even as an ornithologist I know that there are more than five species of frogs of the genus *Rana* in eastern North America; I was certain that what Dr. Mayr meant to say was either "five of the species of *Rana* . . ." or "the five species . . . studied by Moore." So I checked Mayr's bibliography for "Moore 1949." The only reference under that date is a paper on geographic variation of adaptive characters in the leopard frog, which proved upon reading to have nothing to do with the subject in connection with which Mayr cites "Moore 1949." Dr. Moore does, however, mention in a footnote (Moore, 1949a:22) that more of his material on the genus *Rana* is to appear in a symposium volume "to be published in the near future by the Princeton University Press." The paper thus referred to (Moore, 1949b) turns out to be the one in which appear the data given by Mayr on breeding seasons of *Rana* (of which, incidentally, Moore mentions no less than twelve species in eastern North America in all), but this paper is *not* listed in Mayr's bibliography, although ironically enough it appeared in a volume of which Mayr was a coeditor.

Other inaccuracies involving literature citations may be mentioned more briefly. On p. 153 there are two references to "Dunn, in Mayr 1944." The only "Mayr 1944" in the bibliography is "The birds of Timor and Sumba," in which Dr. Dunn did not take part; the Dunn reference is alphabetized under that author's name without any mention of Mayr (actually Dunn's paper was a sort of appendix to one by Mayr which is not listed). Mayr relatively seldom gives exact page citations, even for short passages from long books; this in itself is an inconvenience. On p. 310, however, there is a citation of "Grinnell 1926:260." The only Grinnell 1926 listed in the bibliography has pages running from 429 through 450; the only Grinnell reference which *has* a p. 260 has nothing on that page remotely pertinent to Mayr's point. As documentation for a statement that ". . . many workers in recent years have attempted to calculate the average amount of dispersal per individual per generation . . ." (p. 566), Mayr cites among others a paper by A. H. Miller in which I am unable to find any such calculation. On p. 511 Mayr states that circular overlaps "have been shown to be probable for three species of ducks and geese in the Perry River region of arctic North America (Gavin 1947)." Gavin gives such evidence for two geese, *Branta bernicla* and *Anser albifrons*, but none for any species of duck. In some instances Mayr may state as fact what the author in the reference cited presented only as tentative conclusions, an especially dangerous procedure if these tentative conclusions are later shown to be incorrect. For example, Mayr (p. 511) gives a list of species in which "circular overlaps have been described," and includes without comment "*Charadrius hiaticula* (Bock 1959a)." In actuality Bock merely suggested that there might be such a circular overlap in *Charadrius*, and admitted frankly that there was no real evidence for it. Subsequently Vaurie (1964:2-4) has shown that it probably does *not* exist.

Having found, in areas of my special interests, such inaccuracies of citation and of second-hand presentation of material, and having read the comments of Alexander (1963) and of Brown (1964), I cannot help wondering to what extent I can rely on Mayr's citation of primary literature not readily available to me for verification.

Turning from bibliographic citations to matters more strictly ornithological, one again encounters disquieting passages, either having to do with matters of fact or of interpretation. Mayr's familiarity with the literature and the taxonomy of North American birds does not appear to be up to the standards of his knowledge of birds of the Pacific. On p. 117 he discusses what he designates "the so-called 'Potomac Warbler'" [i.e., *Dendroica potomac* Haller]. This possible hybrid may be "so-called" somewhere in the literature, but every reference I have ever seen and every ornithologist with whom I have discussed these enigmatic birds used the English name proposed by the describer, "Sutton's Warbler." In an additional reference to this presumed hybrid, Mayr states (p. 127) that it "comes from an area where the Parula Warbler (*Parula americana*), one one of the parental species, is rare." In point of fact, the Parula Warbler was common in that area, and the *other* presumed parental species, the Yellow-throated Warbler (*Dendroica dominica*), had never been observed, as clearly stated in the original paper (Haller, 1940). And I am informed by ornithologists who know much more about wood warbler behavior than I do that there is no justification for Mayr's speculation that "pair formation was apparently facilitated by similarity in the nesting behavior of the two parental species" (p. 117).

In the same discussion of hybridization, Mayr makes the valid point that "many of the known hybrids of animal species are found at the margin of the normal geographic range of one of the two parental species, or even beyond it" (p. 127), but then goes on to use a most unfortunate example. He states "The 'Cincinnati Warbler,' which appears to be a hybrid between the Blue-wing [sic] Warbler (*Vermivora pinus*) and the Mourning Warbler (*Oporornis formosa* [sic; = *O. philadelphia*]), was found in an area south of the range of the Mourning Warbler." In the first place, the presumed parents of the probable hybrid described as the "Cincinnati Warbler" are the Blue-winged and the Kentucky Warbler, whose misspelled scientific name ("*formosa*" = *formosus*) Mayr used for the Mourning Warbler; both of these species breed in southern Ohio, contrary to the point Mayr was trying to illustrate in citing this hybrid. In the second place, the specimen in question was collected on 1 May, a date far too early in the spring for any conclusions to be drawn about ranges of presumed parents; on 1 May this individual could have been five or five hundred miles from its hatching place. Dr. Mayr may have confused the original "Cincinnati Warbler" with a second, somewhat similar presumed hybrid which was taken in Michigan on 28 May 1948, and which is thought to be a possible offspring of the Blue-winged and Mourning warblers although collected slightly south of the known breeding range of the latter species (see Langdon, 1880; McCamey, 1950).

Mayr's choice of examples from the family Parulidae seems to have been persistently unhappy. On p. 304 he states "Most migratory species of the North American warbler genus *Dendroica* are geographically invariable." If by "geographically invariable" he means, as I assume he does, that no subspecies are recognized, he is just barely correct by the standards of the current A.O.U. Check-list—12 monotypic species to 10 polytypic. But "geographically invariable" is a little strong if one considers that subspecies not currently admitted by the A.O.U. have been described in at least two (*nigrescens*, *striata*) of the "monotypic" species of *Dendroica*. In fact, Mayr's repeated reference to monotypy in Parulidae (see also p. 417) is misleading when it is remembered that

several species considered monotypic in the A.O.U. Check-list in addition to those in *Dendroica* exhibit geographic variation of less than the degree currently invoked for subspecies (cf. *Parula americana*, *Limnothlypis swainsonii*).

Many of Mayr's generalizations will, of course, be accepted at face value (especially by students), as they are troublesome to check. Some, when investigated, prove to be weak or even baseless. For instance, on p. 568 Mayr states "Fruit- and nectar-feeding birds which have to follow shifting food supplies show greater dispersal and less subspeciation than the more sedentary insect eaters." Perhaps logical enough, but let us test this generalization. An ideal group, differing chiefly in feeding adaptations, consists of the primarily insectivorous Parulidae (wood warblers), the primarily frugivorous Thraupidae (tanagers), and the primarily nectar-feeding species currently assembled as the family Coerebidae (honeycreepers), although some authors believe this to be a composite group of derivatives from the Parulidae and Thraupidae respectively. According to Mayr's generalization, the Parulidae should have the most subspecies per species. Using, for convenience, the species and subspecies as listed by Hellmayr (1935, 1936), we find that the insectivorous Parulidae average 2.37 subspecies per species, and the frugivorous Thraupidae 2.49; the nectar-feeding Coerebidae, even after subtracting the bias caused by the 22 insular subspecies of *Coereba flaveola*, still average an even 3 subspecies per species. These figures are exactly the opposite of what Mayr has led us to expect.

Another somewhat dubious generalization is Mayr's comparison of migratory emberizids with migratory parulids in which he suggests that the large amount of geographic variability shown by the former may be related to the fact that they are "ground-living birds and perhaps more exposed to selection by predators and microclimates than are species living in tree tops, such as most Parulidae" (p. 418). But among the most migratory and the most geographically variable of the Parulidae are the Yellow Warbler (*Dendroica petechia*) and the Yellowthroat (*Geothlypis trichas*), neither of which can be characterized as a tree top bird, and both of which occupy habitats shared with emberizids.

On p. 335 Mayr discusses the nineteenth-century species concept, using as his example the Song Sparrow (*Melospiza melodia*) and related species. His point is that the western forms of Song Sparrow *insignis*, *rufina*, *gouldii*, and *fallax* were "described as 'species' because to their describers they seemed as different from each other as the four original species [i.e., the Fox, Song, Swamp and Lincoln's sparrows] of eastern North America." An interesting notion, but wholly unfair to the describers who were working within a primarily binomial system of classification. Of the four western forms listed, I have been able to check the original descriptions of *insignis*, *gouldii*, and *fallax*. These clearly show that the describers knew perfectly well that their new forms were Song Sparrows, allied to and even intergrading with the Eastern Song Sparrow; *gouldii* is even referred to in one place as "var. *gouldii*" by Baird, its author. Incidentally, Mayr departs from A.O.U. Check-list usage in employing the generic name *Passerella* rather than *Melospiza* for the Song Sparrow and its relatives, although recent students of New World emberizines tend to agree that if generic lumpings are to be made, *Zonotrichia* (and, indeed, *Junco*) cannot be excluded from the assemblage (Bond, 1956:188; Dickerman, 1961).

Others among Mayr's generalizations would be exceedingly difficult to challenge. I would be curious, for instance, to know who has gone to the trouble to do the detailed research necessary to support a statement like "not a single geographic race is known that is not also an ecological race" (p. 357).

Some additional ornithological details deserve comment. On p. 598 the word "Proavis" is used without any explanation. Mayr may believe it to be self-explanatory, but a student would not be likely to know that this is merely a convenient name for a hypothetical

undiscovered stage in the transition from reptile to bird. In discussing geographic variation in proportions (pp. 304-305), the choice of tail/wing ratios in the drongo *Dicrurus hottentottus* as the sole example given was infelicitous, as the "tail" in measurements of birds actually constitutes the tail *feathers*, epidermal structures such as are separately discussed in Mayr's next paragraph. On p. 324, the generalization that birds from northern populations of migratory species normally have relatively longer wings than more southerly populations is contradicted by the map on p. 322 based on Salomonsen's data for *Charadrius hiaticula*. The caption for the figure on p. 591 reads "Geographic variation of bill function in the Hawaiian honey creeper *Hemignathus lucidus*," but drawing "A" portrays a different species, *H. obscurus*, as the remainder of the caption indicates. On p. 371 Mayr refers to several North American birds which demonstrate east-west pairs of populations now united by hybrid zones. Among such well known examples as the flickers, towhees, and Myrtle/Audubon's warblers, he lists "ruffed grouse (*Bonasa*)."¹ I know of no such situation in the genus *Bonasa*; Mayr no doubt meant the Spruce/Franklin's Grouse (*Canachites*), the only North American grouse with such an east-west pair. On p. 377 he again invokes the flickers, this time as an example of great variability in a narrow allopatric hybrid belt. But this "belt" in the flickers, judging from specimens exhibiting introgression, may well be the broadest among North American birds. On p. 564 the Cattle Egret is said to have "colonized northern South America across the Atlantic around 1930 . . ." whereas this colonization took place at least fifty years earlier (Bond, 1956:12).

Some of Mayr's usages of scientific names of birds are difficult to interpret. "*P. lazuli*" for *Passerina amoena*, the Lazuli Bunting, is clearly a slip of the pen on p. 118. On p. 345 Mayr uses the generic name *Edolisoma*, although in the Peters' Check-list (Mayr and Greenway, 1960) he himself had "lumped" this genus with *Coracina*. On the other hand, his use on p. 117 of "*T. [ympanuchus]*" instead of *Pedioecetes* as the genus of the Sharp-tailed Grouse is equally clearly an expression of his conviction that the latter species ought to be considered congeneric with the Prairie Chicken. Revival of the old name *Cardinalinae* (p. 97) for the subfamily known to most readers as *Richmondinae* may be startling, but apparently has some justification in the technicalities of nomenclature (although this had not been made "official" at the time of publication of Mayr's book). Less clear is Mayr's use of *Quiscalus* rather than *Cassidix* in citing the work of Selander and Giller on the Boat-tailed and Great-tailed grackles (p. 87); this could either be a slip of the pen or another implied advocacy of generic "lumping." It remains highly questionable whether a textbook of this type is the proper place for taxonomic or nomenclatorial innovations, especially when unexplained, no matter how soundly based these changes may be (see my earlier comments on this subject; Parkes, 1958:102).

Several reviewers have taken issue with Mayr on certain of his statements of principles involving various aspects of evolution, some major, some minor. Lest it be said that my review concerns itself with nothing but misquoted references or misspelled scientific names, let us proceed to matters of wider significance. On p. 389 Mayr quotes favorably what he admits to be a broad generalization concerning the characteristics of central versus peripheral populations of a species. Among these characteristics he lists relatively high population density per unit area for central populations. This may often be true; but peripheral populations are frequently members of depauperate faunas and may reach extremely high population densities, presumably correlated with absence of competing species, or of predators, or both, a phenomenon well known to visitors to small islands (see Tompa, 1962, for a good example). Incidentally, the figure on p. 388 chosen to illustrate characters of peripheral versus central populations of the drongo *Dicrurus*

leucophaeus suggests that in this case "peripheral" and "central" have been defined to suit the example.

In discussing geographically isolated populations, Mayr (pp. 366-367) states that their "isolation is never complete, since a certain amount of gene flow reaches even an isolated oceanic island (or else it could not have been colonized originally)." Leaving aside the possibility that such an oceanic island may have been colonized by a combination of fortuitous circumstances with an infinitely small likelihood of repetition, this discussion does not allow for the development or the strengthening of a barrier *after* a colonization has taken place, effectively preventing even the small amount of gene flow inherent in the fact of the original colonization. In his comparison of the potential for speciation in central versus peripheral populations, Mayr makes two statements (top of p. 527, top of p. 535) that I cannot interpret other than as directly contradictory to one another. And surely circular reasoning is involved in Mayr's claim (p. 491) that he has "shown" that the earliest immigrant birds from Asia to Australia and North America have evolved into new families and genera, later ones into new species and subspecies, and the most recent have not yet begun to speciate. After all, the chief (often the only) evidence for the relative antiquity of such immigrations is the degree to which they have become differentiated (see Parkes, 1959:425ff.).

Mayr states on p. 60 that "In continental areas without physical barriers the border of the species range indicates the line beyond which the species is no longer adapted, and the very existence of such borders is tangible proof of the limitations of this adaptation." Although one might hedge by quibbling over the definition of "adaptation," this sentence as it stands does not seem to me to allow sufficient leeway for the principle of competitive exclusion, which is clearly discussed by Mayr a few pages later.

The superspecies is an exceedingly useful concept, and many recent authors, including the reviewer, have employed it. In actual use, however, there is an inescapable subjective element inherent in the choice of forms considered to belong to one superspecies, even more so than at standard hierarchal levels of classification. It thus appears a bit dogmatic to state flatly that "There are 17 superspecies (13.6 percent) among the 135 species of Solomon Islands birds" (p. 499).

Some points on terminology may also be brought forward. Mayr has included a useful ten-page glossary, but coverage is uneven. I encountered several terms which a student may well have wished to have defined ("isogenic," p. 174; "transduction" and "heterokaryotic fusion," p. 181; "euryecous," p. 345), although Mayr felt that it was necessary to define "firefly." Rather more serious is the lack of any attempt to define either "evolution" or "phylogeny" (the latter is also absent from the index). That these two terms cannot be considered self-evident is shown by the recent and thoughtful discussion by Bock and von Wahlert (1963).

Mayr's writing is clear and readable, even when discussing difficult concepts, and merits high praise when contrasted with the dense prose often found in evolutionary literature. In two places the choice of words in translations from German could be improved. The German "Stoff" is rendered better in English as "substance" than as the cognate "stuff," which tends to be a colloquial word; "sex stuff" on p. 100 has an almost ludicrous sound. On p. 356, in translating Steinmann's terms for ecological races of the European trout, the names Lake Trout and Brook Trout might better have been put in quotation marks and uncapitalized, as these are the accepted English names of two very different species. The book is pleasingly printed, and is remarkably free from typographical errors. I found only one which seriously affects the sense of the text, and that has already been called to our attention by Dr. Mayr (in Stebbins, 1964, footnote 2); on p.

521, "The absence of drastic reduction in gene flow . . ." should read "The absence *or* drastic reduction. . . ."

A major departure from the kind of discussion of speciation found in Mayr's 1942 book is the final chapter of "Animal Species and Evolution," entitled "Man as a Biological Species" (there is no index entry for either "man" or "*Homo*" in the 1942 book). This is an odd conglomeration including descriptions of the major fossil hominids, discussion of the variations in living *Homo sapiens*, political and social implications of evolution, and speculations on man's future. This chapter, or portions of it, has already been reviewed by specialists (see, for example, Newcombe, 1963). Although I stated that I would review Mayr's book chiefly as an ornithologist, I am, after all, a member of the species being discussed in the final chapter, so I will undertake to offer critical comments on a few points mentioned therein.

There are some striking contradictions to be found in this chapter. To begin with a minor one, on p. 626 Mayr states that the fossil genus *Limnopithecus* "is related to the gibbons," but that *Pliopithecus* is "even closer to the modern gibbons." This suggests that it would be stretching matters a bit to *call* either of these genera gibbons, but on p. 627 Mayr characterizes *Limnopithecus* as an "unmistakable gibbon."

At the top of p. 647, Mayr states "to look for and speak of 'pure races' is sheer nonsense," but halfway down the same page he contrasts "Human populations that are clearly the product of hybridization" with "unmixed races." On p. 656 Mayr states "none of these hybrid populations has produced an eminent person." The context does not make it clear whether he refers only to the specific populations cited several lines above (the Rehoboth Bastards and the Pitcairn Islanders, neither of which one would expect to produce more than locally "eminent" persons), or to hybrids between major races of man in general. If the latter is meant, then the definition of "eminent" must be stringent indeed to exclude many historical and living persons of, for example, mixed Caucasian and Negro or Caucasian and American Indian ancestry.

There appears to be a discrepancy between the statement on p. 647 that some anthropoids and "many other animals" far exceed man in individual variability, and that on p. 648 which refers to the "high individuality of man." Although he does not actually employ a trinomial, Mayr's taxonomic discussion of Neanderthal Man (pp. 641-642) clearly indicates that he leans toward assignment of this problematical form as a subspecies of *Homo sapiens*. This is one of several solutions to the Neanderthal question under debate among anthropologists; I would question whether there are any other pairs of taxa of warm-blooded vertebrates which are currently regarded as subspecies and which differ as radically in osteological characters as do *sapiens* and *neanderthalensis*.

Mayr states flatly (p. 652) that the evolutionary trend toward increased brain size in hominids came to "a sudden halt" nearly 100,000 years ago, and postulates some factors to explain this "drastic reduction of the selective advantage of increased brain size." I have discussed this point with an anthropologist. In the first place, it may be a little premature to describe such an "abrupt halt" in talking about a period of less than 100,000 years (possibly substantially less, according to my friend), considering the order of magnitude of the time periods between the earlier stages of hominid evolution which demonstrate increase of brain size. But even granting Mayr's premise of the "abrupt halt," the factors he invokes in explanation are inadequate. These are an increase in the size of the "unit of selection" from the individual through the family to the tribe or nation; "The larger such a unit is, the relatively less will the genes of its leader contribute to the gene pool of the next generation and the more protected (biologically) will be the average or below-average individual of the group." And Mayr goes

on to emphasize the "dysgenic effect of urbanization and of density-dependent diseases," and "the development of cultural tradition and the steady improvement in means of communication," pointing out that the achievements of the superior individuals enable the inferior ones to make a living and to reproduce successfully. All no doubt true, but the factors invoked to explain a supposed abrupt shift of selective pressures some 100,000 years ago could scarcely date back more than ten thousand (more likely around six thousand) years.

In discussing the effects of cultural tradition on the evolution of man (p. 656), Mayr runs into a semantic problem when he states that "cultural tradition is not altogether absent elsewhere in the animal kingdom." In man, "tradition" involves *telling* things to other individuals as well as *showing* them, especially as regards events in the past. In the migration routes of birds cited by Mayr (as well as in learned behavior, say, milk-bottle opening by titmice), *showing* only is involved, and it is dubious whether such phenomena should be called "tradition." Dictionary definitions of the word place special emphasis on the word-of-mouth aspects of tradition.

Although Mayr states in his preface that he has deliberately taken unequivocal stands on controversial issues, some flat statements in the final chapter, as elsewhere in the book, may conceal the controversial nature of the subject matter. The statement on p. 654 that "A rise in frequency [of genes controlling metabolic disturbances characterizing genetic diseases] will have no drastic effect on the future of mankind as long as adequate medical facilities are available" seems overoptimistic after one has read the contrary opinion by Muller (to which Mayr, in all fairness, gives a citation on p. 655).

It is perhaps time now to step back from our scrutiny of twigs, and assess the significance of our findings. This review, already lengthy, by no means includes all of the points jotted down for possible correction or discussion during my reading of the book. Thus there are more twigs susceptible to critical comment, based on my particular knowledge, than a simple count from this review would indicate. And, as previously mentioned, non-ornithological specialists have also contributed twig-level reviews based on their own fields of interest. There is a really important principle involved here, which is faced whenever major works of synthesis are to be evaluated, no matter what the subject. In a review of a book on China, Lindsay (1964) wrote "No one of the errors is particularly important, but their cumulative effect destroys confidence in the book as a reference work." I might not express my ultimate evaluation of Mayr's book in these exact words; for one thing, it is much more than a "reference work." But it seems to me that the reviewers at the forest level who have heaped unrestricted praise upon Mayr's book have done so on the basis of an assumption—an assumption they had every reason to believe was correct, but one that the tree and the twig reviewers have shown was, unfortunately, unjustified. This assumption was, in brief, that the well-earned high reputations of Ernst Mayr and of the Harvard University Press, respectively, would insure that what industrialists call "quality control" of the text and references would be impeccable. Nobody denies that this book is a major contribution to the literature of evolution. The lively discussions in the pages of several journals indicate that the book has already had the "heuristic" effect that Mayr, in his preface, hoped for, and every serious student of evolution will, if he can afford the twelve dollars, buy it or have his library buy it. But this brings me back to my major summarizing point. A student who buys a major book published by the Harvard University Press and written by Ernst Mayr (whether considered in the light of his personal scientific reputation or simply as Director of the Museum of Comparative Zoölogy) has a right to expect a level of accuracy of detail that he just does not get in "Animal Species and Evolution." This makes all the more

unfortunate the publisher's statement on the dust-jacket flap: "In accordance with the author's feeling that the acquisition of new knowledge will require a new statement, rather than an emendation of a previous one, no substantive revisions of this volume are planned for future printings." The key word here appears to be "substantive"; the philosophy expressed by the whole statement seems to be that the extant body of knowledge in this field has been definitively presented in "Animal Species and Evolution." Whether or not this is true, and to what extent "substantive" revision might, after all, be desirable, can best be determined by the author and publisher in response to this and other reviews.

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ORNITHOLOGICAL LITERATURE

A COMPARATIVE STUDY OF BIRD POPULATIONS IN ILLINOIS, 1906-1909 AND 1956-1958. By Richard R. Graber and Jean W. Graber. Illinois Natural History Survey Bulletin, Vol. 28, Art. 3, 1963: 152 pp., 32 figs., 56 tables, 4 pls. Price not indicated.

Most of us are aware of the ecological changes resulting from the activities of man upon the earth's surface. One of the most influential causative agents of such changes is agricultural practice. Few studies have provided data which permit an evaluation of conditions existing about 50 years apart as well as a comparison of the bird populations during each period. As a result of putting together data of this type the Grabers have contributed significantly to our knowledge of several aspects of Illinois ornithology, including population changes in relation to time, man, and climatic changes. In addition, this volume contributes information of importance to the management of bird habitats, particularly in states such as Illinois, where the landscape has been changed considerably by agricultural and industrial activities.

A. O. Gross and H. A. Ray, under the direction of S. A. Forhes, in August 1906 began a series of statewide cross-country censuses. These were continued at intervals until September 1909 and provided a quantitative record of Illinois bird populations in relation to a changing environment. In 1956-58 the Grabers conducted similar statewide censuses. This paper is an analysis of their field data and a comparison with those from the first survey.

The strip census method was used for the early censuses. Censusing was at random in the sense that habitats were censused as they were encountered along the straight-line routes. The Grabers censused in most of the counties covered by Gross and Ray but did not follow the same routes. Otherwise their procedures were similar, as was the coverage. In addition, during the summer of 1958, they censused additional acreage of certain habitats of limited area such as marsh and orchard. Censuses were made in northern, central, and southern zones of Illinois.

Gross and Ray included data from all seasons of the year but the Grabers limited their censuses to the winter (December to 1 March) and summer (June to mid-July) seasons. By using Gross's original notes the Grabers recalculated the early population densities for precisely the seasonal periods used in their censuses, thus insuring that the two sets of data were comparable. The population data in this bulletin represent summer and winter censuses of the two surveys. The populations determined from the censuses were compared with the acreage of the various habitats, thereby giving an estimate of the state population of the commonest species during each period. Basic quantitative data are presented in two types of tables. The first, with emphasis on statistics, impresses the reader with the inherent variability in the population data presented, and the second, with emphasis on avifauna, provides data on the species of birds found in each habitat. While the data are presented primarily for comparisons within their study, it is possible to extrapolate beyond this point.

Total population densities as indicated by the strip censuses varied from 10 to 107 birds per 100 acres in cornfields and from 35 to 215 birds per 100 acres of woodland. During the summers of 1907-09 a total of 6,662 acres were censused between 22 May and 15 July; in the summers of 1957-58, 6,785 acres were censused during the same day span. Habitats represented by less than 50 acres were disregarded. The habitats censused (in order of predominate acreage) were: corn, pasture, oats, mixed hay, forest, soybeans, wheat, fallow fields, red clover, residential areas, plowed ground, all shrub and hedge, ungrazed grass, alfalfa, orchard, marsh, garden crops, small grain stubble, sweet clover,

barley, and rye. The first four types of habitats constituted about 60 per cent of the total acreage censused.

Winter bird populations were censused in the following habitats: corn, pasture, small grain stubble, wheat, hayfield, forest, plowed ground, soybean stubble, fallow field, shrub area, orchard, and marsh. A total of 60 species was recorded (all zones combined) in cornfields during the summer and winter periods. During winter, 29 species were recorded in cornfields (all zones). Broken down by zones and periods the number of birds per acre of cornfield was: North, 1909, 0.6 and 1958, 0.9; Central, 1909, 0.5 and 1958, 0.3; South, 1909, 0.7 and 1958, 0.7. An interesting comparison of winter avifauna in the hand-picked cornfields of the earlier census with those of mechanically picked ones of the 1950's showed that more shrub and forest-edge birds used the former areas whereas more prairie and open-field birds used the latter. Also there appeared to be an increase in the number of birds presently using northern cornfields during winter. Perhaps this is correlated with increased amounts of shelled corn left in the fields after mechanical picking operations.

During four summer seasons and three winters, 168 species of birds were identified in census strips. Nine additional species were identified outside the census strips. H. R. Smith and P. W. Parmalee (1955, "A Distributional Check List of the Birds of Illinois") included 384 species for the state. Subtraction of extinct, accidental, and migrant species from this figure leaves 185 species which occur in the state during winter and summer. This number is close to that obtained by the Grabers. Only nine species were recorded in all years and all zones during both winter and summer. An annotated list of the common species includes a discussion of such factors as habitat preference, estimated population in each of the three census zones, estimated state populations, and a statement of explanation for changes in population numbers.

In a discussion of the avifaunal differences between censuses, the Grabers pointed out that of the 177 species of birds recorded during the two census periods, 104 appeared on both lists. Fourteen species identified in 1906-09 were not identified in 1956-58. Fifty-nine species were reported in 1956-58 which had not been recorded during the earlier censuses. Apparently the winter concentrations of birds, particularly Bald Eagles, along the Mississippi River were at points outside the census strips.

Included in the discussion are comments about: Events Previous to 1800; Development of Managed Habitats; Specific Changes in Avifauna; Specialization in Managed Habitats; Population Density and Avifaunal Variety; Population Changes and Latitude; Range Extensions; Habitats and the Future of the Avifauna; Man and the Avifauna. The stimulating ideas elaborated upon in this section add much to the value of this work.

It is obvious that "The value of systematic bird censuses increases as the years pass, for without some reference to the past we cannot see the trends of evolution; we can see neither the magnitude nor the direction of change." The early work of Gross and Ray and the recent work of the Grabers represent but 4 years out of a half century. The Grabers recognized the possibility of confusing short-term fluctuations with relatively permanent changes but justifiably accepted the data largely at face value. However, they stressed that the data are open to evaluation and this should be borne in mind by the reader.

My review has just touched upon a few of the topics presented in this important contribution and perhaps does not indicate adequately my great satisfaction with it. Living in Illinois and studying the birds therein has made me aware of the lack of good ecological works for the state. When ornithologists study habitats and bird populations, particularly of songbirds, they seldom take cropland into consideration because it is

generally regarded as too sterile to be of interest or to warrant their time. Most of the censuses and population studies have been conducted in the "more rewarding" areas of forests, marshes, prairies, etc. In an age when agricultural land covers large portions of some states, it is difficult to ignore it as a type of managed habitat.

The Grabbers are to be complimented for this well-prepared ornithological contribution and I trust that it will serve as a stimulus for similar studies in other localities.—WILLIAM E. SOUTHERN.

ANIMAL WORLDS. By Marston Bates. Random House, New York, 1963: 8 $\frac{3}{4}$ \times 11 $\frac{1}{4}$ in., 316 pp., 245 photos. (100 in col.). \$15.00.

While this book is patently designed for eye appeal and the luxury market, it happens also to have a text that is every bit as good as its appearance. From his seemingly bottomless store of information on natural history, Dr. Bates has the knack of developing meaty ideas and putting them down in a fluent style that is entirely his own. Although he occasionally cites the findings of investigators, as a rule he does not encumber his story with references to sources. There is consequently no bibliography. I can see no objection to this procedure in a popular work of this sort, but I do raise the question: If the reader is sufficiently stimulated, as he should be, by the ideas expressed, should he not be given leads to further information?

"Animal Worlds" is a fine elementary text on ecology of environments. The "Worlds" for animals are such places as the open sea, ocean depths, margins of the sea, coral reefs, tropical forests, deserts, and mountains. Each environment is treated in a separate chapter. First the subject is colorfully defined and described, then it is discussed at length with regard to its ecological factors and the ways in which some of its prominent or more unique creatures—from lower invertebrates to birds and mammals—have adjusted to them. The final three chapters deal with man, his world, and his impact on other environments.

The illustrations leave little to be desired in variety, composition, and sheer appeal. The color work, however, is of poor quality generally, the reproductions in many instances showing an unnecessary fuzziness and a washed-out effect.—OLIN SEWALL PETTINGILL, JR.

THE ROYAL BIRDS. By Lillian Grace Paca. St. Martin's Press, New York, 1963: 6 $\frac{1}{4}$ \times 9 $\frac{1}{2}$ in., xii + 164 pp. Illus. by the author. \$7.50.

The "Royal Birds" of this book are swans, not only the Mute Swan—long considered the property of the British Crown, but the several other species in the world, all "definitely aristocrats."

Seven of the ten chapters are concerned with the different species. The introductory chapter traces the history of the Mute Swan as a bird of royalty, while the concluding two deal with swans in myth and legend and the care and keeping of swans. The generous number of drawings, over 90, show a pleasing softness of line and texture and satisfactorily portray a wide range of attitudes and actions. The text reads easily. Although a few errors and ambiguities have crept in, for the most part it is correctly factual—and objective. Only where it is based on the author's observations and interpretations of behavior does it get out of hand, becoming sugary, sentimental, and (in places) outrageously anthropomorphic. The author seems obsessed with the idea that cygnets must be trained or educated to feed, swim, fly, build nests, and so on. The book is at best a review of, not a contribution to, the knowledge of swans.—OLIN SEWALL PETTINGILL, JR.

THE GREAT AUK. By Allan W. Eckert. Little, Brown and Company, Boston, 1963: 5½ × 8¼ in., [iv] + 202 pp., endpaper maps. \$4.75.

THE PEREGRINE FALCON. By Robert Murphy. Illustrated by Teco Slagboom. Houghton Mifflin Company, Boston, 1964: 6½ × 9¼ in., [viii] + 157 pp., numerous illus. \$4.00.

Both of these books are admitted novels with birds as the central characters; both authors have made use of reference material, even though the term "novel" relieves them somewhat of this obligation; and both have maintained a fine balance of information on the life histories of the subjects, descriptions of the wilderness settings, and the hazards encountered on the nesting grounds and during the long migrations.

The chief difference between the two books lies in the attitude of the authors. In "The Great Auk" the birds have human traits. We read, for example, of birds "chuckling with something akin to embarrassment," and being "intensely proud of their egg." In the "The Peregrine Falcon" we find none of these anthropomorphisms. Mr. Murphy writes as a naturalist with sympathy and understanding of a handsome and fearless bird which is in grave danger of following the path of the Great Auk to extinction. His book is altogether delightful and Mr. Teco Slagboom's spirited drawings give it an extra polish.—ELEANOR RICE PETTINGILL.

BIRDS OF WISCONSIN. By Owen J. Gromme. University of Wisconsin Press, Madison, 1963: 9¼ × 12¼ in., xvi + 220 pp., 105 col. pls., many bird silhouettes and distributional maps. \$22.50.

For an amateur to review a book of this sort may seem at first to be somewhat presumptuous. A good deal of pains was taken in its production: the binding is handsome, the paper is glossy, the pictures are colored, the format is large, and the price is high. Obviously, no effort was spared to make it attractive and useful. And yet the prefatory material indicates that the purpose is to present formal plates (there are 89 showing 328 species of birds) to be used for identification, plus 16 informal pictures added for good measure. In these days even amateurs use other means of identifying the birds they see, and certainly professionals do not need another book of pictures.

Related species are shown on a single plate where possible and on the facing page, cleverly tied in with silhouettes of the birds shown in the paintings, are Wisconsin distributional maps (summer range in yellow, winter in blue, and through the year in green) and date lines showing by months the occurrence of the species in Wisconsin and its nesting period there, plus a brief notation of its status. This material brings up to date from 1903 information with regard to the changes which have taken place in bird distribution in Wisconsin.

Mr. Gromme states that the original plan was to publish the plates with a detailed text in a single volume. The plates, however, were completed before the text and the "present publication of the plates only was the result of a desire to make the identification portraits available for public use without further delay. Work on an accompanying text continues in expectation of a second volume to complete the original plan."

There remains, then, a handsome picture book (though not "one of the art treasures of ornithology" as the jacket inflatedly claims) with fine reproductions of water color paintings and one oil, done between 1942 and 1962. As to the technical quality of the paintings themselves, this reviewer is not a competent judge, but in spite of some lapses (the Common Merganser seems quite out of shape and the color of the Bobolink leaves much to be desired) on the whole they seem to be well done.—EDWARD F. DANA.

PUBLICATION NOTES AND NOTICES

Checklist of the Birds of Thailand. By Herbert G. Deignan. United States National Museum Bulletin 226, 1963: x + 263 pp. Paper covered. \$1.25.

The present list includes the names of 1,173 birds and is complete "so far as the avifauna of Thailand is known" to 1962.

Readings in Population and Community Ecology. By William E. Hazen, Editor. W. B. Saunders Company, Philadelphia, 1964: x + 388 pp. Paper covered. \$4.75.

A collection of 25 papers, photocopied and reprinted from various journals, which "attempts to explore some of the avenues that research and speculation in population and community ecology have taken." Following an introductory paper ("The Concept of Pattern in Ecology" by G. Evelyn Hutchinson), the papers are grouped under four rubrics: "Single Species Populations," "Relationships Between Species," "Community Metabolism," and "Community Structure."

Birds of the Detroit-Windsor Area: A Ten-Year Survey. By Alice H. Kelley, Douglas S. Middleton, Walter P. Nickell, and the Detroit Audubon Society Bird Survey Committee. Cranbrook Institute of Science Bulletin 45, 1963: 119 pp. Paper covered. \$1.00.

The work is based on extensive data for 286 species gathered during the 10 years ending in 1954. Information under each species, depending on its status, includes records of occurrence, migration dates (with extremes), and breeding data. The area covered encompasses approximately 5,916 square miles, including five counties in southeastern Michigan and three in southwestern Ontario.

Ecological Studies of the Mute Swan (*Cygnus olor*) in Southeastern Sweden. By Björn E. Berglund, Kai Curry-Lindahl, Hans Luther, Viking Olsson, Wilhelm Rodhe, and Gunnar Sallerberg. *Acta Vertebratica* (Nordiska Museet and Skansen, Stockholm), Vol. 2, No. 2, 1963: pp. 161-288. Paper covered. About \$4.88.

Nine chapters by different authors (named above) covering a wide range of topics from general ecology and food selection to botanical analysis of feces and migration. In English.

IX Bulletin of the International Council for Bird Preservation. Published by the International Council for Bird Preservation, 1963: 180 pp., 14 pls. (1 col.). \$2.25. (For copies, direct inquiries to Dr. S. Dillon Ripley, Smithsonian Institution, Washington 25, D.C.)

Contains special reports on oil pollution of the sea, the effect of pesticides on bird life, and birds in danger of extinction. Also included: A listing and history of national birds and many reports from national sections on urgent conservation problems.

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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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CONTENTS

- LIFE HISTORIES OF CENTRAL AMERICAN PIGEONS .. *Alexander F. Skutch* 211
- NESTING OF THE BLACK-TAILED FLYCATCHER ON BARRO COLORADO
ISLAND *Alfred O. Cross* 248
- A REVIEW OF SHARP-SHINNED HAWK MIGRATION ALONG THE NORTH-
EASTERN COAST OF THE UNITED STATES *Bertram G. Murray, Jr.* 257
- COMPETITION AND THE GENUS *TYRANNUS* *Henry A. Hespenheide* 265
- FLOCK SIZE IN A SPRING CONCENTRATION OF WHISTLING
SWANS *Daniel Q. Thompson and Marjory D. Lyons* 282
- HOSTILE DISPLAYS OF ROSE-BREADED GROSBEAKS TOWARDS
A RED SQUIRREL *James Baird* 286
- GENERAL NOTES
- CATTLE EGRETS NESTING IN MEXICO *Robert W. Dickerman* 290
- SOME WATERFOWL DIVING TIMES .. *Donald S. Heintzelman and Carole J. Newberry* 291
- MIXED TRIO OF A SHOVELER DRAKE AND BLUE-WINGED TEAL
PAIR *Gerald F. Martz* 291
- DIAGNOSED DISEASES AND PARASITISM IN RIO GRANDE
WILD TURKEYS *Jack Ward Thomas* 292
- A SOUND-TRIANGULATION METHOD FOR COUNTING BARRED
OWLS *Rondal E. Bell* 292
- BLACK-LEGGED KITTIWAKE IN WEST VIRGINIA *Ralph M. Edeburn* 294
- BLACK SWIFTS NESTING IN A LIMESTONE CAVE IN COLORADO *Donald G. Davis* 295

ORNITHOLOGICAL NEWS	297
ORNITHOLOGICAL LITERATURE	298
<p>W. E. Clyde Todd, <i>Birds of the Labrador Peninsula and Adjacent Areas</i>, reviewed by Harrison F. Lewis; R. Meyer de Schauensee, <i>The Birds of Colombia and Adjacent Areas of South and Central America</i>, reviewed by Raymond A. Paynter, Jr.; Paul Schwartz, <i>Bird Songs from the Tropics</i>, reviewed by Ernest P. Edwards; Lou Blachly and Randolph Jenks, <i>Naming Birds at a Glance</i>, reviewed by Robert S. Arbib, Jr.; Archie Carr, <i>Ulendo</i>, reviewed by Kenneth C. Parkes.</p>	
PUBLICATION NOTES AND NOTICES	305
ANNUAL REPORT OF THE CONSERVATION COMMITTEE .. <i>Roland C. Clement</i>	306
PROCEEDINGS OF THE FORTY-FIFTH ANNUAL MEETING	<i>Pershing B. Hofslund</i> 313

LIFE HISTORIES OF CENTRAL AMERICAN PIGEONS

ALEXANDER F. SKUTCH

IN the last 35 years, I have found nests of 15 of the 25 species of pigeons and doves resident in Central America. Whenever these nests were conveniently situated and other occupations permitted, I tried to learn something about them; but most of the studies that I began were prematurely ended by the loss of nests to predators. In the cases of three species whose nests were available in fair numbers, the Ruddy Quail-Dove (*Geotrygon montana*), the Ruddy Ground-Dove (*Columbigallina talpacoti*), and the Blue Ground-Dove (*Claravis pretiosa*), I succeeded in following all stages of the breeding operations, and reports of these studies have already been published (Skutch, 1949, 1956, 1959). For another species, the White-tipped or White-fronted Dove (*Leptotila verreauxi*), I have extended but less complete observations, which are presented in this paper. On the remaining species my observations are more fragmentary, sometimes restricted to a single phase of the breeding cycle, such as nest building or incubation, or in some cases to the description of the nest and eggs. In aggregate, however, this material permits us to sketch in at least rough outline the biology of the Central American representatives of the Columbidae, on whose habits very little has been published. In this paper I shall first present my hitherto unpublished observations, species by species, and in the concluding section I shall attempt to draw such generalizations as seem to be warranted by the available information. In this summary I shall draw upon observations contained in the above-mentioned published papers.

As an example of the number of species of pigeons which may be found in a single locality in Central America, I may add that on our farm of about 250 acres (102 hectares) at El Quizarrá in the valley of El General, Costa Rica, around 2,500 feet above sea level, the following seven species are resident and have been found nesting: Scaled Pigeon (*Columba speciosa*), Short-billed Pigeon (*C. nigrirostris*), Ruddy Ground-Dove, Blue Ground-Dove, White-fronted Dove, Rufous-naped Gray-chested Dove (*Leptotila cassinii rufinucha*), and Ruddy Quail-Dove.

SCALED PIGEON

Although not lacking in beauty, the pigeons of the Western Hemisphere cannot vie in splendor and ornateness of plumage with some of those of the islands of the southwestern Pacific and neighboring regions. One of the most beautiful of the American representatives of its family, the male Scaled Pigeon (*Columba speciosa*) is clad in rich shades of chestnut and brown, glossed on the neck with purple and green, with crowded, scale-like markings of black and white or cinnamon-rufous on the neck, upper back, and breast. The

female's colors are paler. Although individuals from the same region exhibit considerable diversity in plumage, throughout its vast range from southern Mexico to Paraguay the species is so uniform that no geographical races are recognized. An inhabitant of the wooded lowlands of continental America, this large pigeon ranges upward to at least 4,000 feet in southern Costa Rica, 5,000 feet in western Panama (Ridgway, 1916:319) and the Santa Marta region of Colombia (Todd and Carriker, 1922:197), and 3,500 feet in British Guiana (Ridgway, loc. cit.).

Todd and Carriker (loc. cit.) mention a flock of not less than a hundred Scaled Pigeons which in early November had gone to roost in scrub on a hillside at an altitude of about 1,500 feet in the Santa Marta region, but such concentrations appear to be rare even there. In northeastern Venezuela this pigeon was found in small flocks of less than ten individuals, always in the rather heavy woods of the "quebradas" which cut back into the savanna of the mesa (Friedmann and Smith, 1955:492). But in the valley of El General and neighboring areas, which seems to be the only part of Costa Rica where the Scaled Pigeon is somewhat common, I have met it singly or in pairs, never in flocks. Here one most often sees the handsome bird perching conspicuously on a dead limb at the very top of a tall tree at the forest's edge, with the sky as its background, or flying swiftly and directly across a clearing, high overhead. It seems to subsist on small fruits which it finds high in the trees, and I have not seen it on the ground.

Voice.—The Scaled Pigeon's call, heard chiefly in the dry season and early part of the wet season—from January to April or May—is a deep, full, far-carrying *cooo*. Comparing this booming sound to the lowing of distant cattle, Friedmann and Smith state that in northeastern Venezuela it has earned for the bird the appellation "paloma tora" (bull pigeon). In El General, however, it is called "paloma morada" (purple pigeon).

Nest and eggs.—Strangely enough, in El General this pigeon which spends most of its life high in the giant trees of the rain forest often chooses to nest near the ground, in secondary vegetation. I have frequently watched a solitary bird struggle to break a twig from a high dead branch at the forest's edge, then fly down into a neighboring second-growth thicket with its single piece. Sometimes the pigeon has traveled over the low, tangled growth for 200 or 300 yards before vanishing amid the foliage, where doubtless its mate was waiting to receive the contribution and arrange it in the growing nest. But the almost impenetrable density of the rank intervening vegetation, often a 2 or 3 years' growth on a resting grain field, discouraged the attempt to find the nest by following the flight of the building pigeon.

Over the years, however, I have discovered ten of these nests in El General, between 2,500 and 3,000 feet above sea level. Two of the nests were situated

at a height of 15 feet on sotocaballo trees (*Pithecolobium* sp.) growing on the shore of the broad, rushing Río Buena Vista. One was far out on a lower branch, the other in a tangle of vines that had overgrown the tree. Possibly in former times most of the Scaled Pigeons' nests were placed in such streamside vegetation, but since the recent extensive destruction of the forest in this region, many have taken to building in the low, second-growth thickets that soon cover abandoned croplands and neglected pastures. Of the eight nests not beside a river, five were built at heights ranging from 7 to 15 feet in tangles of vines that had grown over bushes and small trees in second-growth thickets. One nest was lower and more exposed, only 2 feet above the ground on the leaning stalks of a cluster of bracken fern (*Pteridium aquilinum*), in a bushy field from which maize had been harvested only 7 months earlier. The last two nests that I have found were in very different situations, about 50 and 60 feet up in the tops of trees so densely covered with lianas that the nests were hardly visible from the ground. Both of these nests were in a small grove of secondary woods between coffee plantations and about 600 feet from the nearest forest, whence the material for building at least one of them was carried across an intervening pasture. These nests were found in 1960 and 1963, and both may have belonged to the same pair of pigeons.

The accessible nests were broad, slightly concave platforms composed of fine sticks and branched dry inflorescences, in one instance of the burío tree (*Helio-*carpus excelsior**). Nearly always thin, some of the nests were so slightly constructed as to be hardly more than a latticework for supporting the egg. In one nest, the largest stick measured 10 inches in length by $\frac{3}{16}$ inch in diameter at its thicker end.

Five of these nests contained each a single white egg, and three held solitary nestlings. The earliest nest had an egg on 21 February 1937, and the latest of the accessible nests held an egg on 22 May 1936. A pair of doves were found building on 29 July 1963, but I could not learn whether an egg was laid in this high nest, invisible amid a tangle of vines. Although I found no nest with two eggs, Belcher and Smooker (1936) reported two sets of two from Trinidad, where a number of species of birds occasionally or regularly produce larger sets than I ever discovered in Costa Rica. In other respects, too, the Scaled Pigeons of Trinidad differ in their breeding habits from those in El General. The nests described by these authors were fairly substantial platforms of twigs, from 30 to 40 feet up in smallish trees in the forest. Their eggs measured 39 by 29.9, 39.6 by 29.8, 40 by 29.8, and 37.4 by 29.1 mm.

The nestling.—The nestling Scaled Pigeon has a number of behavior patterns which appear to serve for its defense. When a young pigeon in pinfeathers is disturbed, it rises in the nest, stretches up its neck, puffs out its breast, and lifts its wings, all of which make it look much bigger than it did while resting quietly. In

this attitude it sways upward and backward, downward and forward, with each forward and downward movement making with its bill a low clicking or clacking sound. As long as it feels itself menaced, the nestling continues to perform rhythmically in this fashion. The *clack* is produced by the mandibles in a peculiar manner. The lower mandible is pushed slightly forward until its apex rests against the downwardly bent tip of the upper mandible. The bill is then slightly open. Apparently the two mandibles are pressed together by muscular tension until the lower one suddenly slips back into its normal position; and the two, striking together along their entire length, emit the sharp sound. The nestling also darts forward to peck an intruding hand with its bill; and, after its feathers begin to expand, it strikes with its wings. Taken in hand, it struggles vigorously without ceasing to clack its bill, and at the same time it hisses slightly. Doubtless all this belligerent display intimidates small animals, yet some nestlings are taken by predators.

For the first week or so after the nestling hatches, the parents remove its droppings and keep the frail platform clean, although the empty shell may be left there for some days. But later the adults relax their attention to sanitation, with the result that a nest from which the youngster has just flown is foul with excrement. I do not know the length of the nestling period, but one nestling which appeared to be only a few days old when first found was 2 weeks later resting a yard from its nest, well clothed with feathers. It watched me come close, then took wing and flew well. Its plumage was a rich shade of brown, but lacked the light spots which impart a scaled appearance to the adults.

SHORT-BILLED PIGEON

The rather small, brownish Short-billed Pigeon (*Columba nigrirostris*) is confined to the more humid forested lowlands of southern Mexico and Central America, including western and central Panama. At higher altitudes it is replaced by the Ruddy Pigeon (*C. subvinacea*), and the similarity in plumage, in the colors of bill, eyes, and feet, and even in voice of these two species makes it difficult to learn how far upward *C. nigrirostris* ranges, or how far downward the related form extends. There appears, moreover, to be a considerable vertical overlap in their ranges. The numerous published records of specimens are not as helpful in working out this problem as they might be, because the citations usually give the locality rather than the altitude at which the collection was made, and in mountainous regions specimens from a named locality may come from points with a vertical separation of a thousand feet or more. In the lower parts of the basin of El General, where most of my observations were made, the Short-billed Pigeon, distinguished from its congener by the duller, more olive hue of its brown back, is the resident form.

I have found Short-billed Pigeons in pairs throughout the year. They live

chiefly in the upper levels of the rain forest but often enter neighboring clearings to forage. Here they are attracted by the small green berries of the mistletoes which often heavily parasitize the scattered trees, and while eating they sometimes permit one to approach close enough to distinguish their black bills, bright red eyes, and coral red feet. They descend almost to the ground to eat the berries of the pokeberry (*Phytolacca rivinoides*) which springs up profusely on the scorched ground of newly made clearings from which the crop of maize has been harvested. Once I saw a pair of these pigeons alight on a sandy patch of shore beside a mountain torrent, where evidently they picked up gravel or possibly small invertebrates.

Voice.—The far-carrying, melodious, tetrasyllabic call of this pigeon, heard chiefly in the dry season and the first months after the rains return, is one of the characteristic and memorable sounds of the lowland forests of Central America. Years ago, I learned from Frank M. Chapman to paraphrase it *O, je t'adore* and, whenever heard, it naturally brings these words into my mind. But the boys who used to carry my portfolio for collecting plants in El General gave the pigeon's call the less romantic rendering *Tres tontos son* (They are three fools), and these words suggest the call almost equally well. Eisenmann's (1952:21) notation *ho, cu-cu-coóoo* is perhaps more accurate but less easy to remember. The only difference that I could detect between the song of this pigeon and that of the Ruddy Pigeon of the mossy, epiphyte-burdened subtropical forests is that the latter is somewhat less soft and liquid.

Nest building.—Early in the morning of 21 March 1944, I watched a Short-billed Pigeon break pieces from old inflorescences of a burío tree that stood in tall second-growth woods, about 100 yards from the nearest primary forest. To detach a part of the many-branched dry panicle was strenuous labor, and sometimes the bird tugged at branch after branch before he found one that yielded to his effort. Having procured a branching piece of the inflorescence, he flew down into a dense tangle of vines, shaded by taller trees, at a point about 25 feet above the ground. After much moving through the resisting undergrowth, I found a spot whence I could glimpse this pigeon's mate, who sat amid the vines, received the pieces which the other brought, and worked them into what obviously was the foundation of a nest. In the course of 2 hours, the active partner took to the other at least 17 contributions, but never more than one branching piece on a journey, as far as I could see. It seemed that sometimes he stood on the other's back while he delivered it, but obstructing vegetation did not permit a clear view of the transaction. The partner who took charge of arranging the material remained on the nest continuously throughout the 2 hours that I watched. At the end of this interval, I was forcing my way rather noisily through the undergrowth toward the neighboring road, when the member of the pair who had been fetching material began to call *O, je t'adore*, while the mate answered from

the nest with a throaty, growling note. This strengthened my conclusion that the more active partner was the male, as in a number of other pigeons and doves of which the sexes differ in appearance.

On 10 August 1945, I watched a Short-billed Pigeon break twiglets from a dead branch at the top of a small tree in the forest. He had chosen a cacique, a tree of the myrtle family which has very tough wood, and he struggled hard to detach pieces, trying one twig after another, and sometimes hanging head downward with spread wings while he threw all his weight against it. He continued with indomitable persistence until he secured a fragment of the branch, which he then promptly carried up to the crown of a tall palo de vaca or milk tree (*Brosimum utile*) that grew close by, into the midst of which he vanished. Soon he returned to the same dead branch for another twiglet. Several that were easily broken off were dropped, but at last a satisfactory one was secured and borne up into the same great tree. Here, somewhere about 100 feet above the ground, his mate was evidently sitting to receive and arrange the materials which he continued to bring to her, but she was perfectly concealed amid the heavy masses of foliage into which the pigeon disappeared each time.

Nests placed so high as those of the Short-billed Pigeon, amid such dense foliage, are not often found after completion, when the parents' visits to them are far less frequent. I am aware of no record of the eggs of this species.

PALE-VENTED PIGEON

The Pale-vented Pigeon (*Columba cayennensis*) is a large species with light-colored, purple-tinged plumage, ranging from southern Mexico to Brazil and Paraguay. A lowland bird, it is reported by Carriker (1910:394) to occur at 4,000 and even 5,000 feet in the Central Plateau of Costa Rica, but it is certainly rare at such high elevations. Although it is present in the lower reaches of the Térraba Valley, I have not once met it in El General, the mountain-rimmed basin at the head of the same valley, lying chiefly above 2,000 feet. Absent from the generally arid Pacific side of northern Central America, it is the most abundant large pigeon of the deforested and open parts of the Caribbean side, from Guatemala to Panama, and upward to 2,000 feet. It is found chiefly where there are more or less isolated large trees, as in pastures, plantations, marshy areas, and along rivers, and it usually rests on the higher branches. Once in June I found a flock of 14 perching in a tree in a pasture, but usually I have seen smaller groups or single individuals. These pigeons eat the small black berries of *Conostegia*, a shrub of the melastome family, and doubtless a variety of other fruits. Cherrie (1916:351) states that they subsist almost exclusively on fruits. Their call is resonant and stirring, *Woo co-co-co cooo*, repeated over and over. Sometimes in March they engage in angry fights, slapping each other with resounding blows of their wings.

Nest and eggs.—I found two nests on Alsacia Plantation, in the first hills which rise up on the eastern side of the Motagua Valley opposite Quiriguá, Guatemala. They were in low shrubs in pastures, at heights of 3.5 and 4 feet, well hidden by foliage. In the case of the lower nest, a vine had overgrown the bush and added to the density of the leafy screen. The nest, composed of branched inflorescence stalks of some unidentified plant, was a frail, shallow saucer, or merely a slightly concave platform. The more deeply cupped of these two nests was about 6 inches in diameter by 1.5 inches in depth. Each nest contained a single pure white egg, measuring respectively 34.9 by 25.4 and 36.5 by 26.6 mm. These eggs were found on 9 April and 8 May 1932.

In the Orinoco region of Venezuela, Cherrie (1916:351) found Pale-vented Pigeons nesting in moriche palms, in tangled thickets in and around marshy places, and in the scrub oaks scattered over the savannas. The slight platforms of dead twigs were placed from 2 to 5 meters above the ground, and each contained a single egg. Belcher and Smooker (1936) state that on the islands of Trinidad and Tobago this pigeon builds its frail structures of twigs from within hand reach to 15 feet up. They found nests from 20 February to 23 May, and each contained a single egg or young bird. Eisenmann (1957:252) reported that where they are not persecuted the Pale-vented Pigeons nest in suburban gardens, but he gave no details.

RED-BILLED PIGEON

When viewed in full sunlight, the prevailing deep vinaceous purple of the Red-billed Pigeon (*Columba flavirostris*), contrasting with the bluish gray of its rump and upper tail coverts, makes it outstandingly beautiful. At least as applied to the Costa Rican race, the Latin *flavirostris* is more accurately descriptive than the English "Red-billed," for in the field the bill appears pale yellow rather than red. This species ranges from Texas to central Costa Rica. In the north it inhabits more or less arid country, mainly below 3,500 feet. But at the southern extremity of its range the race *minima* is distributed from the semiarid lowlands of Guanacaste to the Central Plateau of Costa Rica and surrounding mountains, up to about 7,000 feet above sea level. It has even become established in clearings in the heavy rain forest on the wet Caribbean slope. On the excessively wet northern side of the Cordillera Central, I did not find this pigeon between July and March, but at the end of this month a pair arrived in the clearing in the heavy, subtropical forest where I dwelt. These pigeons perch high in the trees, singly, in pairs, or rarely in larger groups. Their song is loud, deep-toned, and far-carrying: *Woooo, c'c'coo, c'c'coo, c'c'coo*. A shorter version consists of a long-drawn, sonorous, ascending note followed by three shorter notes: *Cooo cu cu coo*.

Nest and eggs.—In the valley of the Río Pejivalle on the Caribbean slope of

Costa Rica at an altitude of about 2,100 feet, I found a pair building a nest on 15 April 1941. Their site was about 80 feet up in a crotch of a tall dead tree standing beside a stream that flowed through pastures. Here it was above the foliage of all the surrounding streamside trees, but well screened by the ferns, bromeliads, and other epiphytes that grew on the dead tree. At 0848 one member of the pair went to the nest with nothing in its bill, then promptly left, perched on the end of a dead branch, and called with deep, resonant notes, which soon drew its mate. The first pigeon then flew up beside the newcomer and crouched, and after a while the latter acceded to this invitation and mounted it. Presently they reversed roles, the one who had been below mounting the one who had been on top. Thus, to my regret, I could not distinguish the sexes by their positions in coition. Soon they proceeded to build. While one member of the pair sat continuously on the nest, the other made five trips, each time bringing a single good-sized twig and delivering it to the stationary partner for arrangement in the structure.

In this same locality, a week later, I noticed another pair building high up in a clump of thorny pejibaye palms (*Guilielma utilis*) growing in a field of sugarcane on a hillside. Screened by the clustered, plume-like fronds, the nest was wholly invisible from the ground.

The other seven nests of which I have records were found from 1937 to 1954 on the Hacienda Las Cónavas, a few miles east of Cartago, Costa Rica, at an altitude of about 4,500 feet. Here the breeding season is long, for one pair seemed to be incubating as early as 26 March 1952, while in other years eggs were present as late as mid-August. One nest was in a *Callistemon* tree in the garden, one in a young cypress (*Cupressus Benthamii*) in a hedgerow, and the remaining five in a long, narrow plantation of half-grown cypresses in the midst of open pastures. This dense planting was a favorite site, and here I discovered three nests on 28 June 1937, while two were present on 14 August of the following year. The nests in the young cypress trees were built on slender, horizontal branches at heights ranging from 7 to 15 feet above the ground, whereas that in the garden was 25 feet up. These nests, made of coarse sticks, were thin, frail platforms, which in one instance measured 7 by 9 inches in diameter. There was never more than one egg or nestling in a nest, and this is the number which the Red-billed Pigeon lays in the northern parts of its range. The eggs were pure white, and one measured 40.5 by 26.6 mm.

Care of the young.—Nests with still unfeathered nestlings were perfectly clean, although there were sometimes a few droppings, probably of the parents, beside them on the supporting branch. But when older, feathered nestlings were present, the nest was heavily soiled around the edges, although clean in the center. From this it is evident that parent Red-billed Pigeons, like parent Scaled Pigeons, attend to the sanitation of the nest while their nestlings are young

but neglect this when they are older. When disturbed, feathered nestlings rise up, stretch out the neck, and make a clacking sound with the bill, not so loud as that produced by the young Scaled Pigeon. They strike and bite intruding fingers, but not with force sufficient to cause pain.

The parent Red-billed Pigeons were most attentive, and on several visits I found one of them brooding, or at least resting beside, a well-feathered nestling. The situation of the nests in the cypress plantation surrounded by broad open fields was favorable for distraction displays, and these parents made the most of it. While brooding they allowed me to come very close, and sometimes it was necessary to shake their tree in order to make them go and reveal what they were covering. On leaving the nest, they fluttered across the open pasture, beating their wings loosely as though scarcely able to fly, yet skimming over the short grass at a good speed. Thus they led me for 100 feet or more, until they reached a bush or low tree, in which they alighted, and there continued to flap their wings in a loose and apparently uncoordinated fashion, while they watched my advance. When I came closer than they deemed safe, they dropped down and again flew low over the pasture until they came to the next bush that provided a limb for perching, and here they paused and fluttered their wings as before. At times they would make still a third fluttering flight, before at last they flew off in their normal way, leaving me several hundred yards from the nest where I had disturbed them. A parent of a feathered nestling, after having lured me away in this fashion, returned while I was examining its nest 10 or 15 minutes later, perched on the top of a neighboring cypress tree, and flapped its wings loosely as it had done while luring me off in the first place.

A still more spectacular performance was given one day when a dog followed me into the cypress plantation. At my approach, a pigeon dropped from beside its feathered nestling almost to the ground. As it descended, the dog jumped toward it, and to save itself the bird had to flee more rapidly than it could do while fluttering over the ground in the usual distraction display. But it flew slowly, only a foot or so above the grass, and led on the dog, who continued to follow with high hope of catching the pigeon, until the two had passed over the boss of the hillside and were beyond view.

BAND-TAILED PIGEON

The large, grayish Band-tailed Pigeon (*Columba fasciata*) is easily recognized by the conspicuous white crescent on its nape and the dark band across the middle of its gray tail, the apical half of which is more whitish than the remainder. It occurs from southwestern British Columbia through Mexico and Central America to Peru, Bolivia, and British Guiana. Although in the northernmost portion of this vast range it is found at low altitudes, elsewhere it is an inhabitant of the highlands, in Arizona, for example, nesting above 7,000 feet,

and in New Mexico extending as high as 11,000 feet (Ridgway, 1916:219). In Guatemala the nominate race is found chiefly between 5,000 and 10,000 feet, although it occasionally descends as low as 2,400 feet (Land, 1963:52). In Costa Rica the race *C. fasciata albilinea* (which is sometimes considered to be a separate species) inhabits the high mountains, chiefly between 7,000 and 11,000 feet, although at times it descends lower in search of food (Carriker, 1910:394). In South America the situation is similar: in the Santa Marta region of Colombia, Todd and Carriker (1922:193) noted the presence of the Band-tailed Pigeon in the Subtropical and lower part of the Temperate Zone, from 5,000 to 10,000 feet; while in the Cordillera de la Costa of Venezuela, Schäfer and Phelps (1954:52) recorded its occurrence in the Subtemperate belt between 2,000 and 2,400 meters (6,562 to 7,874 feet).

In northern Central America, Band-tailed Pigeons live chiefly in the zone of mixed woodlands, where pines grow amid oaks and other broad-leaved trees, but occasionally they are found about the edges of the forests of great cypress trees on the high mountaintops. In southern Central America, where native conifers (except *Podocarpus*) are absent, they are associated with the oak trees so abundant in the forest above 4,000 or 5,000 feet. I have met them flying singly, or a few together, or in large, compact flocks. They rest high in tall trees, often on the topmost twig of a lofty pine or cypress, where from afar their stout bodies are visible, standing against the sky in statuesque immobility. On taking flight they often make a loud, slapping noise with their wings, in the manner of other large pigeons. In regions somewhat accessible to men, they are much persecuted and very wary.

Food.—In Central America, Band-tailed Pigeons subsist on a variety of small fruits, often descending almost to the ground to gather those of a low shrub. In Guatemala I watched them eating the berries of mistletoes, and surprised them in fruiting bushes of *Fuchsia arborescens* and a species of *Cestrum*; but they were too wary to continue eating the small black berries of the first, or the white berries of the second, while I watched them. While walking over the open summit of the Cerro de las Vueltas in the Talamancan range of Costa Rica in March 1936, I saw hundreds of these pigeons, which had been attracted by the small fruits of a bushy pokeberry (*Phytolacca*) that flourished there.

Band-tailed Pigeons are very fond of acorns, which in season appear to be their principal food. At the end of September 1933, when the abundant oak trees on the Sierra de Tecpam in Guatemala were laden with ripening acorns, flocks of Band-tailed Pigeons settled in the treetops and tried prematurely to pluck them. Perching precariously near the ends of the twigs, they grasped the acorns in their bills, making strenuous but, as far as I could see, always unsuccessful attempts to detach them. In trying to pull the acorns from their cups,

the heavy birds often lost their balance and went with a loud flapping of wings to another perch. A party of a score or more caused a great commotion in the treetops. Six weeks later, when the ground was littered with fallen mast of the oaks, the pigeons still gathered them from the treetops, where they stood far out on the twigs, plucked the acorns from their sockets, and swallowed them whole. Now that the fruits were so easily detached, the birds foraged in silence, and I might pass beneath a tree where a dozen were feasting without becoming aware of them until, alarmed by my presence, they noisily took wing.

Voice.—In Guatemala, the deep mellow notes of the Band-tailed Pigeon sounded to me like *C'cooo c'cooo*. Sometimes in flight, in addition to their loud wingbeats, they produced a low, rattling sound, which apparently issued from their throats.

Bathing.—On the northern slope of Volcán Irazú, at an altitude of about 5,500 feet, we found several Band-tails near a stream of hot water that welled out of the mountainside in a pasture. My companion, Dr. Roderich Graf Thun, told me that he had seen the pigeons bathing here.

Nest and eggs.—The single Band-tailed Pigeon's nest that I have seen was situated in a young pine tree on a bushy mountain slope above Tecpam, Guatemala, at an altitude of about 9,000 feet. The loosely constructed platform of coarse sticks, about 8 by 7 inches in diameter, rested on a nearly horizontal branch, in contact with the main trunk, 20 feet above the ground. When found on 13 March 1933, this nest contained a single white egg, which was almost equally blunt on the two ends and measured 42.9 by 28.6 mm. No other egg was laid in the following days. In the United States, this race of the Band-tailed Pigeon also as a rule lays a single egg, although sets of two are sometimes produced. But in the only nest of the southern race *albilinea* of which I have found a record, two eggs were present. This nest, at an altitude of about 7,500 feet in the Santa Marta region of Colombia, was placed about 10 feet from the ground in a small tree and its eggs were creamy white (Todd and Carriker, 1922:198).

Incubation.—I spent the whole of one day and parts of three other days watching the parents attend their egg in the pine tree. On 19 March, I began my vigil at 0550, while it was still too dark to distinguish the nest. As the light increased, the female, who was covering the egg, became increasingly restless, until, at 0620, she flew away. But after an absence of only a minute she returned and sat quietly until her mate came to replace her at 0823. He then incubated without interruption until the female came back at 1557 in the afternoon. She sat steadily until, at 1840 hours, I could no longer see her amid the pine needles and I left. At 0550 the next morning I reentered the blind, and when there was sufficient light I saw that the female was still at her post. At 0613 she took an outing that lasted only about a minute, then sat until her mate relieved her at

0831. On 17 March he was already present when I began to watch at 0900 hours, and he covered the egg continuously until the female arrived at 1600 in the afternoon. On 18 March, the male was present at 0840 in the morning, and in the afternoon I watched the female replace him at 1530. Then she remained until nightfall.

These pigeons, then, incubated on a very simple schedule, well adapted to a bird able to sit quietly for long periods without eating. The female went to the nest between 1530 and 1600 in the afternoon, and if undisturbed she sat continuously until soon after 0600 the following morning, when she went off for about 1 minute, probably to stretch her wings and avoid soiling the nest; for she was not absent long enough to find food. Returning, she remained on the nest until, between 0815 and 0830 hours, the male came to take charge of the egg. He sat without a break for from 7 to 8 hours, until his mate returned in the afternoon. If the pigeons were not disturbed, their eggs were left exposed for less than 2 minutes in the course of a day. At a nest of the Band-tailed Pigeon watched by Peeters (1962) in California, the male did not come to cover the eggs until after 1000. The female also came late in the afternoon, usually after 1700.

The changeover was effected without ceremony. The newcomer flew up into the pine tree with no sound except the loud wing flaps which broke its momentum as it lighted on a branch at a distance from the nest. Then the partner on the egg stretched up its neck, slowly and deliberately arose, walked out along the supporting branch, and when in a clear space noisily beat its wings as it launched itself into the air. Neither bird gave any greeting or sign of recognition to the other. After the departure of its mate, the new arrival flew to the supporting branch, walked along it to the nest, and settled down on the egg. At first it held its neck upstretched and looked around, as though to assure itself that no enemy lurked near, but if it sighted nothing alarming its neck gradually sank down between its shoulders. Then it shifted to a more comfortable position, perhaps turned the egg, and was ready for a long period of continuous sitting.

Often one's attention is drawn to the nest of a pigeon or dove by its loud, abrupt flight as he unwittingly approaches. The bird's swift departure gives the impression that it burst wildly from the nest, and one wonders that the egg was not thrown from the shallow receptacle by this sudden movement. But long watching from concealment corrects the impression that pigeons are stupid birds who jeopardize their eggs by panicky departures. The Band-tailed Pigeons in the pine tree were very reposeful, sat for long intervals without shifting their position, and rarely turned their egg. The male rotated on the nest and stretched his wings even less than the female. When perfectly at ease, each kept its head between its shoulders, turned to the left. Distant noises were usually disregarded

by the sitting bird, except when very loud and sharp. Sounds from a nearer source caused it to stretch up its head and look around. If the noises became more alarming, the pigeon rose in the nest and prepared to flee. But if the approaching animal proved to be only a horse or a cow, snorting or treading on dry sticks which snapped loudly, the bird settled down again, then slowly, very slowly, its neck contracted and its head turned leftward. Thrice, while I watched, men hunting cattle or firewood passed beneath the nest without frightening away the incubating pigeon, who lifted its head, took in the situation, and decided to risk remaining.

These pigeons seemed to know that their departure in the presence of an intruder would reveal their nest's position. I admired the cool judgment, the careful weighing of risks, that kept them at their post to the last moment compatible with their own safety, and indirectly that of their offspring, which could not survive without them. I believe that only a very sudden fright could make a pigeon take wing without first stepping from its nest, which might be damaged by taking off directly from it, as a hummingbird does. The loud wingbeats, which give the impression of immoderate haste, are the necessary accompaniment of a heavy bird's launching itself into the air, and are not indicative of a panic-stricken departure.

A few days after I completed my study of incubation, the egg vanished from the nest in the pine tree. Fortunately, Neff and Niedrach (1946) provide details of the care and development of a nestling in Colorado. For 20 days after it hatched, the parents brooded it almost continuously, leaving the nest only rarely for short periods, up to 30 minutes, to drive away an intruder or fly to a nearby spring for water. While brooding, they followed much the same schedule that the Guatemalan pair had followed while incubating: the male came to the nest between 0845 and 0930 in the morning and took charge of the nestling until his mate returned between 1545 and 1715 in the afternoon. Once, when the male failed to appear, the female sat throughout the day. Until after the twentieth day, the male alone fed the nestling, during the first week giving it three meals daily, between noon and 1500 hours, while in the second week the number of meals was reduced to two, delivered between noon and 1330. Only after she ceased to brood, after the nestling's twentieth day, did its mother feed it. It left the nest when between 27 and 30 days old. At a nest studied by Peeters (1962) in California, parental care followed much the same pattern.

Need of protection.—Of all the Central American pigeons, the Band-tailed seems most in need of legal protection, not only because its large, conspicuous flocks are very vulnerable, but also because it lives in the highlands where the human population is densest. In some areas, as in the Cordillera Central of Costa Rica in the dry season, loose flocks fly down the mountain in the morning, evidently to forage at lower altitudes, then return upward in the

middle of the afternoon. As they fly laboriously up the slopes, often into a headwind, they fall an easy prey to gunners stationed in the open pastures over which they must pass. This slaughter continues into the nesting season.

WHITE-WINGED DOVE

The White-winged Dove (*Zenaida asiatica*) is a brownish pigeon with a conspicuous white area on the wing coverts. It has an extensive but discontinuous range, occurring from southern United States to Costa Rica, in the southern Bahama Islands and Greater Antilles, and on the Pacific coast of South America from southern Ecuador to northern Chile. An inhabitant of arid or open country, in Central America it is found chiefly on the Pacific coast, in the western parts of the highlands, and in dry interior valleys in the Caribbean drainage. Along the middle reaches of the Río Motagua, especially on hot, dry plains which support an open growth of tall cacti and thorny scrub, many White-winged Doves forage over the ground, although they are less abundant than the associated Inca Doves (*Scardafella inca*). They are equally at home in the more arid parts of the Pacific coast, from the Gulf of Nicoya northward. In Guatemala they range far upward into the zone of oaks and pines, and I occasionally met them as high as 9,000 feet above sea level. On the Sierra de Tecpam they nested in March and April, but after the rainy season began in mid-May they vanished and I saw none either on the mountain or on the plateau at its foot, about 7,000 feet above sea level, until late in the following November, a month after the advent of the dry season, when heavy frosts whitened the open fields at the end of every clear and windless night. They sang much after their return at the end of the year. In Costa Rica, where the highlands have a shorter dry season, this dove is rarely seen as high as 4,000 feet.

Unlike the arboreal pigeons we previously considered, White-winged Doves forage over the ground, and in regions naturally forested they are found chiefly in pastures, stubble fields, open woodland, along the roadways, and in similar areas of sparse vegetation. After they have satisfied their hunger they rest in neighboring trees, from which when disturbed they take flight with loudly flapping wings.

Voice.—Of all the pigeons I have heard, White-winged Doves have the longest, most complex, and most distinctive song, which on one occasion sounded to me like *Guu-gu-g'g'gu guu g'gu guuu*. Gosse (1847:306) referred to the "loud stammering coo" of this pigeon, which in the United States is sometimes called the "Singing Dove," and in Guatemala "El Cantorix." Even when heard in a frost-whitened clearing amid the highland oak forests, the White-wing's long-drawn song carried my thoughts back to the hot, cactus-studded regions of the lowlands where I first became familiar with it.

Nest and eggs.—Although in southernmost United States the White-winged

Dove nests, or formerly nested, in great colonies many acres in extent, colonial nesting seems not to occur in Central America. None of the three nests which I found was in sight of another of its kind. The first of these nests was 9 feet up in an organ cactus in a pasture near El Rancho in the Motagua Valley of Guatemala, at an altitude of about 1,000 feet. The second was 8 feet up among the close-set shoots of a pollarded *Viburnum* tree that grew beside a small rivulet flowing between a pasture and a rather open thicket, at an altitude of about 8,500 feet on the Sierra de Tecpam. The third was about 25 feet up, far out on a branch of a cypress tree that stood in an open pasture in the same locality. Each of the nests was a frail, shallow saucer of coarse sticks, about 4.5 inches in diameter. The two highland nests were liberally lined with dry pine needles, but this material was absent from the one in the lowlands, which was without a lining. In each instance the doves had selected a rather solid foundation for their slight structure. The first rested on the flat surface of a fallen cactus branch which had lodged in a horizontal position among the close-set limbs of the cactus tree. The second, in the *Viburnum*, was built upon an old nest, apparently of the Rufous-collared Thrush (*Turdus rufitorques*), by placing coarse sticks around the rim and pine needles in the bowl. The nest itself rested solidly on the cut-off end of the trunk, amid the clustered sprouts. The foundation of the nest in the cypress tree appeared to be an older dove's nest.

Each of these nests contained two eggs when found, that in the Motagua Valley on 25 June 1932, those in the highlands on 23 March and 14 April 1933, at the height of the dry season. These eggs were pure white, and their measurements average 29.7 by 22.1 mm. Those showing the four extremes measured 31.8 by 23.8 and 27.0 by 19.4 mm.

Incubation.—I spent the whole day of 30 March watching the nest in the *Viburnum* tree beside the rivulet, where the doves were incubating two eggs. Passing by starlight over fields where the frozen herbage crunched underfoot, I entered my blind as a many-voiced chorus of Rufous-collared Thrushes swelled through the cold, thin air of the high mountains. The slowly increasing light revealed a dove sitting quietly on the nest. Doubtless this was the female, although in this species the sexes cannot be distinguished by their appearance. When finally the rays of the rising sun struck the hillside behind the nest, an exposure of 5 minutes was enough to melt the white frost from the sparse brown herbage of the pasture, and soon Rufous-collared Thrushes and Steller's Jays (*Cyanocitta stelleri*) were foraging over it with evident success. But the spot where I sat in the shade was long in receiving the warming rays, and it was nearly noon before the numbness left my hands and I ceased to be chilly. In this boreal setting, I watched the nest of a bird which I had come to associate with the hottest and driest regions of the lowlands.

The dove sat nearly motionless, and when her mate arrived at 0832 hours she

still maintained the same attitude in which dawn had revealed her. Appearing suddenly, he alighted in a neighboring rajón bush (*Baccharis vaccinioides*) and approached the eggs by walking over a long, naked, nearly horizontal branch which passed through the *Viburnum* tree close by the nest. As he drew near, the female rose, walked to the other side of the nest tree, took wing, and flew out of sight. Reaching the nest, the supposed male settled slowly on the eggs. Neither partner had uttered a syllable: the changeover was effected in perfect silence save for the whistling of wings in flight and the loud flaps of the male as he arrested his course and of the female as she launched forth into the air.

Then for nearly 5 hours the male sat in the position in which he had settled on his arrival. Although sometimes he preened and shifted the eggs beneath himself, he never rotated in the nest. Toward the middle of the afternoon he grew restless, shifted his position from time to time, stretched his wings, and preened more often than in the forenoon. He also had intervals of drowsiness, when he closed his eyes briefly as though in sleep; but after a second or two, or four at the longest, he would open them to look around. Finally, when the sun was sinking low over the mountains and the thin air was becoming chilly again, his looked-for relief arrived. At 1715 the female alighted in the rajón bush and waited there while her mate, who after sitting without interruption for 8 hours and 43 minutes had become quite restless, slowly stepped from the nest, walked to the outside of the tree, and took wing. Then with mincing steps she walked over the long horizontal branch to the nest, a distance of about 12 feet. As she stepped into it, she uttered a subdued version of her queer, polysyllabic song, then very slowly settled on the eggs. Here she remained motionless while the stars and crescent moon shone forth, and a Whip-poor-will (*Caprimulgus vociferus*) began to call from a perch in the rajón bush close by her.

In the course of the day, these doves had many visitors, and it was interesting to observe their reactions to them. Early in the morning, a Steller's Jay gathered material for a nest from the ground nearby, but the incubating dove seemed indifferent to it. Toward noon a pair of Black-eared Bush-Tits (*Psaltriparus melanotis*) discovered some downy feathers, doubtless shed by the doves, among the branches below the nest and gathered billfuls with much small twittering, at times venturing within a foot of the sitting dove, who paid no attention to these tiny, bustling visitors. When two horses waded up the stream beneath the nest, the dove merely raised his head to discover the source of the sounds he heard. He was equally unperturbed when a bull and three cows came running noisily down the slope toward him, then drank and waded in the stream and cropped the lusher herbage on its banks, sometimes directly beneath him. Yet I could not with the utmost stealth approach within 25 feet of the nest without sending off the sitting bird. Like the Band-tailed Pigeons, these doves were alert

to sounds, looked around for their source, assessed the threat, and stuck to their post as long as this seemed prudent.

On 2 April, the sitting dove, departing from its usual practice, remained on the nest while I approached in full view to within 10 feet. Then, losing courage, it flew directly from the nest with such force that it nearly rolled out an egg. One of the two eggs was pipped. When I returned the following morning, the nest was empty.

INCA DOVE

Nearly everywhere in the drier lowlands of Central America and southern Mexico, the rather harsh, disyllabic call of the little Inca Dove (*Scardafella inca*) is heard on every side through much of the warm, bright day. Although most abundant at low altitudes, the Inca Dove is established in dry interior valleys well into the highlands. The highest point at which I found it in Guatemala was at the foot of the Sierra Cuchumatanes between Huehuetenango and Aguacatán, 7,400 feet above sea level. Although Carriker (1910) does not include this species in his list of Costa Rican birds, it was abundant at Las Cañas in southern Guanacaste in November 1937. Here it associated with Ruddy Ground-Doves, Common Ground-Doves (*Columbigallina passerina*), White-winged Doves, and White-fronted Doves. Since Guanacaste was well known ornithologically in Carriker's time, it is evident that the Inca Dove has extended its range southward, or at least become more abundant at the southern extremity of its range, since the beginning of the present century. Even as late as 1916, Ridgway could cite no record of its occurrence in Costa Rica.

On 16 July 1932, I found an Inca Dove's nest near the railroad above El Rancho in the dry valley of the Río Motagua in Guatemala. The slight structure of straws, fine sticks, and bits of weed stems, 3 inches in diameter, was situated 5.5 feet up in an organ cactus, where it rested in the angle between a short joint and the upright stem. The nest then contained one white egg, and 3 days later there were two, which measured 21.8 by 17.1 and 23.0 by 17.5 mm.

PLAIN-BREADED GROUND-DOVE

Although the little Plain-breasted Ground-Dove (*Columbigallina minuta*) occurs from southeastern Mexico to Paraguay, its range is discontinuous, and in Central America it is by no means so widely distributed and common as the slightly larger Ruddy Ground-Dove. The single nest that I have seen was found near Los Amates in the Motagua Valley of Guatemala on 24 May 1932. The slight, shallow saucer of grass and straws was situated on the ground in a pasture, at the base of a tuft of coarse grass. Its concavity was 2 inches in diameter by 0.5 inch deep. The two white eggs measured 22.2 by 16.3 and 21.4 by 16.3 mm.

COMMON GROUND-DOVE

The widespread Common Ground-Dove (*Columbigallina passerina*), ranging from southern United States to Ecuador and Brazil, is in Central America found chiefly in the highlands, up to 8,500 feet in Guatemala, and in somewhat arid regions at low altitudes. Here I have discovered no nest, but near Cali in western Colombia I found one on 3 January 1941. The slight, round mat of fine stems was situated on the ground, beneath a small *Lantana* bush that provided scant shade, in a scrubby pasture, near a stream in a deep and narrow valley. It held two white eggs, which were covered by the male parent at 1230 hours. He drew my attention to the nest by fluttering off and walking slowly, mincingly away, keeping himself somewhat shielded behind the neighboring shrubs. Eager to resume incubation, he approached the nest several times while I stood close beside it.

As Griscom (1932:115) pointed out, the Common Ground-Dove and the Plain-breasted Ground-Dove are not found together in Central America. Although their geographic ranges are largely coextensive, they occupy different regions, perhaps as a result of interspecific competition.

BLUE GROUND-DOVE

When I published my life history of the Blue Ground-Dove (*Claravis pretiosa*), I was able to report only one determination of the incubation period, and a doubtfully adequate one of the nestling period (Skutch, 1959). At a nest found in a coffee bush in 1960, the first egg was laid during the daytime of 22 February and the second between 0715 and 1225 on 24 February. The first had hatched by 0725 on 9 March, and the second between 1700 on this date and 0730 on 10 March. The incubation period was accordingly between 14 and 15 days, slightly longer than my earlier determination of approximately 14 days. One of the nestlings in the coffee bush died. In the afternoon of 21 March, I found the survivor resting a few inches from the nest. The following afternoon it was resting on the nest's rim, and by the afternoon of 23 March it had gone, leaving the nest heavily soiled. Its nestling period was 13 or 14 days. The nestlings which disappeared when only 9 days old, as earlier reported, were probably driven from their nest prematurely, if not carried off by a predator.

Five nests found in El General since my earlier paper was published bring the total up to 28. Eggs were laid in these nests as follows: February, 5; March, 8; April, 10; July, 1; August, 3; September, 1. It is instructive to compare this distribution with those given beyond for the White-fronted Dove and the Rufous-naped Gray-chested Dove. In all three species, freshly laid eggs are rare or absent in May and June, the first 2 months of heavy rains, and laying is resumed, but on a reduced scale, in July, August, and September.

WHITE-FRONTED DOVE

The brightest color of the plainly attired, brownish and grayish White-fronted Dove (*Leptotila verreauxi*) is the beautiful cinnamon-rufous which it reveals when it raises its wings; but this coloration of the under wing coverts does not suffice for identification, because it is shared by other members of the genus. The White-fronted Dove has a wide range, extending from southern Texas to central Argentina and from the Atlantic Ocean to the Pacific. In Central America it is present over the whole Pacific slope, from sea level up to about 8,500 feet in Guatemala and 5,000 feet in Costa Rica, but on the Caribbean slope its occurrence is restricted. Where the continental divide is not too high, as on the Isthmus of Panama and in central Costa Rica, it "spills over" from the Pacific side, and it is also found in somewhat arid valleys in the Caribbean drainage of northern Central America. It prefers conditions intermediate between those of the humid rain forest of the Caribbean littoral and those of the driest parts of the interior valleys. Where Inca Doves and White-winged Doves abound amid cacti and thorny scrub, as in the most arid section of the Motagua Valley, White-fronted Doves are not often seen, although these three species occur together where the vegetation is somewhat more luxuriant. In the valley of El General, White-fronted Doves have become numerous in clearings in the heavy forest. Because of its great geographical range and tolerance of varied ecological conditions, this is the pigeon which the bird watcher who travels widely through the tropical and subtropical parts of the American continents is likely to meet in more localities than any other.

In the regions where I am familiar with it, the White-fronted Dove avoids both the interior of heavy forest and broad, treeless fields. It prefers light and somewhat open thickets, orchards, plantations of coffee or bananas, and shady pastures and dooryards. In October and November I have usually found single individuals in El General, but by December many White-fronted Doves are in pairs. In my experience, this dove never flocks. It forages chiefly, if not exclusively, on the ground. It is fond of maize and enters thatched granaries with open fronts to pick up exposed grains. While feeding chickens on the lawn in the early morning, I have often watched one or two of these doves hovering on the outskirts of the flock, gathering the grains of maize which I threw farthest. Later, when the domestic fowls have gone off to scratch at the woodland's edge, the doves come to eat what they have left, not disdaining spoiled grains which the chickens reject. Sometimes the doves looking for corn chase each other, and one immature White-fronted Dove chased a Rufous-naped Gray-chested Dove. But I have seen no fighting.

Voice.—In December, when after long months of heavy rainfall the weather becomes drier in El General, the White-fronted Doves begin their sonorous calling. They are most vocal in the warmer parts of the day, toward noon and

in the early afternoon. Perching inconspicuously amid dense foliage, often inside the compact crown of an orange tree, they repeat their hollow notes over and over interminably. The full, deep, long-drawn, moaning *coo-ooo* has a peculiar tone quality which makes it unmistakable. While producing this distinctive call, the dove puffs out its chest most conspicuously but keeps its bill closed, apparently emitting the sound through its nostrils. These doves have another utterance which I have far more rarely heard. More musical, higher in pitch, and almost soprano in tone, it consists of two parts and sounds something like *coo woo*. The same individual sometimes produces both of these calls alternately. Amid the coffee groves and low copses of the Central Plateau of Costa Rica, I heard the deep hollow call much in October, when these doves are rather silent in the wetter region of El General. Over much of the Pacific slope of Central America, this is one of the most characteristic bird notes through a large part of the year.

Nest building.—In the valley of El General, the White-fronted Dove sometimes begins to breed in late December, but few of its nests have been found before March. Most of the 20 nests that I have encountered in El General were placed in bushes and tangles of vines in low and often dense thickets, from 1 to 2 yards above the ground. Very rarely they were lower than this; the lowest of all was only 1 foot up on matted calinguero grass (*Melinis minutiflora*) on a steep slope above the edge of a thicket. Sometimes the nest was placed on a stump. One pair had built on a stump a yard high and about 1 foot in diameter, at the edge of a patch of cassava (*Manihot utilissima*). Another nest was 5.5 feet up on the top of a sprouting stump in a field of sugarcane. One nest was 9 feet up on a horizontal branch of a poró tree (*Erythrina Berteroana*) growing in a small coffee plantation. White-fronted Doves may be tempted by some especially attractive foundation to build even higher than this. A nest was placed 13 feet up on the base of a large plant of the golden-spray orchid (*Oncidium* sp.) in a calabash tree with dense foliage. In two successive years, the same female built 15 feet up in a burío tree (*Heliocarpus appendiculatus*) standing close by our house. Here the attraction was a platform-like expanse between four thick upright branches, shaded by a small epiphytic bush, the whole forming a well-enclosed, secure foundation. But nests as high as this are exceptional. The extreme range in height of 19 nests was from 1 to 15 feet. Twelve of these nests were from 3 to 6 feet up, two were below 3 feet, and five were above 6 feet.

Among the doves which early in 1952 hunted over our lawn and picked up grains of maize was a White-fronted Dove with a swelling on the back of its neck, which made the feathers stand out unevenly in a sort of ruff. We saw much of this dove, and after a while we began to refer to it as "Ruffles." At first we did not know the sex of this bird, but later, when it nested close by

the house, it became evident from its behavior that it was a female. In July 1952, Ruffles was very lame and hopped over the ground with one foot held up. By October she had nearly recovered and walked with only a slight limp, which she afterward lost. Fortunately for my studies, she did not lose her ruff, which for well over 3 years served as a conspicuous mark of recognition in a species of which the sexes are normally indistinguishable in appearance. Once I met Ruffles in a second-growth thicket beside the river, about 1,000 feet from the dooryard where she was often to be found.

In 1953, and again in 1954, Ruffles and her mate, who bore no recognition mark and so was not necessarily the same in both years, nested in our garden. In both years the history of their nesting was much the same. The first nest was built in a very dense clump of *Thunbergia erecta* on the bank in front of the house, two eggs were laid, and they vanished before hatching. Then, after an interval, the pair built a second nest in the platform-like crotch of the burío tree, 110 feet distant from the *Thunbergia*—the highest nests that I have seen, whose site has already been described. In the first year the nest was well shaded by the crown of the tree, but by the second year the crown had been cut away, because the tall, easily uprooted tree menaced the house, and the nest was exposed to the sky, although well enclosed on the sides. In both years, the second nest was successful, but in neither was it followed by another in the garden.

In 1953, the first nest, in the *Thunbergia*, had its full set of eggs on 11 March and was empty by 17 March. At 0820 on 20 March, I found Ruffles sitting in the crotch of the burío tree, while her mate picked material from the lawn and carried it up to her. Each time he took a single article in his bill, but often this was a fairly large, branched piece of dry grass or weed. Sometimes he picked a piece from the ground, shook it, then promptly dropped it as unsatisfactory. Flying up to the crotch with his burden, he usually entered from the north, passed by or over his mate to deposit the material beside her, and promptly emerged on the south, to fly down to the grass for more. Often I clearly saw that he stood on the female's back while he laid his billful beside her, but sometimes he seemed merely to pass by her. He never arranged what he brought, leaving this to his partner, who often turned around in the nest and, as far as I could see, gave much attention to shaping it. Frequently she rapidly vibrated the tips of her wings as the male approached her. From 0820 to 0920 the male dove brought material 12 times. From 0920 to 0953 he made 14 trips. Then Ruffles flew down to the ground, where she and her mate touched bills and each nibbled the feathers of the other's neck. She had not returned to the crotch by 1020.

The following day, 21 March, I found Ruffles sitting on the nest soon after sunrise, but she did not stay long. After she went I examined the nest and

found it far from finished. At 0851 hours Ruffles went to sit on it. Next her mate came, looked down at her from a neighboring branch, then flew to the ground. He brought nothing on this visit of inspection. While he was absent, Ruffles called from the nest in a low voice. From 0851 to 0948 he made ten trips with materials, which he laid beside his partner as on the preceding day. The pieces were on the average smaller and finer than those he had brought the day before. Often they were curling petioles, and always they were carried singly. When he delayed long to bring something, Ruffles called softly from the nest. At 0948 she flew down, and no more building was done that day, as far as I saw. On the following day the pair worked between 0800 and 1000 hours. The nest was completed in 3 or 4 days.

A typical nest of the White-fronted Dove was a thick, shallowly concave platform that measured 5 to 6 inches in diameter, not including the projecting ends of sticks. The pile was about 3.5 inches thick. It was composed of weed stems, straws, sticks, dry pieces of vine, fragments of fronds of the bracken fern, rootlets, and the like. The longest stiff pieces were two crooked straws about 12 inches long: but three very thin, curved pieces of vine were, when straightened, 20, 18, and 16 inches long. Most of the nest's components were under 10 inches long. The nest contained over 350 pieces of material, not counting the finest fragments. It weighed 68 grams. White-fronted Doves' nests are among the thicker and more substantial of pigeons' nests.

The eggs.—Of 20 nests of the White-fronted Dove in El General, 18 contained two eggs or nestlings, the remaining two a single egg or nestling. This dove likewise lays sets of two eggs at the northern extremity of its range in Texas. Because the doves spend so much time on the nest before their set is complete, and frequent interruptions may cause desertion, it is difficult to learn when their eggs are laid. When Ruffles settled on her second nest in the burío tree in the evening of 31 March 1954, there was still no egg. She sat through the night and by 0700 next morning she had laid the first egg, which was covered intermittently during the day of 1 April. At 0710 hours on 2 April, there was still the single egg. From 0800 to 1500 I looked frequently at the nest, but each time one member of the pair was sitting and I could not see what it contained. Finally, at 1500, I chased off the dove and found two eggs, the second of which had been laid since 0710 that morning. At nest 12, the first egg was present at 0725 on 4 July and the second was laid between 0805 and 1030 the next day. At nest 17, the second egg was deposited between 0700 and 1015. The second egg of a set is laid somewhat more than 24 hours after the first, but the exact interval is unknown.

The eggs are white or sometimes pale buff, without much gloss. The measurements of 15 average 29.6 by 21.6 mm. Those showing the four

extremes measured 31.0 by 21.0, 29.4 by 23.0, 27.8 by 21.8, and 29.4 by 20.2 mm. This does not include a runt egg which was only 22.2 by 16.7 mm.

In 20 nests in the valley of El General, 2,000 to 3,000 feet above sea level, eggs were laid as follows: December, 1; January, 1; February, 3; March, 7; April, 3; July, 3; August, 1; September, 1. As in the case of the Blue Ground-Dove, the absence of records in May and June seems significant, for these are the very months when I have devoted most time to the birds, most kinds of which are then at the height of their breeding season.

Incubation.—The nest in the burío tree was too well screened to invite prolonged observation, and I made no study of the pattern of incubation in this species. I saw Ruffles, the female, replace her mate at various times between 1500 and 1630 in the afternoon, and she sat through the night. In 1953 she laid her second egg between 0700 and 1015 hours on 25 March, and it hatched between noon on 8 April and 0615 on 9 April, so that the incubation period was not less than 14 days and 2 hours nor more than 14 days and 23 hours. The following year, Ruffles laid her second egg between 0710 and 1500 on 2 April, and it hatched between 0700 and 1640 on 16 April, giving an incubation period between 13 days and 16 hours and 14 days and 9.5 hours. The incubation period is, then, approximately 14 days.

Parental care.—White-fronted Doves are among the most devoted parents that I know. When covering eggs or young, they sometimes permit a man to approach within arm's length before they take flight. They spend much time guarding their nestlings, even those which are well feathered and ready to leave the nest. When driven from their young, they give some of the most prolonged, vigorous, and convincing distraction displays that I have ever witnessed. And, unlike many other pigeons, they keep their nest irreproachably clean as long as it is in use.

On 26 July 1936, a boy led me to see a White-fronted Dove's nest which he had found in a small coffee plantation. Sitting above our heads in a poró tree, the dove apparently felt secure, for our presence beneath it, and shaking the supporting limb, did not even make it shift its position. Next morning I returned with a mirror and a long stick to see what the nest contained. When I touched the sitting bird's tail with the stick, it raised its wings straight up above its back, in an attitude of defiance that revealed the beautiful cinnamon of the inner surfaces, which are ordinarily concealed. Hoping to make the dove depart, I tried to touch it again with the stick's end, which received a resounding blow from the uplifted right wing.

I then abandoned the attempt to make the dove leave its nest; but thinking that I might glimpse the contents when it rose up in an attitude of defiance, I tied the mirror to the stick and raised it toward the bird. When the intruding object reached the level of the nest, the dove suddenly dropped to the ground and

began to move away, hopping and limping, quivering its wings or loosely flapping them, as though badly injured and unable to fly. The weeds beneath the coffee bushes had just been cut, leaving the ground clean and free of obstructions, an excellent stage for the dove's performance. I followed it at a walking pace: and the bird, all the while moving as though in the greatest agony and distress, easily kept its distance of 15 or 20 feet ahead of me, until it reached the edge of the plantation, 200 feet, as measured later, from its nest. Here the dense growth of weeds and bushes forced it to interrupt its display, and it flew over the barrier into the neighboring thicket. But it alighted on a log in full view of me and stood fluttering its wings as though trying vainly to fly. Tangled vines prevented my following, and after a minute of this acting the actor vanished amid the dense vegetation. When I returned to the nest, my uplifted mirror revealed a single half-grown nestling. Never before had I seen a pigeon defend its nest so bravely, nor make such an earnest attempt to lure me away when finally it was forced to retreat. At every stage of its complex performance, it gave the impression that it was acting with intelligent deliberation, carefully calculating the risks it ran, adapting its performance to the diversities of the surroundings, taking care not to jeopardize its own life while it safeguarded that of its offspring.

One day when I visited another nest that contained a single nestling whose feathers were just beginning to expand, the brooding parent stayed until I almost touched it, then dropped to the ground and fluttered off in a distraction display such as I have already described. A few seconds later, the nestling, quite unable to fly, jumped from the nest and tried to escape over the ground. Easily overtaking it, I replaced the young fugitive in the nest and held it there until it had become calm and made no further attempt to flee.

After this episode, I did not again go near this nest but viewed it from a distance. On every visit, even in the warm middle of the day, I found a parent brooding the now fully feathered nestling. On seeing me, the parent crouched low in the nest, usually with the youngster's head and neck projecting from beneath the parental breast. One afternoon I approached a little nearer than usual, examining the parent and all that was visible of the nestling through my field glasses. The parent at first crouched low, as was its habit, but under my continued scrutiny it became alarmed, fluttered to the ground, and dragged itself away with a flapping of wings all out of proportion to its slow progress. As soon as the parent had passed beyond view, the nestling rose from the nest and went off in the opposite direction. It now flew well, and it did not stop until it was completely hidden from me by the surrounding bushes.

Parent White-fronted Doves appear regularly to use this ruse to divert an intruder's attention while their fledglings escape in another direction. At 0730 hours on 25 April 1953, I went to look at Ruffles' nest in the burío tree, where

an hour earlier a parent had been guarding at least one of the feathered young. With my eyes raised toward the nest, I was startled by a flapping of wings from beneath a neighboring orange tree. A parent dove circled close around me, came down on the grass about 10 yards away, spread its wings broadly and waved them slowly up and down while standing in one spot or walking deliberately over the ground, as though unable to fly. At the moment when the parent began this elaborate distraction display, one or both of the young flew directly off to the far end of the garden. My first impression was that three doves rose from beneath the orange tree in a single burst of wingbeats; but later, when the parent had ceased to display, I could find only a single fledgling, who flew off in a competent fashion, then walked farther away over the surrounding pasture, quite steady on its legs. Climbing then to the nest, I found that both fledglings had gone.

Newly hatched nestlings bristle with the hair-like feathertips typical of young pigeons. Their feathers expand when they are 9 or 10 days old, producing a plumage which resembles that of the adults, except that it is duller and many of the feathers of the back and breast have pale margins, producing the effect of scales. The juvenile's outer rectrices have white tips, as in the adults. But the young dove's eyes are brown, giving it a dreamy, contemplative expression, whereas the bright yellow eyes of the parents impart an alert, startled aspect. The bare skin that surrounds the fledgling's eyes is very dull bluish, not bright blue as in the adults. At one nest, the nestling period was 15 days; at two others, it was 16 days.

Although I have always found White-fronted Doves' nests quite clean after the fledglings departed, the broad platform around the nest in the crotch of the burio tree held an accumulation of droppings. Thus these doves, which surpass many other members of their family in their attention to sanitation, fall short of the majority of passerine birds, although they do better than a few, notably the goldfinches (*Spinus* spp.) and their relatives.

GRAY-CHESTED DOVE

The Gray-chested Dove (*Leptotila cassinii*) is confusingly similar in appearance to the slightly larger White-fronted Dove. In flight the two can sometimes be distinguished by the fact that the White-fronted Dove has all but the innermost tail feathers more or less broadly tipped with white, whereas in the Gray-chested Dove only one to three rectrices on each side are so marked. If one can approach near enough, he can readily distinguish these doves by the colors of the featherless parts of the face. In the Gray-chested Dove, the bare skin around the eyes and on the lores is red, while in the White-fronted Dove it is bright blue. In both species, the iris is yellowish to orange, the bill black, the legs and toes some shade of red.

The Gray-chested Dove inhabits the humid Caribbean lowlands over the whole length of Central America and extends into adjacent portions of southern Mexico and northern Colombia. According to Carriker (1910:403), its vertical range in Costa Rica is from sea level to about 3,000 feet, with some stragglers going higher, and it is most abundant between 500 and 1,500 feet. A forest dweller, it forages over the leaf-strewn ground singly or in pairs, never in flocks. Its note is a long-drawn, rather mournful *cooo*, interminably repeated during the dry season.

Nesting.—In 1935, I found four nests of this dove in the lighter parts of the forest on Barro Colorado Island in the Panama Canal Zone. Two were placed in dense tangles of vines, and two on fallen palm fronds which had lodged in the undergrowth and formed broad platforms for the nests' support. In height the four nests ranged from 3 to 9 feet above the ground. They were slight, frail platforms or mats with little or no rim, composed of a few dry twigs, tendrils, and similar materials. One platform was 5 inches in diameter. When found on 19 February, the earliest of these nests held two nestlings in long pinfeathers. Each of the other three nests contained two white eggs, which in the case of the latest were laid about 5 April. The eggs in two sets measured 29.4 by 21.8, 29.4 by 22.2, 28.6 by 21.4, and 29.0 by 21.4 mm. Others have found this dove nesting in the Canal Zone from April to September (Eisenmann, 1952:21).

My attention was drawn to the earliest of these nests when a pigeon burst out of a thick tangle of vines beside the trail along which I was passing through the forest. Since I saw little of the rapidly departing bird, I set up a blind before the nest with two nestlings, in order to enjoy a close view of the parents and identify them. While sitting in the blind, I began to wonder how often the nestlings would be fed, and to satisfy my curiosity I spent the whole of the morning, all of the following afternoon, and most of another morning watching them.

Through the early morning of 20 February, the parent continued to sit motionless on the nestlings just as the light of dawn revealed her, with neck drawn in and bill pointing slightly downward. At 0822 hours she suddenly arose and flew away. At 0855 a dove, doubtless the male, alighted on a branch 2 feet from the nest and walked to it. His first act was to pick up and swallow all the droppings that had accumulated there. The nestlings in pinfeathers stretched up in front of him, gently touching the feathers of his neck with their bills, silently begging for food, but he did not at once respond. After considerable delay, he moved to the center of the nest and covered the nestlings. About 10 minutes after his arrival, he yielded to their entreaties, took a nestling's bill in his mouth, and regurgitated to it. For a while the second nestling rested quietly beneath his breast, but in the midst of the feeding it rose up and continued

to touch the parent's bill, until he shook out the bill of the first nestling and received that of the second into his own. Presently the first managed to push in its bill from the other side, and the two received nourishment simultaneously. While the parent held the bills of one or both nestlings in his mouth, he apparently did not regurgitate to them continuously, for he made violent jerking movements with his head only by spells, which were separated by considerable intervals when he rested quietly holding their bills in his mouth. The feedings occupied about 25 minutes, and at their conclusion the parent brooded the nestlings, or preened their sprouting feathers as they lay in front of him. Although I continued to watch until 1130 hours, no more food was given to the young.

At 1140 on the following day, I resumed my watch. The parent, doubtless again the male, was sitting just as I had left him 24 hours earlier. As the hours slipped by he rarely moved and never changed his position, while the nestlings rested inertly beneath him. At intervals during the afternoon light showers fell. Finally, at 1630, his mate arrived, alighted on the ground between me and the nest, and stood there for many minutes, uttering a very low *coo* scarcely audible 15 feet away, the while bobbing her head up and down and jerking her tail. Then she flew up into the tangle and walked over the thickly matted vines to the nest's side. Here she stood while her partner arose, walked slowly to the edge of the tangle, and flew off into the forest. Then she stepped into the nest and, after a long delay, took the nestlings' bills into her mouth, one on each side, and regurgitated to them for 17 minutes, finally ending the meal by opening her bill and shaking out the bills of the young, who continued to stretch up their heads for more.

Presently the parent ate all the nestlings' excrements that lay before her on the nest, performing this office *after* feeding the young rather than *before* feeding them, as her mate had done. But 40 minutes later a begging nestling persuaded her to feed it for 2 minutes more, after which further requests for food failed to elicit a response. As happened years later in the case of the Ruddy Quail-Dove, which similarly cleans its nest, I wondered whether the parent Gray-chested Doves fed back to the nestlings the excrements they picked up so soon before they began to regurgitate, and if not, how they avoided doing so. When it had become too dark to distinguish the dove, I left her brooding her nestlings.

Two mornings later, I began to watch this nest at 0645 hours, when a parent, doubtless the female, was brooding. At 0830 the nestlings, who hitherto had rested quietly beneath her, crawled out in front and after a while started to preen their expanding feathers. Then, as the hour for their breakfast approached, they stretched up and ruffled the feathers of their mother's neck, sometimes touching her bill with theirs, begging for food. Apparently having nothing to

give them, she continued to sit motionless just as I had found her 2 hours earlier, until at 0848 her mate flew up, walked over the matted vines, and stood beside her at the nest's edge. Only then did she arise and leave. Four minutes later, the newly arrived parent began to feed first one nestling, then both together, and continued to do so for 15 minutes. Despite the youngsters' entreaties, no more food had been given by 1020, when two people passing along the trail frightened the parent away. It had not returned by 1130, when I left.

Thus these nestlings, whose feathers on 23 February were beginning to unsheathe, were brooded, or at least guarded, almost continuously. During 13 hours of watching on 20 and 21 February, they were alone for only 33 minutes, and on 23 February they were attended constantly until the parent was frightened away. The parents alternated on the nest according to the schedule which they had probably followed while they incubated. Each gave the nestlings one long meal, beginning shortly after its arrival and lasting for 15 to 25 minutes; and once the female delivered a second, much shorter meal.

Twice, during my afternoon watch, a party of Rainbow-billed Toucans (*Ramphastos sulfuratus*) flew heavily and noisily about in the trees above and around the doves' nest. Each time that this happened, the male dove depressed his neck, bent down his head, and slightly spread his wings. This apparently made him less conspicuous from above, for his nearly white forehead, face, and throat, as likewise his light-colored breast, were turned downward, while his brown dorsal plumage was presented to the nest-robbing birds in the trees above him. His spread wings screened the light plumage of his sides. The crouching dove blended well with the brown sticks of the nest and the dead stems of the vine tangle that supported it. On both occasions, the dove slowly raised his head and folded his wings, resuming his normal posture, as soon as the toucans had passed from view.

Later in the evening, after the female had returned to the nest, a party of White-faced Monkeys (*Cebus capuchinus*), including a mother with a half-grown child riding on her back, passed with stupendous leaps through the treetops above us. Noticing my blind, some of the party raised an outcry; nevertheless, the brooding dove did not crouch as her mate had done while the toucans were above him, but sat in her usual attitude. Yet these monkeys are, as I have seen, nest robbers, just as the toucans are. Likewise, the passage of a Three-toed Anteater (*Tamanduas tetradactyla*) through the undergrowth not far from the nest, and that of a band of Collared Peccaries (*Pecari angulatus*) which I did not see but strongly smelt, seemed not in the least to perturb the parent dove.

The nestlings were heavily infested with *tórsalos*, dipterous larvae which live beneath the skin of the warm-blooded animals they parasitize. One nestling had nine big lumps, caused by these pests, on its head and various parts of its

body. Yet they evidently had not seriously retarded its development, for this nestling was larger, with plumage further advanced, than its sibling, who supported fewer parasites. Neither their parents nor the Gray-chested Doves attending eggs ever gave a distraction display.

RUFIOUS-NAPED GRAY-CHESTED DOVE

The Rufous-naped Gray-chested Dove (*Leptotila cassinii rufinucha*) is readily distinguished from the preceding forms of *Leptotila* by the warm tawny-brown of its hindhead and nape. Its eyes are pale yellow: the bare skin around them and on the lores is red; the bill is black: the legs and toes are red. Formerly, and perhaps rightly, considered a distinct species, the Rufous-nape is now usually classified as a race of the Gray-chested Dove, from which it differs in appearance far more than the Gray-chested Dove differs from the White-fronted Dove. The Rufous-nape inhabits a limited area on the Pacific side of the continent, extending from the Gulf of Nicoya in Costa Rica southward and eastward as far as Veraguas in Panama. In El General, where it is abundant, it nests as high as 3,000 feet above sea level.

This dove forages largely on the ground beneath the heavy rain forest, and often while sitting in a blind in the woodland, studying the nest of some other bird, I have watched one of these doves, or a pair of them, walk by with bobbing heads, pausing here and there to pick up some small particle of food. Here in the forest it is the only representative of its genus; but when it forages in riverside groves, second-growth thickets, or even in neighboring shady pastures and dooryards, it mingles with its paler-colored relative, the White-fronted Dove. One day, while I watched a nest of the Blue-diademed Motmot (*Momotus momota*) in a roadside bank, two Rufous-napes, evidently a pair, and a single immature White-fronted Dove foraged for a long while on the leaf-stewn roadway in front of my blind. The Rufous-napes, who stayed close together, pushed aside the fallen leaves and other litter with short, sideward jabs of their black bills. Among other things, they ate the small, black berries that had fallen from the various woody melastomes that overhung the road. When the Rufous-napes approached each other, one sometimes rapidly twitched the ends of both its folded wings, in a movement of slight amplitude. They foraged in silence. I noticed no antagonism between these doves and the immature White-fronted Dove, who often came close to them.

Rufous-napes used to enter the thatched shed with an open front, where for many years we stored our maize. They pick up corn which I throw far out for them while feeding the chickens, and after the departure of the latter they hunt over the lawn for grains which the domestic fowls have overlooked or disdained. Here the Rufous-napes often meet the White-fronted Doves, which have similar habits, and are often chased by the latter. But the White-fronts show no

more antagonism toward these smaller relatives than toward others of their own species, and I have never seen any conflict more serious than a mild pursuit.

Voice.—A frequent call of the Rufous-nape is a long-drawn *cooo-ooo*, similar to that of the White-fronted Dove, but weaker and less resonant, so that it sounds more sorrowful to one who listens to it imaginatively. One dove whom I watched foraging over the bare ground of a gully uttered a long-continued, mournful *woooo* which seemed to cost it much effort, for to produce this note it paused in its march and puffed itself up, particularly its breast. This same individual also voiced a short *coot*, much like the call of the Blue Ground-Dove. For this more effortless performance, the dove did not need to interrupt its walk.

Nesting.—In El General, breeding begins early, and one female laid her first egg on 19 February 1960. Although the Rufous-nape sometimes forages well within the forest, I have seen no nest so situated. Of my eight nests, two were at the woodland's edge, four in tall, dense second-growth thickets, and one in an open part of a low, impenetrable thicket. These nests were supported on slender branches, usually amid a dense tangle of vines, at heights ranging from 3 to 15 feet above the ground. The average height of the eight nests was 9 feet. A typical nest was a shallowly concave platform composed of fine sticks, straws, weed stems, tendrils, petioles, and the like. It measured 5 inches in diameter, excluding the projecting ends of the twigs. The longest stick in the nest was 14.5 inches long, and two were about 12 inches long, but most of the pieces were considerably shorter, ranging down to fragments less than an inch in length, which may have been broken from larger pieces. The nest contained 143 pieces of all sizes and weighed 30 grams. Twenty-five feet away, on the other side of a narrow pathway that traversed the thicket, was the above-described nest of the White-fronted Dove, that contained over 350 pieces and weighed 68 grams. The nests of *Leptotila cassinii* are usually much slighter than those of *L. verreauxi*; often the eggs can be seen through the bottom of the former, although this is usually impossible in the case of the latter. In the closely neighboring nests of the two congeneric species, incubation was in progress at the same time, indicating that there is little antagonism between these related birds.

The Rufous-nape's slight nest is constructed very rapidly. On 2 April 1939, I found a pair of doves just beginning to build on a horizontal, vine-draped branch at the forest's edge. The following morning I hid amid the surrounding foliage to watch them at work, but they saw me and refused to continue. When I arrived with my blind at daybreak on 4 April, I found a dove, probably the female, sitting on the nest site, where she remained while I set up the brown tent and took my place within it. In the dim light of dawn the male began his melancholy cooing in the neighboring forest and continued until about sunrise, while his mate replied with more subdued notes from the nest. At 0622 hours

he alighted on a branch a few feet from the nest bearing a fine twig, which he carelessly dropped, and then descended to the ground for another. At this point the female rose up for the first time since I began my watch, and I was surprised to glimpse an egg, for in the middle of the preceding morning the nest had been too rudimentary to support such an object. Ten minutes later, the male returned with a stick in his bill, and as he walked toward the nest his mate arose and flew away. He stepped into the nest, deposited his twig, and departed. After a further absence of 9 minutes, he brought a single dry petiole, placed it on the nest, then settled on the egg. While sitting he repeated the long, deep *cooo-ooo* from which I inferred his sex, and the answering calls of his partner floated out of the distance. Soon becoming silent, he sat continuously for the next 2 hours. I then left, but on a number of subsequent visits through the morning I always found the egg covered. On the following day at 1000 hours, two eggs were present.

On 19 February 1960 at 1010 hours, I found a nest with a single egg, which was covered by one of the parents at 1100 and again at 1630 on the same day. The second egg was laid between 0825 and 1235 on the following day. These eggs, whose slightly glossy shells were faintly buff, measured 27.3 by 20.9 and 26.0 by 21.5 mm.

In El General, 2,000 to 3,000 feet above sea level, eight sets of eggs were laid as follows: February, 2; March, 2; April, 1; July, 1; August, 1; September, 1. In the last of these nests, the eggs were still unhatched by the first day of October, which is often the rainiest month of the year. Although the number of records of nests of this species is small, their distribution by months is strikingly similar to that of the nests of the White-fronted Dove and the Blue Ground-Dove in the same locality.

At the nest where the second egg was laid on the morning of 20 February, the first egg was well pipped at 1600 hours on 4 March. When, an hour later, I returned expecting to see a newly hatched nestling, an empty nest greeted me. In the same interval, the eggs vanished from the nest of the White-fronted Dove 25 feet away. Probably both nests were pillaged by a snake. This frustrated attempt to learn the length of the Rufous-nape's incubation period suggested that it was about 14 days, as in the related White-fronted Dove.

Whether they cover eggs or young, Rufous-napes are admirably steadfast. At the beginning of incubation, birds are as a rule more easily sent from their nests than they are later as their eggs near the point of hatching; yet the dove whom I watched build continued to sit on the newly laid egg while I gently shook the supporting bush; and in order to see what he covered, I found it necessary to coax him to go by tapping on the branch. The following morning, when he was incubating two eggs, he returned to them 5 minutes after I ended my visit of inspection. One day while I was collecting plants, another Rufous-nape called my attention to its nest and eggs by suddenly flying away while I was in the midst

of plucking specimens from the shrub that helped to support the frail structure. A parent whom I disturbed while it brooded an unfeathered nestling amid a thicket fluttered down to a low branch, about a yard from the ground and on the side of me away from the nest. Here it slowly and deliberately beat its wings, with a rhythm too regular to suggest that it was injured but which served very well to attract the intruder's attention. When I approached closer, it flew off, skimming low above the ground until it vanished among the bushes.

RUDDY QUAIL-DOVE

Since the publication of my paper on the Ruddy Quail-Dove (*Geotrygon montana*) in 1949, I have discovered 14 additional nests, all on our farm, bringing the total number that have been found in El General up to 21. These new nests were, like those previously described, all in the primary forest or adjacent stands of tall second-growth woods with a closed canopy. They tended to be lower than the earlier nests, although one was higher. The range in height of all the nests was from 18 inches to 9 feet. Four nests were below 2 feet and five above 4 feet; all the remainder were between 2 and 4 feet. The highest nest was built upon an aroid that grew attached to the side of an erect trunk. The lowest nest was on a maze of slender branches of low bushes; it was composed of large dead leaves that formed a broad and shallow platform, with one small green leaf and one dying leaf in its center. Another nest was in the midst of a cluster of fronds of a thick-leaved polypody fern (*Polypodium crassifolium*) growing on a rock. Situated about 3 feet above the ground, it was a concave platform, loosely constructed of large dead leaves, petioles, and sticks, all of which might have fallen into the fern plant from the trees above it. All the 21 nests held two eggs or nestlings. The eggs, unlike those of most pigeons, are pale or even deep buff in color.

In 21 nests in the valley of El General, 2,000 to 2,500 feet above sea level, eggs were laid as follows: March, 2; April, 4; May, 8; June, 3; July, 3; August, 1. My earliest date for eggs is 11 March, when a completed set was found. It is of interest that most eggs were found in May, which is the month when no eggs of *Claravis* and the two species of *Leptotila* were noticed in the same neighborhood. The difference in time of nesting is probably correlated with differences in diet. The quail-dove hunts over the ground, always within the woodland, and probably depends largely on small invertebrates for its food; the other three species forage on the ground, to a large extent outside the heavier woodland, and evidently eat many seeds, which in weedy areas are most abundant late in the dry season.

The quail-dove's incubation period of 11 days and a few hours is unusually short for a pigeon. From three nests the young left when only 10 days old, at which age they could both fly and walk in a competent manner.

BUFF-FRONTED QUAIL-DOVE

The Buff-fronted Quail-Dove (*Geotrygon costaricensis*) is a beautiful bird, clad in rich maroon and bluish or greenish gray, with a buffy forehead and white cheeks bordered below with a black line. This dove is found in the mountains of Costa Rica and western Panama, from 3,000 or 4,000 to 10,000 feet above sea level (Ridgway, 1916:489). Near Los Cartagos in the province of Heredia, Costa Rica, I occasionally glimpsed it, walking over the ground in shady places or flying rapidly by, but it was rare, shy, and difficult to observe. Here, on 22 June 1963, I found a nest amid the bamboo undergrowth of heavy oak forest, near its edge, at an altitude of 7,500 feet. The nest was 13 feet up on a slender, mossy, horizontal branch of a tall shrub, where it was supported by lateral twigs and a small bromeliad. The nearly flat platform, measuring 10 by 7 inches in diameter, was composed of coarse twigs, a few rootlets, and much green moss and liverworts. In no other pigeon's nest have I seen moss or liverworts; yet it was not surprising to find that the dove had incorporated them in its structure here in the cloud forest, where these bryophytes grew profusely on the trees and shrubs and many birds used them in their nests. When I first saw this dove's nest, it contained a single nestling in pinfeathers, which reared up threateningly with upstretched neck when I raised a mirror to see what the nest held. Ten days later, many feathers scattered over the mossy platform were evidence that the young dove had been attacked by some predator. The nest was heavily soiled with droppings, from which I concluded that Buff-fronted Quail-Doves are less careful of sanitation than their lowland relatives, the Ruddy Quail-Doves.

MOURNING DOVE

According to Eisenmann (1955:36) the Mourning Dove (*Zenaidura macroura*) breeds locally in Central America in British Honduras, Honduras, and western Panama. Long ago, Osbert Salvin believed that this dove was resident in Guatemala (Griscom, 1932:112), and George Cherrie thought that it was probably resident at San José, Costa Rica. Commenting on this view, Carriker (1910:397) expressed the opinion that the few individuals of this species found in Costa Rica in the summer months had failed to migrate northward in consequence of injury, sickness, or some sexual derangement, as not infrequently occurs in shorebirds.

As far as I know, no proof of the Mourning Dove's breeding in Costa Rica has ever been published. In mid-August of 1938, I found these doves not uncommon on the Las Cóncevas coffee estate, near Cartago at an altitude of 4,500 feet. Here they frequented the willow trees surrounding a large, weed-choked pond. Most of the doves that I then saw were in pairs, and their mournful cooing was frequently heard. Although these birds were certainly behaving like breed-

ing adults rather than sickly or underdeveloped individuals, I looked in vain for a nest at this late date. However, the proprietor of the estate, Mr. C. H. Lankester, a naturalist well acquainted with the Costa Rican avifauna, told me that he had found Mourning Doves breeding there, although he had no written records. On 10 July 1963, Mr. Lankester brought me a dove, apparently adult, which had just been badly injured by a collision with an electric wire near San José.

Here in El General, Mourning Doves are rarely seen, but I have records of their presence from 26 February to 13 March 1939 and on 2 November 1943.

Near Quezaltenango, in the western highlands of Guatemala, I heard Mourning Doves cooing throughout the day of 24 July 1934. Some of the doves in a small flock that I then saw had short tails and were apparently not fully grown. Between 7,000 and 10,000 feet on the Sierra de Tecpam in the same country, where the Mourning Dove seemed to be only a migrant, it was last seen on 10 April 1933 and it returned on 19 November of the same year.

SUMMARY AND CONCLUSIONS

This paper presents observations on the nesting and other habits of 15 species of Central American pigeons. For two of these species, the Blue Ground-Dove and the Ruddy Quail-Dove, the information given here is supplementary to that contained in earlier papers. For another species whose life history has already been published, the Ruddy Ground-Dove, no more recent data are available. From all of the writer's observations on Central American pigeons, the following conclusions may be drawn:

Most Central American pigeons forage largely or wholly on the ground. These include species of *Zenaida*, *Scardafella*, *Columbigallina*, *Claravis*, *Leptotila*, and *Geotrygon*. As far as known, only several species of *Columba*, including the Scaled Pigeon, Short-billed Pigeon, and Band-tailed Pigeon, forage chiefly or wholly in trees and shrubs.

Most Central American pigeons live alone or in pairs. Concentrations of the ground feeders may occur in areas with abundant food, but coordinated flock movements are rarely seen. True flocking is found in the Band-tailed Pigeon, the most gregarious member of the family in Central America, and the species most in need of enforced legal protection.

Pigeons have longer breeding seasons than most other birds of the same region. In the valley of El General in Costa Rica, where these observations were chiefly made, most of the pigeons begin to nest early in the year, at the height of the dry season, when relatively few other birds are breeding. In several species, including the Ruddy Ground-Dove, Blue Ground-Dove, White-fronted Dove, and Rufous-naped Gray-chested Dove, egg laying begins in February (or rarely earlier) and is at its height in March and April. In May and June, when most other birds are nesting freely, few or no eggs of these pigeons are found. Laying is resumed in July and continues, on a reduced scale, into September. In the forest-dwelling Ruddy Quail-Dove, however, the peak of breeding comes in April, May, and June, as in most small birds of the region. The early nesting of most of the pigeons is probably associated with the abundance of seeds in bushy and weedy areas in the dry season.

Ground nesting was observed only in the Common Ground-Dove and the Plain-breasted Ground-Dove. The Scaled Pigeon, which lives high up in the forest, often builds its nest low in a neighboring second-growth thicket.

In nest building, one member of the pair stays on the nest to arrange the materials which the other collects and lays beside it. Whenever the sexes could be distinguished, the active

partner was the male and the stationary one the female. In the Scaled, Short-hilled, and Red-billed Pigeons, twigs or pieces of inflorescences are broken from trees, often with great effort; in the Ruddy Ground-Dove, Blue Ground-Dove, and White-fronted Dove, materials are gathered from the ground. Usually, perhaps always, a single piece is brought to the nest at a time, but this piece may be branched. Before being carried off, each piece is tested, often by shaking, and dropped if it proves unsatisfactory. Occasionally a female brings materials to the nest while her mate incubates the eggs, as has been seen in the Blue Ground-Dove and Ruddy Ground-Dove. Unlike the frail, shallow platforms built by most pigeons, the nests of the White-fronted Dove are often thick and substantial.

In nests of *Zenaida*, *Scardafella*, *Columbigallina*, *Claravis*, *Leptotila*, and *Geotrygon*, two eggs were nearly always found. As far as known, single eggs are consistently laid by Central American species of *Columba*, including some which in other regions produce sets of two.

The parents spend much time on the nest even before the first egg is laid, and this egg is (except in the Ruddy Quail-Dove) covered much in the interval before the laying of the second. After the routine of incubation is established, it follows, in all observed cases, the well-known pigeon pattern of two changeovers each day, with the male sitting, usually continuously, through the middle of the day. The chief variations noticed were in the times of the changeovers and the length of the male's diurnal sessions, which in the several species studied varied from about 4 to 9 hours.

The following incubation periods were determined: Ruddy Quail-Dove, 11 days; Ruddy Ground-Dove, 12-13 days; Blue Ground-Dove, 14-15 days; White-fronted Dove, 14 days.

Pigeons differ from most altricial birds in that the number of times the young are fed may greatly exceed the number of parental visits to the nest—a consequence of the parents' ability to secrete food ("pigeon's milk"), which they at intervals regurgitate to the nestlings during their first few days. As the nestlings grow older, the meals become fewer but each lasts longer and is apparently more copious. Day-old nestlings were fed 28 times in a day in the Blue Ground-Dove and 22 times in the Ruddy Quail-Dove. Older nestlings were fed eight times per day in the Blue Ground-Dove, three times in the Ruddy Quail-Dove, two or three times in the Gray-chested Dove. Sightless newly hatched nestlings are usually fed singly; but after they can see, the two young place their bills in the parent's mouth from opposite sides and are fed simultaneously.

White-fronted Doves spend much time brooding feathered nestlings ready to leave the nest, and sometimes Ruddy Ground-Doves do the same. Blue Ground-Doves and Ruddy Quail-Doves leave their nestlings exposed much of the time, even before they are feathered.

The attention given to nest sanitation varies greatly in the family. White-fronted Doves and Ruddy Quail-Doves keep their nests clean at all times. Scaled Pigeons and Red-billed Pigeons clean the nest for some days after the young hatch but later neglect to do so. Ruddy Ground-Doves and Blue Ground-Doves give little attention to sanitation, and their nests soon become foul. Those pigeons which clean their nests eat the nestlings' droppings, sometimes just before feeding the young. This raises the question of whether the nestlings' excreta are fed back to them.

While sitting on the nest, pigeons carefully weigh the threat presented by an approaching object, and leave only if it appears dangerous and likely to discover the nest. Then the parent may give a distraction display. Such performances were observed in the Ruddy Ground-Dove, Rufous-naped Gray-chested Dove, Ruddy Quail-Dove, White-fronted Dove, and Red-billed Pigeon. In the last two species, the displays were especially vigorous and prolonged. When disturbed, nestling Scaled Pigeons and Red-billed Pigeons give an elaborate intimidation display, in which bill clacking is a prominent feature.

The following nestling periods were determined: Ruddy Quail-Dove, 10 days; Ruddy

Ground-Dove, 12-14 days; Blue Ground-Dove, 13 or 14 days; White-fronted Dove, 15-16 days. If undisturbed, the young stay in the nest until they can fly well.

In El General, at least two broods are reared, sometimes in the same nest, by the Ruddy Quail-Dove and the Ruddy Ground-Dove, and doubtless by other species.

Evidence of the breeding of the Mourning Dove in Costa Rica is given.

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EL QUIZARRÁ, SAN ISIDRO DEL GENERAL, COSTA RICA, 16 SEPTEMBER 1963

NESTING OF THE BLACK-TAILED FLYCATCHER ON BARRO COLORADO ISLAND

ALFRED O. GROSS

THE following account of the Black-tailed Flycatcher is based on notes and photographs taken on Barro Colorado Island, Canal Zone, Panama during visits in 1925, 1927, and 1949.

There are two species of *Myiobius* present on Barro Colorado: the Sulphur-rumped Flycatcher (*M. barbatus*) (the local race, *M. b. sulphureipygius*, has sometimes been considered a separate species, *M. sulphureipygius*) and the Black-tailed Flycatcher *M. atricaudus*. The range of the Sulphur-rumped Flycatcher extends from Veracruz and Yucatan south to western Ecuador. It is the most abundant of the two species in Costa Rica and neighboring countries as well as in certain sections of Panama. The range of the Black-tailed Flycatcher extends from Honduras south to Ecuador and Peru. Both species have been collected and are known to nest on Barro Colorado but, according to my experience, the Black-tailed Flycatcher is the more abundant and is the species that I found nesting during the months of June to September.

On 13 July 1949 I was fortunate to see a Black-tailed Flycatcher, at the entrance to the Barbour-Lathrop trail, carrying a single long fiber in its beak en route to its nesting site. There were only a few fibers present in what was the beginning of nest construction. These fibers were tightly wrapped around a slender stem that hung down over the water of a roaring brook. I watched the bird for an hour and during that time it made 35 trips with nesting material, usually a single long fiber. At 9:06 the bird was seen to drop a fiber on the nest without alighting. It flew to a limb of a tree about 2 meters away. Pausing a few seconds, she returned to the nesting site, grasped one end of the long fiber in her beak, and while holding on to the supporting stem with her claws, flitted her wings rapidly, propelling herself for three complete turns. In this manner the fiber was securely twisted around the stem. At 9:10 she flew to a nearby banana stalk where, with considerable effort, she pulled a fiber loose. She then came directly to the nest, circled in flight, spreading her tail and displaying the bright yellow rump patch. It was a unique and a beautiful performance. In some of the trips she alighted on a dead limb near the nest before adding the fiber to the now enlarged, well-anchored mass of nesting materials. The flycatcher exhibited a great deal of energy and activity in her nest building. The procedure of adding fibers was repeated at 9:12, 9:14, 9:17, 9:18, 9:20, 9:21, 9:21½, 9:24, 9:25, 9:27, 9:28, and 9:30. By this time the nesting material was 7 cm in depth. Only one bird was seen and it was assumed that all of the work of nest building was performed by the industrious female.

The next morning, 14 July, it rained very hard but in spite of the downpour the

bird continued to add nesting material, but not as often as on the previous day. Several times I saw her alight on a dead branch of a tree where she rested for a few minutes or preened her feathers to facilitate the drying of her plumage. Great progress was made, however, and by noon the structure took on the appearance of a nest, but as yet there was no nesting cavity formed. It cleared in the afternoon so that motion pictures could be taken to illustrate the method of the construction of the nest. During late afternoon I saw two birds for the first time. One individual, which apparently was the male, kept well away from the nest. He was not seen to take any part in nest building although the female was seen to go to the nest again and again with nesting material. Several times when the female alighted on a branch above the brook the male approached her in a nuptial display. The breast feathers are a dusky olive as seen under ordinary conditions, but when courting these feathers were elevated revealing a distinct yellowish coloration of the mid-basal portion of these feathers. During this performance his long tail was spread wide like a fan and the yellow rump patch was shown at its best. Finally the display culminated in copulation.

The next day, 15 July, the nest had taken the form of an empty cone of well-packed fibers but much was still to be done to the interior of the structure. In the course of an hour the female made 45 visits to the nest. Most of the fibers used were collected from sources within 25 to 30 meters of the nest. The exterior of the nest was approaching completion and hence the construction was now concentrated on the interior. She approached the nest from below flying directly upward to the inside of the cone. She usually remained inside just long enough to deposit the fibers. The bird could not be seen when inside but it was evident the materials were being utilized in thickening the walls and the building of a shelf-like mass on one side to form the nesting bowl.

On 16 July the building of the nest had progressed so that it measured 40 cm from the uppermost fibers twisted tightly about the supporting stem to the bottom of the funnel. The sides were now thicker and the interior cavity of the cone now measured 12 cm in depth. The most conspicuous feature of the exterior of the nest was the addition of ten dried leaves which apparently served to camouflage the structure.

On 17 July the nest measured 48 cm from top to bottom of the cone. The distance of the nest above the water of the brook was 1.5 meters. The male was seen several times during the morning and displayed in the presence of the female, usually when she alighted on a limb in going to or from the nest. The female did not seem impressed and was quite nonchalant concerning her mate's attentions, as she preened her feathers or merely rested a moment from her labors. A great mass of material had been added inside of the funnel and on the northern side fully one-half the width of the interior was taken up by a solidly packed shelf, the beginning of the nesting bowl. During 2 hours she made 35 visits to the



FIG. 1. Typical nest of the Black-tailed Flycatcher *Myiobius atricaudus* 13 August 1925.

nest with nesting material that was deposited chiefly inside of the cone. On several of these visits she carried a mass of spider cocoons. The spider webbing served well in holding and cementing the nesting materials in place.

On 19 July after 6 days of construction the nest was nearing completion. The female was seen flying about the trees near the nest and frequently capturing flying insects in flycatcher style. She did not go to the nest during 2 hours that I watched her. I visited the nest after dark and I was surprised to find the flycatcher in the newly constructed nest. Her long tail projected from the bowl opening and her head was turned backward and tucked under the feathers. She was not disturbed by the flashlight held within a few inches of the nest. There was no egg present when I examined the nest the next morning. The female was seen perched on a dead branch about 4 meters from the nest, at times darting into the air to capture an insect. At 10:26 the male arrived, chased the female, and both disappeared into the jungle. Twenty minutes later the female returned alone but was not seen to visit the nest.

No birds were seen in the vicinity of the nest during the day from 21 to 23 July, but the female continued to roost in the nest at night. Unfortunately, I had to leave the island on 24 July before any eggs were laid.

The following observations of the behavior of the birds and the account of their eggs and young were made jointly with the late Dr. Josselyn Van Tyne during June and July 1925. We located eight nests of the Black-tailed Flycatcher, three of which were closely observed. No nests in early stages of construction were found in 1925. All of the nests were similar in their general location, appearance, and structure, being pendant nests ingenuously attached to long slender stems or vines which overhung the water of Gatun Lake or over nearby brooks. We spent much time exploring the many trails but found no nests of the Black-tailed Flycatcher in the higher densely wooded portions of the island remote from water. The nests ranged in height from 40 cm to one 3 meters above the water. One nest that overhung the water of the lake was discovered while paddling along the shore in a cayuca. This nest was so well camouflaged that at first sight it appeared to be merely a mass of material that had accidentally lodged on the stem.

A nest of the Black-tailed Flycatcher containing two eggs was collected on 13 August 1925 (Figs. 1 and 2). The nest overhung the lake about 0.5 meter above the water. The length of the nest from the point of attachment to the bottom was 51 cm. The circumference at the level of the nesting bowl was 30.5 cm. The size of the opening leading from the porch cavity to the nesting bowl was 3.8×4.5 cm. The nesting bowl was lined with short fine rootlets and slender palm fibers, pale brown in coloration. The exterior of the nest, including the porch, was made up chiefly of long coarse fibers, plant stems, and leaves of various kinds. Several of the longer fibers when untwisted and detached were



FIG. 2. Nest and two eggs of the Black-tailed Flycatcher *Myiobius atricaudus*. One side of the nest has been cut away to show the interior structure such as the "porch," nesting bowl containing the two eggs, and entrance to the bowl, 13 August 1925.

TABLE I
WEIGHTS (IN GRAMS) AND MEASUREMENTS (IN MILLIMETERS) OF EGGS

Date	Weight	Long diameter	Short diameter
28 June 1925	1.58	18.3	12.9
	1.59	18.7	13.1
10 July 1925	1.30	17.0	12.8
	1.35	17.1	12.6
22 July 1925	1.11	17.2	12.5
	1.08	17.3	12.2

as much as 50 cm in length. All of the nests we examined were of similar structure and dimensions. When on the nest the bird was well concealed from view of predators by the overhanging porch. Being attached to long slender vines or stems the nests were free from molestation by peccaries, coatis, and other mammals; even the prowling mischievous monkeys would not dare to descend such a weak slender support so near the water. It is possible the agile lizards might account for some of the few eggs and young that disappeared, but of this we had no evidence. On the whole, as compared to the nests of certain other birds, the *Myiobius* type of nest is excellent and doubtless contributes to the survival of the species.

On 28 June 1925 we discovered a nest of the Black-tailed Flycatcher overhanging the water a short distance from the Barro Colorado station wharf. The nest contained two eggs. When we approached in a cayuca, the bird remained on the nest until we were directly under the structure. The bird was hidden from view except for her long tail which projected from the nesting cavity to the space covered over by the porch. The bird remained in the vicinity while we removed the eggs for description, weights, and measurements (see Table I). She returned to the nest promptly after the eggs were replaced. The next day to facilitate our making observations and photographs we erected a blind between the nest and the shore. Another was constructed on a floating balsa log raft which could be maneuvered in any position in relation to the nest. In the afternoon we spent 2 hours in the raft blind. The bird left the nest several times. In flight she produced a buzzing sound made by the extremely rapid strokes of her wings, but we did not hear the bird utter any notes or other sounds. In approaching the nest she flew down within a few inches of the water, then dashed upward into the nest from below. She went to the nest at 4:45 and remained there for the night. The bird was not seen during the next 2 days. On 2 July there were no eggs. No eggshells were found and there was no clue to explain the absence of the eggs. Although we thought the nest was now deserted, fortunately, we left the nest and blinds intact. On 12 July we saw the flycatcher fly to the nest and found that one egg had been laid 6 days after the first set was known to have disappeared.

There was one egg on 13 July and 14 July. On the morning of 15 July there were two eggs and the female was incubating them. The following observations of the behavior of the adult as well as the description and daily measurements of the young were made at this conveniently located nest.

During the 22 days of incubation various birds such as grosbeaks, puffbirds, manakins, and a little kingfisher were seen in the vicinity of the nest. The flycatcher paid no attention to them and made no effort to drive them away from her territory. At one time a hummingbird was seen sipping nectar from some blossoms within 2 meters of the nest. Without provocation the tiny visitor dashed toward the flycatcher and chased her into the vegetation out of our sight. After a short interval the two birds appeared in the open with the aggressive hummingbird still chasing the flycatcher.

After the eggs hatched the flycatcher was not so indulgent of intruders and exhibited a high degree of territorialism. She was seen to chase wrens away on three different occasions and other birds were similarly treated. During the morning of 4 August we saw two Black-tailed Flycatchers in the vicinity of the nest. The female objected to the presence of the newcomer and violently chased it away. After about 5 minutes the female returned alone and the visitor was never seen again during the remaining days the nest was under observation.

For the purpose of photography I changed the position of the nest so that a side view could be obtained of the bird entering or leaving the nest. This was done by merely turning the long supporting stem about 90 degrees and tying it into position. This slight change confused the bird much more than was anticipated. She attempted to enter the nest on the side to which she was accustomed, fluttered her wings in midair for a few seconds, and then flew away. She returned in 2 minutes and made three darts toward the nest in the same position as her first trial. Finally, after repeated attempts, she discovered the changed position of the entrance. It is evident that the bird relied on her sense of position rather than by sight in locating the entrance.

The following abbreviated notes are taken from observations made by Dr. Van Tyne and myself when the young were 15 days old. The female was very active throughout the day, capturing insects to satisfy the hungry young. She entered the nest from below as previously described, but when once inside the cone she was hidden from our view and hence we could not see the manner of feeding and her behavior in relation to the young. She usually remained at the nest for only a few seconds, just long enough to deliver the food. She then returned to her regular perch to continue capturing insects but at times preened her plumage or just rested a few minutes from her strenuous task. After many of the feedings she was seen to carry a white fecal sac in her beak. This was sometimes eaten but more often dropped into the water where it was quickly devoured by minnows. At no time during our all-day watch did she remain at the nest to

brood the young, but after sunset she entered the nest and remained for the night. The male was not seen and it was evident that he did not share the task of feeding the young and of defending the territory. The young left the nest when 18 days old.

THE EGGS

The coloration of the eggs of the Black-tailed Flycatcher was determined by Ridgway's Color Standards (Ridgway, 1912). One set had a ground coloration of Seashell Pink with a wreath of Vinaceous-Rufous spots near the larger end. In a second set, slightly different in coloration, the ground color was of Flesh Ocher and the wreath of Ferruginous spots.

The weights and measurements of three sets of eggs are given in Table 1.

INCUBATION

The incubation period of the eggs of the Black-tailed Flycatcher was found to be 21 or 22 days, calculated from the laying of the first egg.

Nest 1		Nest 2	
6 July 1925	1 egg	10 July 1925	no eggs
7 July	2 eggs	11-31 July	1 egg
27 July	2 eggs	1 August	1 young
28 July	2 young		
Incubation: 22 days		Incubation: 21 days	

PLUMAGES OF THE YOUNG

The young have no natal down. The eyes are closed for the first 4 days, slightly open on the 5th day, and well open on the 6th day. The skin color is Vinaceous Slate, the underparts lighter in coloration. The maxilla and mandibles Naphthalene yellow in color.

In young 6 days old the papillae of the primaries and secondaries are best seen. The papillae of middle tail feathers are 0.90 mm in length. Those of the ventrolateral tracts and of the rump patch show a distinct yellow through the sheaths.

In young 11 to 12 days of age the unsheathing of the primaries and secondaries is well advanced. The tips of the wing coverts, now unsheathed, are Olive-green. The feathers of the lower back and rump are Barium Yellow. The tail feathers are unsheathed for 1 to 2 mm; those of the crown tract are just beginning to unsheath and those of the nape have proceeded further. The breast feathers are yellow shading to Citrine Drab.

In a young 16 days old the unsheathing of the feathers has progressed to the extent of giving a smooth contour except for the region of the tail and crown, back Deep Olive; crown darker and duller; occiput, rump, and belly yellow; wing coverts and secondaries edged with Deep Olive; primaries and tail feathers dull black; legs and feet Blackish Plumbeous.

Weights and measurements of the young are given in Table 2.

TABLE 2
WEIGHTS AND MEASUREMENTS OF YOUNG

Age (days)	1	2	4	6	8	9	12	15	16	18
Weight (grams)	1.6	2.20	3.5	6.1	6.7	7.5	9.0	10.2	10.0	10.0
Length (mm)	30.1	34	36	50	55	62	74	87	88	94
Tail	—	—	2.0	2.8	3.8	5.2	9.8	16	18.6	24
Middle tail feather	—	—	0.01	0.09	1.9	3.4	6.7	12.5	14.5	19.0
Bill	4.1	4.9	5.0	5.8	6.1	6.8	8.5	8.6	8.6	8.6
Bill-eye	5.5	6.0	7.1	8.2	9.6	9.1	10.2	11.5	11.9	12.0
Bill-nostril	2.4	2.4	2.5	2.9	3.2	3.6	4.1	4.9	4.9	5.0
Manus	7.1	8.0	9.9	12.1	12.9	13.8	16.5	19.0	19.0	19.0
Wing	—	—	10.0	13.5	18.0	21.0	32.0	38.2	40.1	43.8
Extent	28.2	34.0	46.0	68.0	85.0	99.5	129.0	153.0	159.0	161.0
Tarsus	12.3	14.2	17.9	20.1	25.0	27.0	30.5	32.0	32.8	32.8
Foot	9.0	10.6	12.2	15.9	19.5	20.8	23.0	23.5	23.5	23.5
First toe	4.1	4.5	5.5	7.2	8.5	9.2	10.6	10.6	10.7	10.9
Third toe	5.2	5.8	8.5	8.8	10.1	11.2	11.3	13.3	13.4	13.4

The weight in grams and measurements in millimeters of an adult female *Myiobius atricaudus* collected 13 August 1925 are as follows: weight 9.1 grams, length 136, tail 58, bill 9, bill-eye 15, bill-nostril 7, wing 56, extent 172, tarsus 32, foot 24.

(The measurements bill-eye is from the anterior edge of the eye to the tip of the bill, the bill-nostril is the distance from the anterior edge of the nostril opening to the end of the bill. The others are the usual standard measurements.)

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A REVIEW OF SHARP-SHINNED HAWK MIGRATION ALONG THE NORTHEASTERN COAST OF THE UNITED STATES

BERTRAM G. MURRAY, JR.

LARGE numbers of Sharp-shinned Hawks (*Accipiter striatus*) on their autumn migration have been reported from several areas along the northeastern coast of the United States: Fishers Island, New York; New Haven, Connecticut; Cape May, New Jersey; Hooper Island, Maryland; and Cape Charles, Virginia.

Trowbridge (1895, 1902), Stone (1922), and Allen and Peterson (1936) hypothesized on the basis of their observations that: (1) Sharp-shinned Hawks normally migrate inland; (2) northwesterly winds drift ("lateral displacement" of Lack and Williamson, 1959) the hawks to the coast; and (3) once at the coast they continue along the coast. Later, while apparently supporting the wind drift hypothesis, Stone (1937) stated that hawks normally migrated along the coast. Rusling (1937) hypothesized that the northwesterly winds augmented the numbers normally migrating along the coast by drifting inland birds to the coast.

These papers are widely accepted as presenting evidence for the drift of diurnal migrants many miles off course by winds. I propose to show that the reported observations do not support this hypothesis, and I will present an alternative hypothesis that explains all of the observations.

REVIEW OF THE OBSERVATIONS

Fishers Island, New York.—The largest hawk counts [ca. 1,000–3,000 of all species on a very large flight (Ferguson, H. L., Jr., in litt.)] occurred on days of northwesterly winds (Ferguson and Ferguson, 1922), and were smaller than those farther to the west. The direction of movement was "invariably" southwest toward Long Island. The flights usually commenced early in the morning.

New Haven, Connecticut.—Trowbridge (1895, 1902) reported large numbers on days of northwesterly or northerly winds, and only stragglers on other days. A conservative estimate was 15,000 hawks in a day, of which "the sharp-shinned hawks outnumber the other species several times over" (Trowbridge, 1902: 738). The hawks flew westward along the shore of Long Island Sound.

Cape May, New Jersey.—The observations of hawk migration along the coast have been most frequent at Cape May, and they have been reported by Stone (1922, 1937) and Allen and Peterson (1936). Sharp-shinned Hawks were noted daily throughout the autumn, but the greatest numbers occurred on days of northwesterly winds. The migration commenced early in the morning, and if it

continued throughout the day the peak occurred during the morning. The striking observation was that on days of winds between northeast and northwest the birds flew low and northward along the Delaware Bay shore. However, on other days the hawks flew higher and across the bay toward Delaware.

Hooper Island, Maryland.—Hawks occurred in numbers on days of northwesterly winds, when they were seen flying northward (Rusling, 1937).

Cape Charles, Virginia.—During 1936 the largest counts of migrating Sharp-shinned Hawks along the northeastern coast were made at Cape Charles (Rusling, 1937). Hawks occurred daily, but the largest counts occurred on days of northeasterly winds. Contrary to the observations in other areas, few hawks were observed on days of northwesterly winds. On days of northerly or northeasterly winds the hawks flew northward, while on days of southerly winds the hawks regularly crossed Chesapeake Bay.

As I read the cited literature, several questions came to mind:

(1) Why is the number of Sharp-shinned Hawks relatively smaller at Fishers Island, and why are concentrations unreported along the coasts of Rhode Island and Massachusetts, when these areas are so much closer to the "normal inland route" than any of the other areas of concentration? Migration is intensively studied in this area (Bagg and Emery, 1960, 1961; Baird and Nisbet, 1959, 1960; Dennis and Whittles, 1955, 1956).

(2) On the other hand, why are numbers so great at Cape Charles, when this area is farthest from the "normal inland route"? All these hawks must pass through the narrow neck at the northern end of the peninsula (Rusling, 1937). This passage is unreported.

(3) Why are the largest numbers recorded at Cape Charles on days of northeasterly winds, and smallest on days of northwesterly winds?

(4) Why do the Sharp-shinned Hawks appear early in the morning along the coast with the peak before noon? If the origin of the hawks is 100–150 miles inland, and if the hawks are laterally drifted by the wind (oriented downwind drift is unreported for diurnal migrants over land when conditions are favorable for navigation and orientation), why is there not a time lag, with the hawks appearing several hours after sunrise?

(5) Why are the hawks not reported anywhere along the Atlantic coasts of New Jersey and the Delmarva peninsula except at the tips of the peninsulas? At New Haven hawks arriving from inland and striking the coast obliquely on days of northwesterly or northerly winds were seen flying along the coast in large numbers. However, no hawks were seen inland (Trowbridge, 1895). This indicates that the hawks arriving at the coast dropped to an altitude that made them more easily seen.

If hawks are arriving at the New Jersey coast from inland and striking the Atlantic coast obliquely, as shown on the map of Allen and Peterson (1936), is

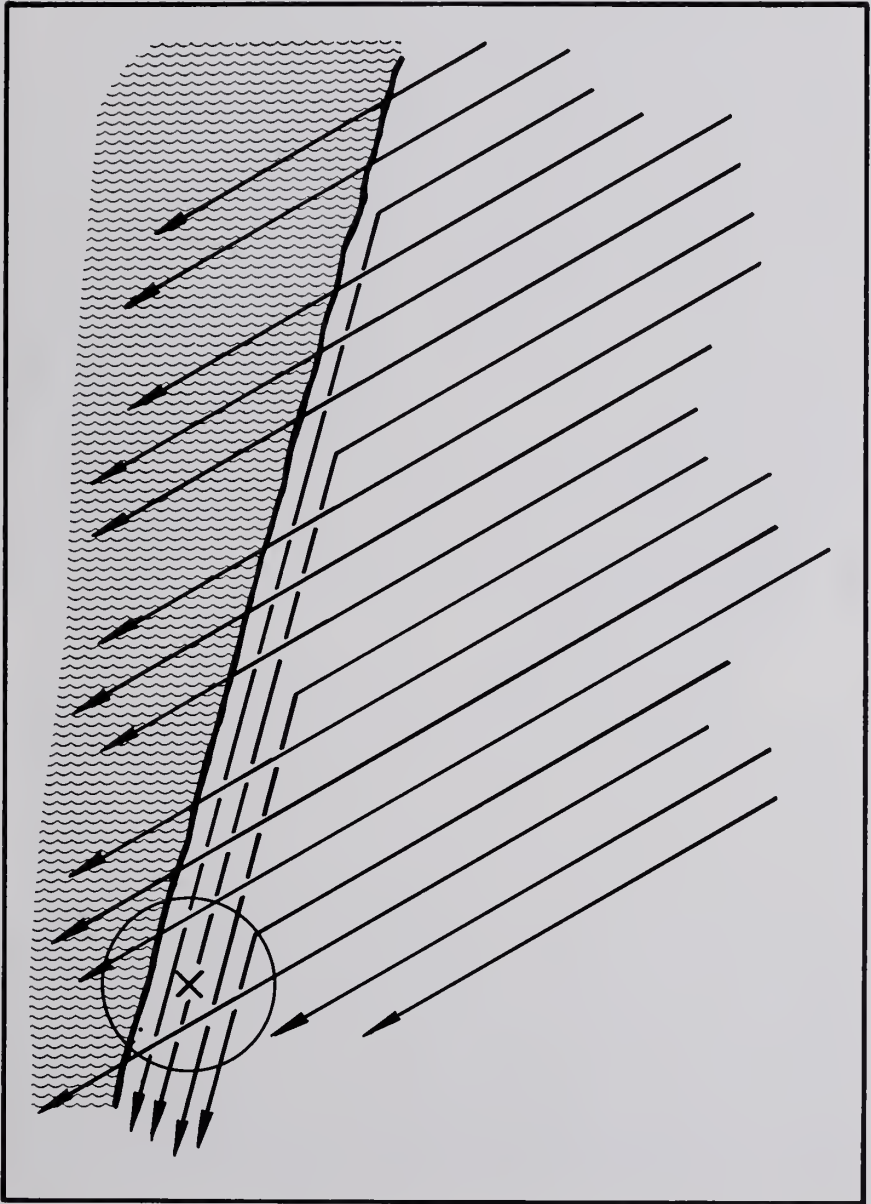


FIG. 1. Hypothetical example of the diversion-line phenomenon (after van Dobben, 1953). See text for explanation.

it not to be expected that the hawks should drop to a lower altitude (as they do at the Delaware Bay shore) and, thus, be seen flying along the coast?

(6) The only evidence presented in support of the wind drift hypothesis and of the inland migration route is the fluctuation in the *daily counts along the coast*, the largest numbers usually, but not always,¹ occurring on days of northwesterly winds. Recent visual and radar observations in Europe (reviewed by van Dobben, 1953, and Lack, 1959*a, b*) indicate that what the observer records from the ground may not be an index to the migratory movement, either quantitatively or qualitatively. That is, observed day-to-day fluctuations in numbers do not necessarily reflect the true fluctuations of the migration over the observation point, and the observed directions do not necessarily indicate the true direction of the bulk of the unobserved migrants. This lack of correlation between visually observed migration and true migration is a result of factors that bring the migrants into the observer's view, rather than those factors that stimulate the migration. Before we can understand the latter, we must be thoroughly familiar with the former (Swinebroad, 1960).

Individually these arguments against the wind drift hypothesis may not be insurmountable, but taken together they indicate that until further evidence is forthcoming the hypothesis of an inland migration route and drift by northwesterly winds of diurnal migrants is, at best, unproved.

THE DIVERSION-LINE PHENOMENON

When a broad-front, or even a narrow-front, migratory movement crosses a topographic feature or a border between two distinct habitats, a *portion* of the migrants changes course and flies along the topographic feature or habitat border (Fig. 1). This topographic feature or habitat border is called a guiding-line (van Dobben, 1953) or a diversion-line (Lack and Williamson, 1959). I agree with Thompson's (1960) statement that migrating birds on occasion fly along these topographic features, and that this is a "fact of observation—all else is theory." Thus, in theory, many factors may be involved in stimulating this behavior, the function of which is unknown. Some possible factors are: weather, wind direction, wind speed, topography, length of the water crossing, time of day, species of bird, altitude of bird, speed of the bird, age of the bird, previous experience of the bird, and length of time the bird has been flying. Few of these factors have been studied, but there seems to be a relationship between wind direction and the numbers of migrants counted flying along a diversion-line.

¹ At Cape May between 16 September and 15 November 1935, the highest count was 1,057 on 15 October with a northwest wind, and the third high count was 591 on 1 October with a south wind (Allen and Peterson, 1936).

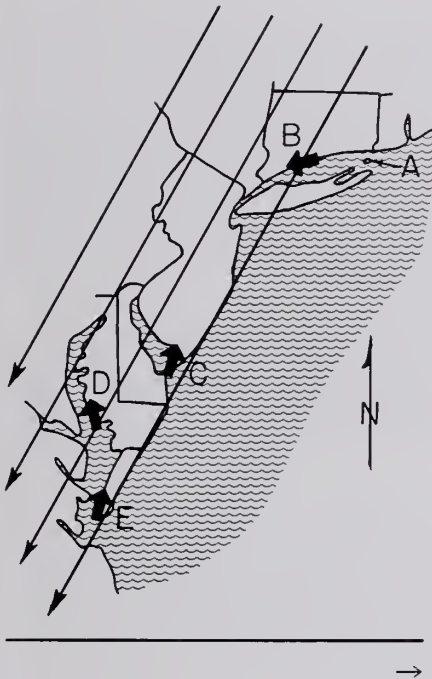
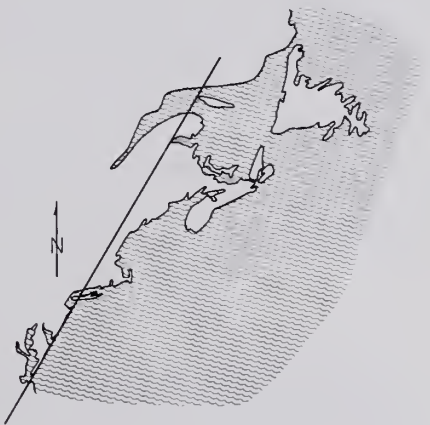


FIG. 3. The northeast-southwest line along the coast indicates the limit of the eastern flank of the bulk of the Sharp-shinned Hawk migration.



FIG. 2. Areas of reported diversion of Sharp-shinned Hawks along the coast of the northeastern United States, indicated by short thick arrows: New Haven, Connecticut (B); Cape May, New Jersey (C); Hooper Island, Maryland (D); and Cape Charles, Virginia (E). At Fishers Island (A) the hawks "invariably" continue southwestward toward Long Island. The long arrows, pointing southwest, indicate the general direction of the broad-front movement.



HYPOTHESIS

The published evidence supports the view that Sharp-shinned Hawk migration proceeds on a broad front in a generally southwestward direction (in the northeastern United States) at an altitude that makes observation difficult, and that the observed "concentrations" or "flights" are manifestations of the diversion-line phenomenon (Fig. 2). Thus, when the broad-front movement comes to the long water crossings of Long Island Sound, Delaware Bay, and Chesapeake Bay, a variable proportion of the migrants drops to a lower altitude and is diverted, depending upon the wind direction and other local factors.

This hypothesis can easily and reasonably answer the questions raised earlier in this paper.

Question (1).—The relatively small flights at Fishers Island and lack of flights in Rhode Island and Massachusetts may be due to differences in the breeding density to the northeast. If the line along the Virginia and New Jersey coasts

is extended northeastward (Fig. 3), the smaller breeding area to the east of the line, due to the presence of the Atlantic Ocean, is evident. The line passes through New Haven, the easternmost point of the larger concentrations.

Questions (2) and (3).—That the concentrations at Cape Charles were larger than at Cape May and that they occurred on days of northeasterly winds rather than northwesterly winds may be accounted for by the various local factors involved in stimulating diversion. Probably, when the winds are northwesterly many hawks do not reach the point, having diverted farther to the north in the vicinity of Hooper Island, a suggestion made by Rusling (1937).

Question (4).—If the migration proceeds on a broad front over the coastal plain, and if diurnal migrants start their migration early in the morning, the appearance of diurnal migrants in the morning is to be expected.

Question (5).—Hawks are not seen along the Atlantic coasts of New Jersey and the Delmarva peninsula, because they normally migrate at an altitude at which they are not easily detected.

Question (6).—From the evidence that migrating hawks occur daily along the coast, the best conclusion is that the eastern flank of the broad-front movement normally passes over the coastal plain. The evidence also supports the view that certain conditions are favorable for *observation* of the hawks.

DISCUSSION

I believe that the arguments expressed herein, although confined to the migration of the Sharp-shinned Hawk, are applicable to the migration of other diurnal migrants that occur regularly along the coast. I know of no unequivocal evidence that supports wind drift of any diurnal migrant.

This analysis points up the fact that a lack of appreciation for the unknowns that stimulate diversion may lead the observer to erroneous conclusions, as emphasized by van Dobben (1953) and Lack (1959*b*). For instance, Fig. 1 illustrates a broad-front movement crossing a diversion-line. The observer at *x* counts four birds flying along the coast for every two birds flying out to sea, when the actual ratio is 1 : 3. If the seaward movement is at a greater altitude than the coastal movement, as it usually is (van Dobben, 1953; Lack, 1959*a, b*), the likelihood of missing the seaward movement is increased, and the observer might erroneously conclude that the migration was entirely coastal. Further, if the factors are unfavorable for diversion, and if the seaward movement is high, the observer might conclude that no migration was occurring at all! That this is a real problem in interpreting visual observations is evident from the radar studied in England (Lack, 1959*b*). Ulfstrand (1960) presents a fuller theoretical treatment of this problem.

SUMMARY

The published evidence on the migration of the Sharp-shinned Hawk along the coast of the northeastern United States is reviewed and is shown not to support the hypothesis that the hawks (1) normally migrate inland, (2) are drifted to the coast by the wind, and (3) continue along the coast. An alternative hypothesis, which is supported by the evidence, is presented: the hawks normally migrate on a broad front in a generally southwestward direction over the northeastern United States at an altitude that makes observation difficult, and the observed "concentrations" or "flights" are manifestations of the diversion-line phenomenon.

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3 JUNE 1963 (ORIGINALLY SUBMITTED 4 DECEMBER 1961)

COMPETITION AND THE GENUS *TYRANNUS*

HENRY A. HESPENHEIDE

IN attempting to explain the great avifaunal diversity of the tropics, as well as certain distributional inequalities between tropical and temperate regions, Klopfer and MacArthur (1960, 1961) have theorized that one of the causes is a reduction of the size and an increase in the overlap of ecological niches in tropical regions. To demonstrate this they have employed the concept of character displacement (Brown and Wilson, 1956) as an index of ecological differences between competing or potentially competing sympatric species. Their data for tropical species, when compared to those of Hutchinson (1959) for temperate forms, differed in the way predicted by the hypothesis, i.e., the tropical species showed more overlap (less character displacement) than the temperate species. However, these data are only based on one class of characters and are without reference to the birds' interactions in nature. There are several other mechanisms which would not be obvious from morphological examination but which would prevent two potentially competing species from competing. Most simply, the two species may not be competing because other factors than competition limit their populations. Alternatively, Lack (1944) has suggested (1) the occupation of adjacent habitats by sympatric species or (2) the maintenance of a zone of equilibrium along a line of meeting by otherwise allopatric species as other "devices" that mitigate the effects of all-out competition at the macrohabitat level. At the level of the microhabitat, differences in physiological and behavioral, as well as morphological, characters may alleviate competition. The hypothesis of Klopfer and MacArthur thus invites comparative studies to determine the means and the extent by which competition is actually avoided in different localities.

It was recognized by Darwin that the more closely related are two species, the more likely it is that their needs are likewise similar. Sympatric congeners, because of this relation, are logical objects of studies of competition (Skutch, 1951), although Elton (1946) has pointed out the lack of necessity for systematic relationship in competition. Examination of the distributions of the six species presently included in the avian genus *Tyrannus* and known to breed regularly in North America north of Mexico shows that four of these occur in southeastern Arizona: the Cassin's Kingbird (*T. vociferans*), Western Kingbird (*T. verticalis*), Tropical Kingbird (*T. melancholicus occidentalis*), and Thick-billed Kingbird (*T. crassirostris*). In the accompanying maps (Figs. 1 and 2), prepared from various sources of distributional data (A.O.U. Check-list Committee, 1957; Blake, 1954; Cory and Hellmayr, 1927; Friedmann et al., 1957; Grinnell and Miller, 1944; Ridgway, 1907), it is seen that *melancholicus* and *crassirostris* reach the northern limits of their ranges and *verticalis* is

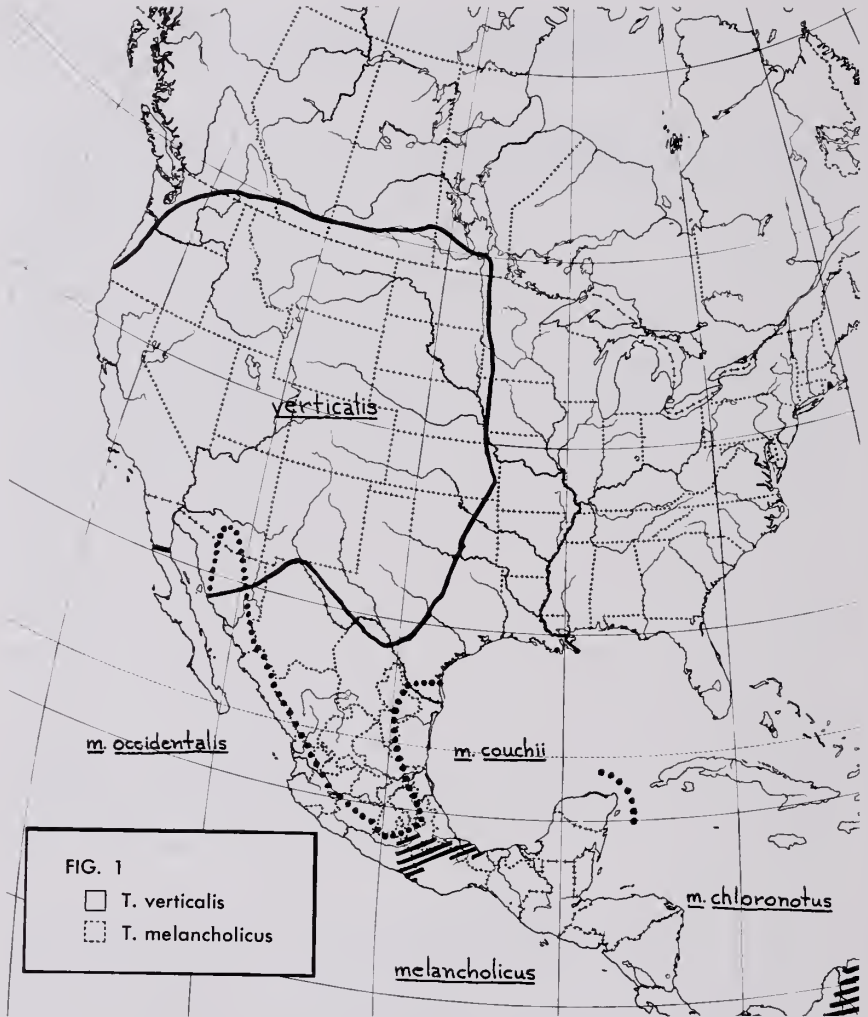


FIG. 1. Distributions of *Tyrannus verticalis* and *T. melancholicus*. Base map reproduced with permission of McKnight and McKnight Publishing Company.

on the southern limits of its range in Arizona. In terms of abundance *verticalis* and *vociferans* are common and the other two are less common (Brandt, 1951; Levy, 1959). Competition is said to exist among all four (Brandt, op. cit.; Marshall, 1957), but at present, information regarding the interrelations of these kingbirds is available only as incidental observations in studies more general in scope, e.g., those of Brandt and Marshall. Although attempts at

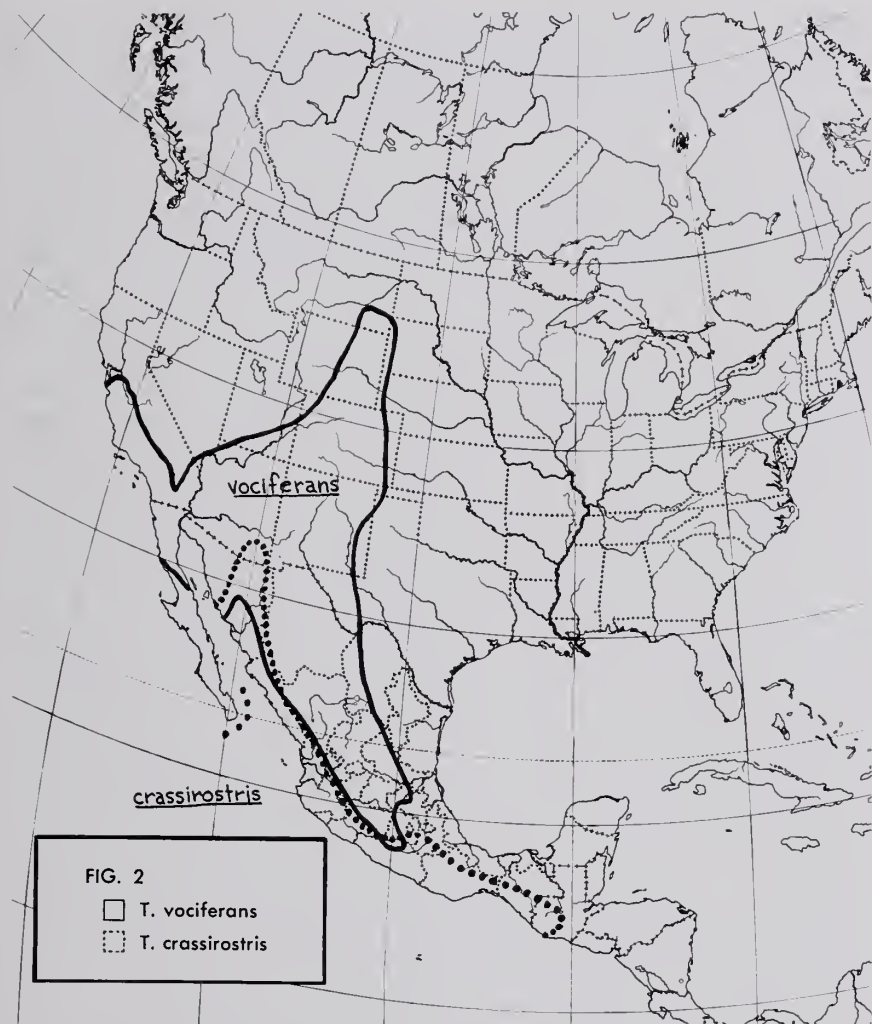


FIG. 2. Distributions of *Tyrannus vociferans* and *T. crassirostris*. Base map reproduced with permission of McKnight and McKnight Publishing Company.

ecological separation have been made, heretofore there has been no quantitative study of the problem.

DESCRIPTION OF STUDY AREA

From 1 June to 27 July 1962, extended observations of kingbirds were made at the Southwestern Research Station of the American Museum of Natural History, located in Cave Creek Canyon of Arizona's Chiricahua Mountains. Several other locations in southeastern Arizona and northern Mexico were visited.

During this period more than 120 pairs of the four kingbird species were studied to determine their breeding ecology. Most of the work centered on 100 pairs of *Tyrannus vociferans* and *T. verticalis* which bred in the vicinity of Cave Creek and along a 37-mile section of U. S. Route 80 east of the Chiricahuas.

Of the kingbird pairs in the two study areas, 53 bred near Cave Creek and were distributed along a 7-mile section of the creek from about 0.9 mile northeast of the town of Portal to about 4.4 miles west-southwest of Portal, i.e., from where the road to San Simone crosses the creek to about the upper limit of sycamores. The plant communities in the vicinity of observed nests would probably form a rough continuum from the moist, cool mountain forests to the hot, arid valley deserts were it not for locally large differences in exposure, the availability of water, or grazing pressure. The most obvious example of such a difference, frequently observed elsewhere, is Cave Creek itself. The mountain stream runs dry as the climate becomes progressively more arid downstream, but the water of the stream allows the formation of a well-defined riparian community along its path. Additionally in the case of Cave Creek Canyon, the canyon walls of 800 to 1,200 feet, which limit vegetation inside the canyon, drop steeply to the desert on the western side of the creek, and sharpen the distinction between plant community types typical of the desert and those typical of the lower slopes of the mountains. On the eastern side, the canyon walls slope somewhat more gradually to the desert over a distance of 2 miles. This slope, as one progresses toward Portal, exhibits the normal change in vegetation types that occurs as aridity increases. Since the creek continues to run along the base of this slope, there is interposed between the completely canyon and completely desert communities an area where the creek is bounded on the one side by a desert shrub community and on the other by an arid association typical of the lower mountainsides. The particular vegetation types to be found within each of three broad zones—canyon, transition, and desert—and in the riparian associations can be briefly generalized as follows:

Within the canyon there are two general types of associations: the one is characteristic of the more-exposed, south-facing slopes and is dominated by several species of oaks (*Quercus* spp.), a juniper (*Juniperus deppeana*),¹ and a century plant (*Agave palmeri*); the other is typical of the less-exposed, but rockier, north-facing slopes and is dominated by pines (*Pinus engelmannii*, *P. leiophylla*, and *P. edulis*) and oaks. The riparian community in this zone is almost entirely dominated by sycamores (*Platanus wrightii*), except at the canyon mouth where a few cottonwoods (*Populus fremontii*) are found. The sycamores dwindle off above 5,700 feet and are replaced primarily by large pines (*P. engelmannii*).

¹ Plant names after Kearney and Peebles (1960).

In the transition zone, to the west there are only 600 or 700 yards of rather dense oaks, juniper, and shrubs before the mesquite (*Prosopis juliflora*) community is reached. On the east the slopes change more or less gradually from pines (esp. *P. edulis*) to a mixture of oaks, juniper, and shrubs of medium height (e.g., *Arbutus arizonica*) and finally to a scattered association of juniper, oaks, and agave reminiscent of the south-facing slopes of the canyon. The riparian community broadens out at the mouth of the canyon and continues with little change to the town of Portal. Cottonwoods continue to be found among the sycamores for part of the way to Portal but are always less frequent than the sycamores.

At the town of Portal, desert shrub communities become characteristic of both sides of the riparian zone, with a change in composition from primarily mesquite to a mixture of several species, notably *Acacia constricta*, *Prosopis pubescens*, *Flourensia cernua*, *Atriplex canescens*, and *Rhus microphylla*. Without the protection of the foothills the riparian zone undergoes a profound change: the sycamores become fewer, smaller, and more scattered until only a higher density of shrubs marks the riparian effect.

Away from the effect of the mountains, the desert takes a rather wide variety of forms, depending on local conditions of soil, moisture, and grazing. To sample these other desert community types, censuses were made along 36.7 miles of U. S. Route 80, from Granite Pass in the Peloncillo Mountains (Hidalgo County, New Mexico) to a bridge 5.8 miles south of Apache, Arizona, and along some of the side roads. These censuses yielded 47 kingbird pairs. Desert shrub community types exist in many combinations of species (see above, also *Mimosa biuncifera* and creosote bush, *Larrea tridentata*) or as pure stands, with mesquite and creosote bush types the most common of the latter. Washes left from the runoff of rains occasionally support either a somewhat different flora (e.g., those lined with desert willow, *Chilopsis linearis*) or more robust forms of shrubs already there, especially mesquite and acacia. Besides shrubs there are other, more open associations, including *Ephedra trifurcata*-*Yucca* sp. stands, various grassland types,² and the extremely depleted herb communities (variously composed of *Gutierrezia microcephala*, *Salsola kali*, numerous annuals, etc.). *Yuccas*, an important nesting site for the Western Kingbird, are found irregularly in groves in most desert community types. Of the other large, but less frequent desert plant species, only the soapberry (*Sapindus saponaria*) was of any significance to kingbirds in the study.

Man's influence on the vegetation is varied but apparently is nearly always beneficial to kingbirds (see Table 1). Other than the indirect consequences of grazing by cattle, the most significant effects to both vegetation and kingbirds are the opening of the riparian association for buildings, orchards, and corrals

² Of *Aristida* and *Bouteloua*, e.g., see Darrow (1944).

TABLE 1
DISTRIBUTION OF NESTS

Zone	<i>vociferans</i>			<i>verticalis</i>		
	C*	D	Total	C	D	Total
Upcanyon	9		9			
Transition	27		27	8		8
Desert	2	4	6	7	43	50
<hr style="border-top: 1px dashed black;"/>						
Riparian	1	2	3	6	6	12
Town	1	2	3	1	9	10
Roadside					11	11
Desert					17	17
	38	4	42	15	43	58

* C = nests found in Cave Creek Canyon; D = nests found in desert census; see text.

and the planting of shade trees, orchards, and other crops in desert locations. Other, nonvegetational effects of man—again significant and beneficial—include the erection of fences, telephone wires, and assorted structures, and those miscellaneous activities which increase insect populations, especially the keeping of animals and the impoundment of water (cf Table 1).

The discussion which follows will be based primarily on the kingbirds found along Cave Creek and that portion of U. S. 80 delimited above. Other localities were visited to observe briefly either additional habitat types or different kingbird species. Of these, the most important were Guadeloupe Canyon, an arid cottonwood-sycamore canyon at the conjunction of Arizona, New Mexico, and Mexico; Sonoita Creek near Patagonia in Santa Cruz County, Arizona, and the Rio Magdalena at several points from Imuris to Terrenate, Sonora, both examples of cottonwood river bottom.

Nesting distribution of nests.—The distribution of nesting sites of the 100 kingbird pairs found in the two study areas was considered in terms of the three habitat zones described above. As seen in Table 1, abstracted from the several census maps, the greatest proportion of the Cassin's Kingbirds' nests was located in the transition zone, despite the limited amount of this type of area present. Canyon and desert localities both had nesting Cassin's Kingbirds, but these areas were clearly less preferred. The smallest numbers were in the desert and these were often associated with man's activity. The Western Kingbird was found primarily in the desert localities with a small number of pairs inhabiting the transition zone. The greater portion of the pairs of desert birds observed chose riparian or roadside and other man-created habitats in which the uniform desert community types were "interrupted," while about a third chose the more uniform desert localities.

TABLE 2
LOCATION OF NESTS

Plant type	<i>vociferans</i>	<i>verticalis</i>
Trees:	44	30
Sycamore	35	15
Cottonwood	2	10
Unrecorded	3	5
<i>Pinus engelmannii</i>	3	
Juniper	1	
Shrubs (<i>Chilopsis</i> , Mesquite, <i>Sapindus</i>):		11
<i>Yucca</i> :		17
	44*	58

* Two abandoned nests of pairs which later re-nested are included.

Location of nests.—The choice of the particular plant species in which a kingbird pair nested appeared to be largely dependent on the local flora. Since the riparian vegetation in most cases was composed either of sycamores or cottonwoods with few of the other species present, a bird which wished to nest in riparian communities had to nest in what was available or not nest at all. Thus, the particular plant species used is apparently of little importance (see Table 2).

On the other hand, the data suggest that what is of importance to kingbirds is the height of the nest, nest tree, or both. All of the nests of the Cassin's Kingbird were in trees. The average height of 15 nest trees whose heights were recorded was 52 feet, with a range of from 40 to 80 feet. Two of Bent's records (1942) of Cassin's Kingbirds nesting at comparatively low heights of 8 and 10 feet are therefore of interest. Another low nest attributed by Bent to a Cassin's Kingbird pair was checked with the original source (Rockwell, 1908) and was found to be incorrect, the birds being Western Kingbirds; other low nests attributed by Rockwell to Cassin's Kingbirds are subject to some doubt as he apparently had some difficulty in distinguishing the two species (op. cit.:166, lines 31 ff.). Western Kingbirds in this study area nested about equally in smaller and larger plant species, although it should be noted that they were never observed to choose a smaller species when trees were available; e.g., all nests of both kingbird species found along Cave Creek were in trees. The height of nest plants when shrubs (range 10–15.5 feet) or yuccas (range 10.5–18 feet) were roughly the same and averaged 13 feet for 12 nest sites. Only one height of a nest tree used by a Western Kingbird was recorded, there being no apparent difference from those used by Cassin's Kingbirds.

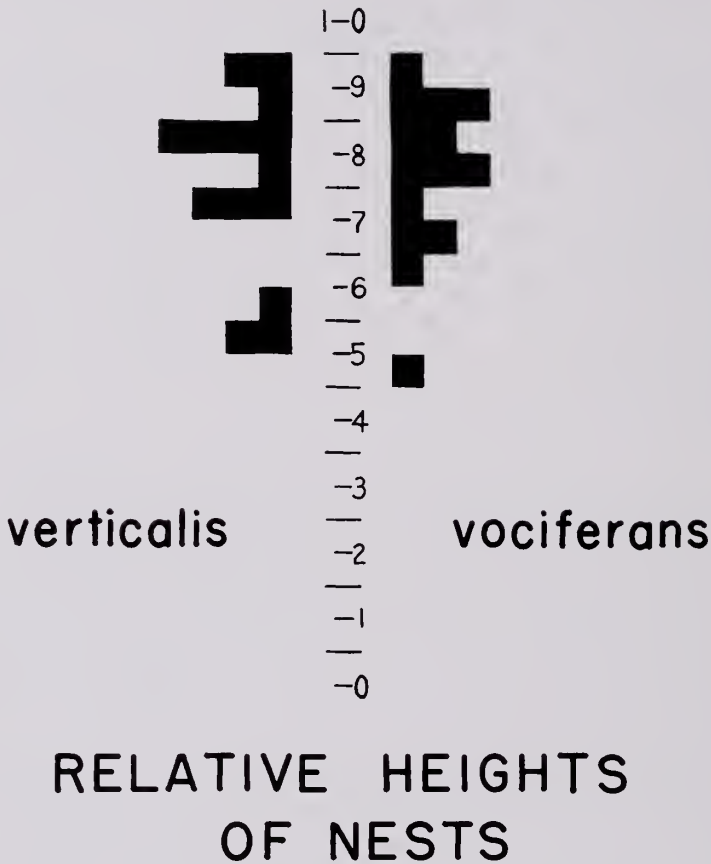


FIG. 3. Height of kingbird nests relative to that of the plant in which it was found.

While the absolute height of kingbird nests varied over a wide range (from 5.5 to 70 feet), their height relative to that of the nest plant was roughly the same for both species (see Fig. 3). Of 14 nests of the Cassin's Kingbird ranging from 22 to 70 feet high, the average relative height was 0.81, ranging from 0.47 to 0.92. Of 14 Western Kingbird nests placed at 5.5 to 50 feet high, the average was 0.76, ranging from 0.54 to 0.92. It is interesting to note that the nest with the lowest relative height was destroyed, though its likewise exceptional location in a completely dead pine may have been a more significant factor. The heights of the nests were not limited by the configuration of the nest sites since the sycamores and desert shrubs from which the data from 23 of the 28 nests were taken are branched over most of their height.

Observations of the other two kingbird species and data in the literature in-

NON-CALIFORNIA
vociferans
(AREAS 1-2)

CALIFORNIA
vociferans
(AREA 3)

verticalis
(AREAS 2-4)

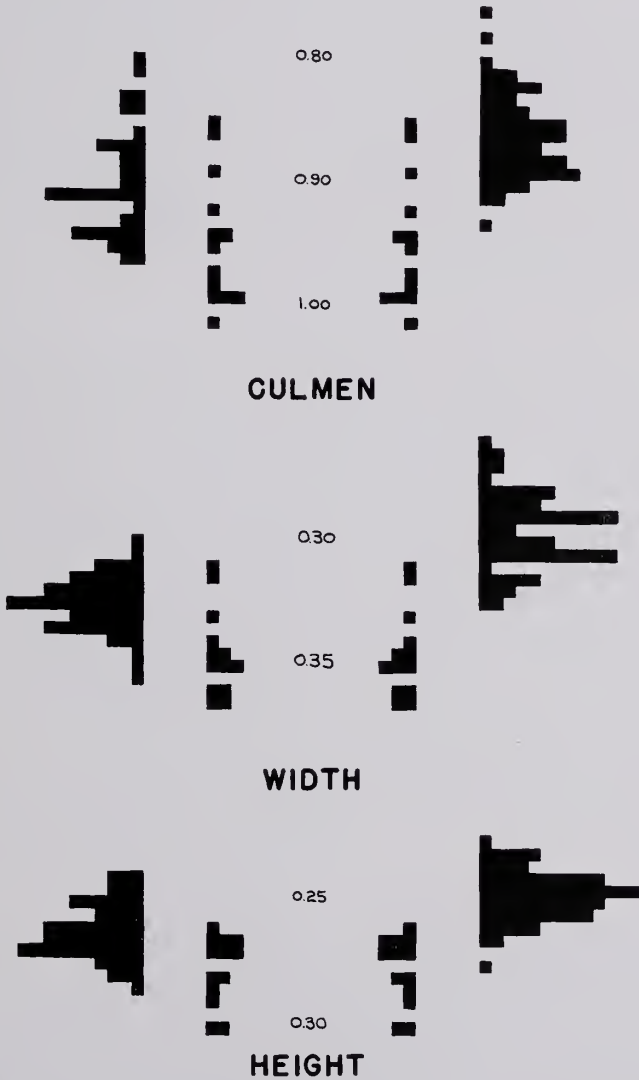


FIG. 4. Measurements of the bills of *Tyrannus vociferans* and *T. verticalis* in thousandths of an inch. There is an indication the California population of *vociferans* shows a slight character displacement in the presence of *verticalis* and in relative isolation from its own species.

dicate that their nesting habitats are roughly similar to those of the two under more intensive study. Tropical Kingbirds were observed on the Sonoita Creek in Arizona and near Imuris in Sonora, at both places in cottonwood river bottoms. Although no nests were found, reports indicate the breeding of *melancholicus* is most like that of *verticalis* in its choice of both high and low sites (Bent, op. cit.: Marshall, op. cit.: Davis, 1944). The nesting of *crassirostris*, on the other hand, is apparently most like that of *vociferans*. Observations of the Thick-billed Kingbird were made at Patagonia, Guadalupe Canyon, and near Terrenate in Sonora. The one nest of this species observed was being built at Patagonia, 55 feet high in a 65-foot sycamore (relative height, 0.84). Comparison with reports from van Rossem (1941), Selander and Giller (1959), and Marshall (op. cit.) indicates this is typical for the species: no reports of low nests have been found.

MORPHOLOGY

In order to assess morphological limitations on feeding behavior the index of character displacement as interpreted by Hutchinson (op. cit.) and Klopfer and MacArthur (op. cit.) was employed. Measurements of 160 kingbird bills were made at the U. S. National Museum and the American Museum of Natural History. The bill was measured along three coordinates: the length of the culmen from the base of the red feather patch of the crown to the tip, the width at the anterior extent of the nostrils, and the height at the angle of the gonys. The cumulative results for *vociferans* and *verticalis* are shown in Fig. 4. To test the apparent bimodal distributions obtained initially for possible geographical variation (see Brown and Wilson, op. cit.), measurements of specimens from four different regions were graphed separately (see Fig. 5):

T. vociferans occurring alone—

- (1) Mexico, not including the Baja Peninsula:

T. vociferans and *verticalis* sympatric, the populations of *vociferans* isolated—

- (2) Texas to southern Arizona, north to Colorado, Utah, Wyoming, and Nevada;
- (3) southern California and the Baja Peninsula:

T. verticalis occurring alone—

- (4) Idaho and northern California.

These groupings of measurements showed that there was no significant intraspecies difference in the presence of the other species—which might have been expected if character displacement had occurred—except possibly in the case of the California population of *vociferans* (see Fig. 4 and Table 3) which was the only really isolated population in either species: however, the small sample allows only tentative generalization.

TABLE 3
A. AVERAGE MEASUREMENTS OF BILL DIMENSIONS OF KINGBIRDS (IN INCHES)

	Culmen	Width	Height
1. <i>verticalis</i> (59 specimens)	0.865	0.298	0.248
2. <i>vociferans</i> —non-California (51)	0.911	0.328	0.265
3. —California (13)	0.950	0.348	0.280
4. <i>melancholicus chloronatus</i> (10)	0.988	0.278	0.363
5. <i>occidentalis</i> (7)	1.016	0.278	0.378
6. <i>crassirostris crassirostris</i> (10)	1.064	0.402	0.470
7. <i>pompalis</i> (10)	1.144	0.415	0.470

B. RATIOS OF MEASUREMENTS FROM SYMPATRIC FORMS

	Culmen	Width	Height	Product
Non-California <i>vociferans</i> / <i>verticalis</i>	1.05	1.10	1.06	1.22
California <i>vociferans</i> / <i>verticalis</i>	1.10	1.17	1.14	1.47
<i>c. crassirostris</i> / <i>m. occidentalis</i>	1.05	1.44	1.24	1.87
<i>c. pompalis</i> / <i>m. occidentalis</i>	1.13	1.49	1.24	2.09

It should be noted (Table 3) that the ratios of the magnitude of the larger bill to the smaller fall well below those suggested by Hutchinson as typical for temperate sympatric species and are closer to those of Klopfer and MacArthur for tropical species. Ratios were likewise prepared (see Table 3) for *melancholicus occidentalis* and *crassirostris*, which have an extensive overlap of distribution. Interestingly, the members of *crassirostris* north of Sinaloa apparently show a marked increase in the magnitude of bill.³ The possibility that this is a case of tropical-temperate character displacement is somewhat confused by the increase in bill size from the Central American subspecies of *melancholicus chloronatus* to *m. occidentalis*. The bills of both species are larger than those of *vociferans* and *verticalis*.

DISCUSSION OF THE DATA

Competition for space may take place at three different levels: the geographic ranges of the species, the types of communities within a given geographical area, and the particular microhabitats within a given community. Of these, the Cassin's and Western Kingbirds show significant differences in requirements in the first two. By tracing the two ranges and the zone of overlap onto heavy paper and by cutting and weighing the pieces, it was found that at the level of geographical range the zone of overlap was 63.7% for the Cassin's Kingbird and

³ This portion of the population was named *pompalis* by Bangs and Peters (1928).

TABLE 4
DISTRIBUTION BY HABITAT

Habitat type	<i>vociferans</i>	<i>verticalis</i>
Riparian or riparian-like flanked by		
Pine and juniper-oak	9	
Pine to juniper-oak and desert	27	8
Desert only	6	22
Nonriparian—desert		28
	42	58

27.5% for the Western Kingbird with no way of assessing the population densities of the species affected in the zone of overlap as compared to others.

At the level of preference of habitat, relations are somewhat difficult to assess, owing to the difficulty of strictly delimiting a habitat. This difficulty is in turn complicated by the nesting peculiarities of the two species, i.e., nesting in one habitat while feeding in another. On the basis of the above data, it is apparent that the Cassin's Kingbird will nest in any broad habitat zone in which there are tall trees for the nest. This was emphasized most strongly by a pair of kingbirds that nested in a cottonwood about 3 miles southwest of Apache: the only other tree for perhaps a mile was a small sycamore 35 feet tall, 400 yards to the southwest. Except for two bushes and telephone wires, there was only short grass desert. The Western Kingbird, on the other hand, showed a large range in the height of the plants used for nests, but occurred only in areas where there was habitat at least as open as a desert shrub community nearby. A summary of nest distributions by habitat types is given in Table 4. "Riparian-like" habitats are those in which tall trees occurred, especially in desert locations, e.g., the town of Rodeo. It should not be inferred that a well-defined riparian association was necessary to the nesting of the Cassin's Kingbird. Large pines and junipers were used in three cases in Cave Creek Canyon on the north-facing slopes somewhat away from the creek, and the species was observed in the oak woodland in the foothills of the Santa Rita Mountains where there was no riparian community nearby. In desert riparian localities investigated by Brandt (1951:399) it was estimated there were ten pairs of Western Kingbird per Cassin's Kingbird pair in the sycamore "strands."

There is no evidence that the microhabitat of the two species is different. Although both species are highly territorial intraspecifically, interspecific territoriality apparently does not exist. Intraspecifically defended territories frequently overlapped interspecifically and one instance of Western and Cassin's Kingbirds nesting in the same tree was observed near Portal. Interestingly, it is

doubtful that the territory is actively maintained even intraspecifically in adjacent feeding habitats by pairs nesting in the riparian association, especially in view of the distances involved in feeding flights which in some observed cases approached a quarter of a mile. Chance aggressive encounters may occur, however. The generalized kingbird niche appears to be that of an overcanopy species, with the choice of feeding habitat, at least in the case of the Cassin's Kingbird, dependent only on the location of the nest. This conclusion is supported by several observations. (1) The position of the nest relative to the height of the plant in which it is placed has already been discussed. (2) The frequent location of Western Kingbird nests along roadsides, where the added height of telephone wires and fences as perches is important, is indicated in Table 1 and by the choice of several particular nest sites that would appear to be substandard were not the wires present (e.g., a census along 30.3 miles of U. S. 80 south of Rodeo, N. M., on 24 July showed 155 birds perched on wires). (3) Feeding sallies of kingbirds, in a small sample of 30 attempted captures, showed 53% attempts above the perch level, 17% at the level, and 30% below. The perch chosen in a particular foliage type was almost invariably the highest possible, or within a few feet of the highest. (4) As for the species' independence of particular plant formational types, the Cassin's Kingbird, it has been noted, fed in a full range of formational habitat types from short grass desert to riparian associations. Observations, of an upcanyon female feeding young showed that of 240 minutes, 29% was spent in the riparian zone or at the nest, 40% in pine, 25% in juniper, and 3% in either pine or juniper. The members of a pair watched for 210 minutes (female 120 minutes, male 90 minutes), feeding young at a nest on the desert edge of the riparian zone near Portal, spent 39% of the time at the nest sycamore, 59% in the desert shrub or high grass, and 4% in the riparian. The low last figure was due at least in part to another nearby and highly territorial Cassin's pair in the riparian zone. Likewise, though desert shrub communities were clearly preferred by the Western Kingbird, individuals nesting in the riparian zone were observed feeding there.

The possibility that there is a difference in the time of nesting has been suggested for the California populations of the two species of *Tyrannus* as a microhabitat difference (Evermann, 1886; Willet, 1912), but no such difference was observed in Arizona. Although stomach contents of the two kingbirds have been studied (Beal, 1912), these data are of little use because of their miscellaneous origin, and the morphological indices had to be used. In view of the large degree of spatial isolation other than in the microhabitat, it would not be surprising if there was little selection for differences in bill size, though if the larger bills of California birds are significant the amount of isolation may be important.

The effect of competitors other than congeners on food supplies or breeding spaces of the kingbird seems negligible. Of the other 11 species of flycatchers

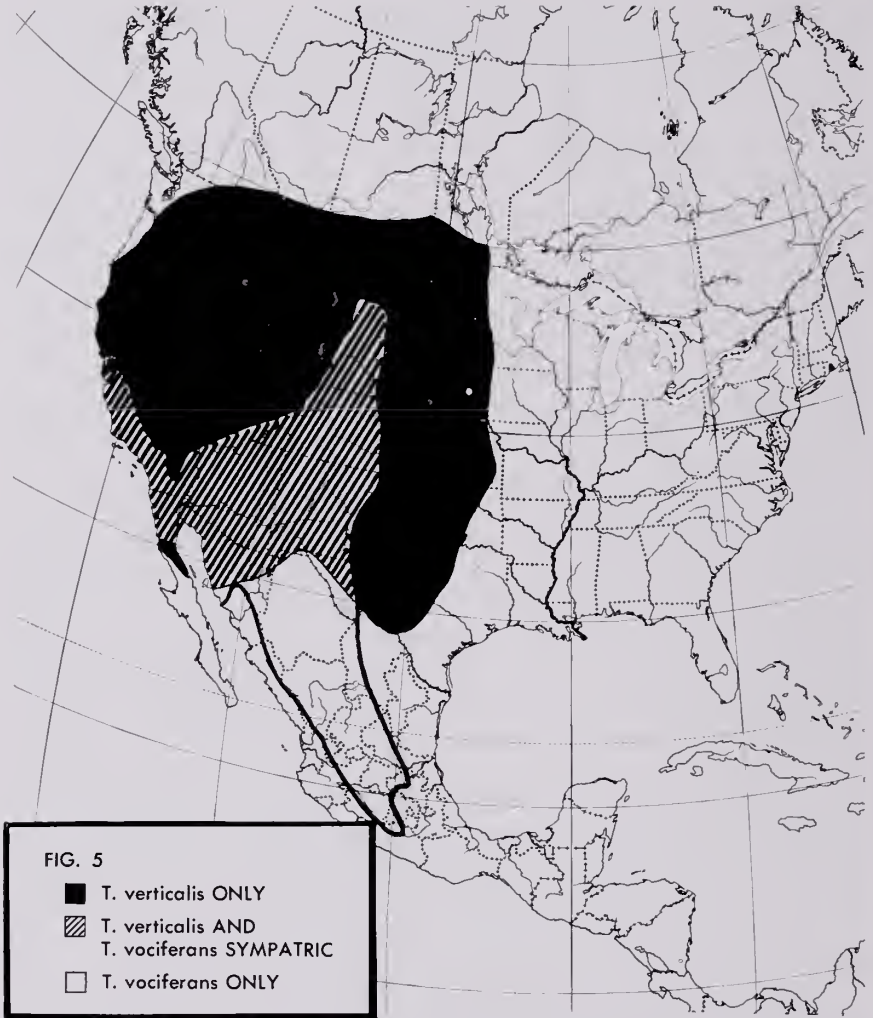


FIG. 5. The distributions of *Tyrannus vociferans* and *T. verticalis* in relation to one another. Note the relative isolation of the California population of *vociferans*. Base map reproduced with permission of McKnight and McKnight Publishing Company.

seen by me in southeastern Arizona, nine were found in association with kingbirds. Of these, four were hole-nesting species that usually tended to feed near the middle or bottom of the foliage profiles of both tall and medium-height foliage types and included the three species of *Myiarchus* and the Sulphur-bellied Flycatcher (*Myiodynastes luteiventris*). The Sulphur-bellied Flycatcher was the only one of these four seen to feed above the canopy, but the small,

peripheral nature of the species' population reduces any possible competitive significance. The Western Wood Pewee (*Contopus sordidulus*) and Beardless Flycatcher (*Camptostoma imberbe*) occurred at the middle of the higher foliage profiles, the former nesting on the top of higher horizontal limbs and feeding in and on the edge of rather dense foliage, and the latter feeding quite unlike typical flycatchers. The Black (*Sayornis nigricans*) and Say's Phoebes (*S. saya*) and the Vermilion Flycatcher (*Pyrocephalus rubinus*) were understory species along streams or in semiopen areas of tall trees and little undergrowth, nesting on man-made structures or on the tops of the lowermost branches of large trees.

There are also several possible nonflycatcher competitors. In desert localities the Loggerhead Shrike (*Lanius ludovicianus*) utilized the same perches and probably took some of the same insects as the Western Kingbird, but its preferred nesting sites and habitats were largely substandard for kingbirds. In some of the towns and riparian localities visited briefly Phainopeplas (*Phainopepla nitens*) were common, but their competitive effect on kingbirds is unknown. Raptors were always vigorously attacked by kingbirds, but there was no significant effect by either of the two parties on the other, and a Cooper's Hawk (*Accipiter cooperii*) pair nested successfully in a tree at the Southwestern Research Station only 100 feet from a tree that housed two broods of Cassin's Kingbirds and 250 feet from a second kingbird pair. The typical overcanopy feeders—three species of swallows and the White-throated Swift (*Aëronautes saxatilis*) occurred in the vicinity of kingbirds—tended to fly higher than kingbirds except at dawn and dusk when they frequently fed just over the treetops. Their specialized method of feeding which relies primarily on large quantities of small insects probably prevents their sharing many prey species with the kingbirds which instead rely on individual captures of large insects. Caprimulgids and the smaller, insect-eating owls are temporally isolated from competing with kingbirds.

CONCLUSIONS

At present it appears that the following factors prevent serious interspecific competition between *Tyrannus vociferans* and *T. verticalis*: (1) a high degree of spatial isolation and (2) the limiting of the populations of both species by (a) the intraspecific competition for nest sites within each species and by (b) the choice by each species of only a small part of the available habitat for nesting while feeding in all of it. *Tyrannus melancholicus* and *T. crassirostris* are virtually entirely isolated geographically from competition with *T. verticalis* and *T. vociferans*, although sympatric with each other over most of the range of *T. crassirostris*. The relations between the latter two species remain to be investigated, but indications are that they resemble the relations between the two species discussed in detail.

This study also indicates that Klopfer's and MacArthur's use of culmen lengths or similar indices to measure microhabitat differences in sympatric, congeneric species must take into account the fact that morphological similarities between related forms may be permissible where other forms of spatial isolation allow the avoidance of competition. The necessity for the examination of other, possibly variable, morphological, physiological, and behavioral characters in those species in which microhabitat delimitations occur may make a multipower index more useful, should the problem of ecological determinants of distribution be investigated more closely and on a comparative basis.

ACKNOWLEDGMENTS

Appreciation is extended for the aid received at many points in the field and museum work and in the writing of this paper. Specifically, observations and assistance in the field work were generously provided by W. John Smith as an aside in his behavioral studies of many of the same kingbirds, also by Dr. Robert H. MacArthur and William C. Russell. Dean Amadon and Wesley Lanyon of the American Museum of Natural History, Dr. W. J. Gertsch at the Museum's Southwestern Research Station, and Philip S. Humphrey of the United States National Museum insured that my stays at these institutions were both profitable and comfortable. The study, and especially the writing of the paper, proceeded under the constant guidance of Dr. Peter H. Klopfer whose valuable criticisms are reflected in both the ideas and the words of the result. Dr. W. D. Billings kindly reviewed and criticized the description of the vegetation. The study was made possible by National Science Foundation Undergraduate Research Participation Program grants for the summer and fall of 1962 and by an N. I. H. grant, No. 4453, to Dr. Klopfer.

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FLOCK SIZE IN A SPRING CONCENTRATION OF WHISTLING SWANS¹

DANIEL Q. THOMPSON AND MARJORY D. LYONS

THE role of the family in the formation of goose flocks and the importance of flock-size counts as a means of estimating productivity and mortality in geese were described by Elder and Elder (1949). Their material referred mainly to frequency distributions of fall flocks and they emphasized that it would be very interesting to see a frequency distribution curve for migrating spring flocks. The present paper describes an attempt to study flock organization from repeated counts of a spring aggregation of Whistling Swans (*Olor columbianus*) in east-central Wisconsin.

The upland prairies of east-central Wisconsin are a traditional gathering area of Whistling Swans during spring migration. In early April 1962, a gathering of approximately 1,000 swans settled down on a 7-acre vernal pond about 2 miles southwest of the Ripon city limits. Canada Geese (*Branta canadensis*) were also present in this gathering and the resultant clamor could be heard in the city at all hours of the day and night. The center of this gathering ground was about 300 yards from the nearest road, but the swans frequently wandered to within 100 yards of the road as they foraged in the corn stubble surrounding the roost pond.

The authors began a series of systematic observations of the gathering on 4 April 1962 when 1,022 swans were counted in company with approximately 500 geese. The concentration continued at this level for the next 3 days. An abrupt drop in numbers occurred on 8 April when only 43 swans were present at dawn. By 10 April only 6 birds remained: there were no Canada Geese present. Over the first 4 days of observation, morning counts averaged 749 swans; midday and evening counts averaged 466 and 771 swans, respectively.

Pronounced diurnal foraging flights were not characteristic of these swans. Much, if not most, of the foraging was done on the pond itself or on surrounding fallow fields. The departure of this swan concentration was more likely related to decreased food (waste grain) than to changes in water level. It is probably significant that on 10 April a new gathering of 600 swans appeared on a flooded cornfield 6 miles southwest of the Ripon concentration area.

Departures and returns of small groups of swans occurred throughout the daylight hours at the Ripon gathering site. After a preliminary exchange of field notes and comments, the authors made independent daily counts of all departures and arrivals of swan groups during morning, noon, and late after-

¹ Contribution of the New York Cooperative Wildlife Research Unit: New York Conservation Department, Cornell University, U. S. Bureau of Sport Fisheries and Wildlife, and Wildlife Management Institute, cooperating.

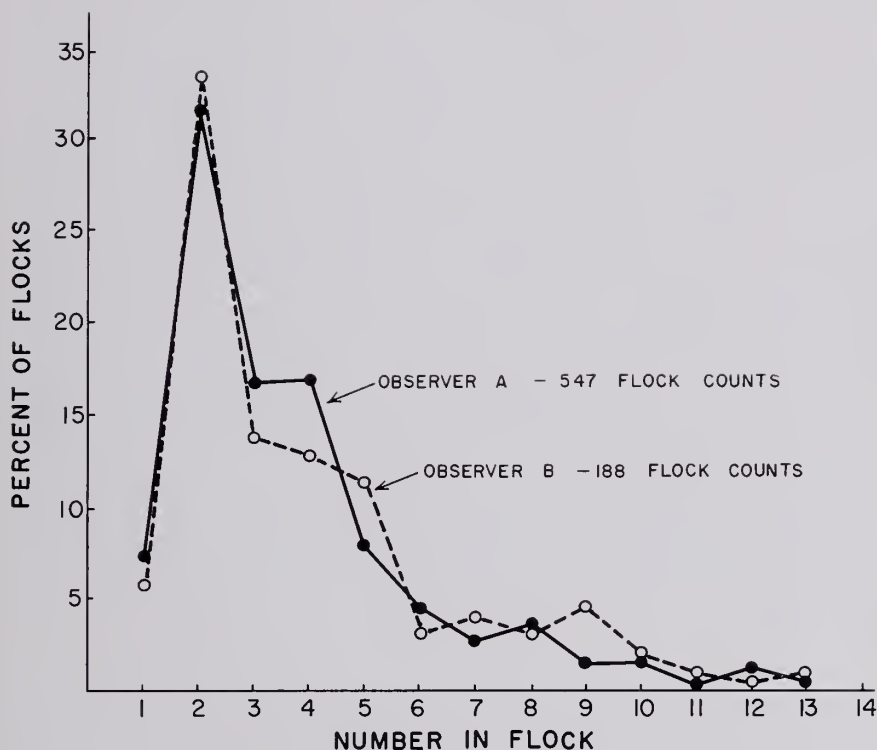


FIG. 1. Size of flocks of Whistling Swans in local movements, 4 April to 10 April 1962.

noon sampling periods. While McAtee (1924) was able to distinguish between dark-necked young birds and white-necked adults in fall swans, and Gabrielson and Lincoln (1959) state that young swans in their first winter are easily distinguished from their parents, we did not feel secure in making this distinction in the spring migrants observed at Ripon. Differences between young and adult members of a family group were often strikingly obvious as they walked through a stubble field, but varying light conditions and greater distances frequently made these distinctions uncertain. Perhaps we were too conservative in our attempts to separate young from old. It would have been very interesting to have compared age-ratio counts from this source with the findings from our flock-size counts.

The results of swan flock counts are presented in Fig. 1. Since the observers usually did not overlap in time of observation, differences in counts are not altogether the result of sampling error, i.e., the counts are not necessarily of the same groups of birds. The very close agreement obtained serves as a non-parametric test of the significance of differences in flock-size frequencies.

The peak in pairs which characterizes the frequency curve in Fig. 1 is similar to the frequency distribution of flock-size counts reported by Elder and Elder (op. cit.) among local movements of Canada Geese in fall. We are tempted to suggest that the higher proportion of pairs in our swan data would likely result from an increase in courtship flights in spring migrants; however, Delacour and Mayr (1945:3) state that pair formation in swans takes place in fall, without elaborate displays. We are, of course, not even certain of the sex or age of pairs in our tallies. A correct interpretation of the secondary peaks in three, four, and five size classes hinges on the time of dissolution of parental and sibling bonds. McAtee (op. cit.) describes family groups on Currituck Sound, N. C., in fall and says, "this grouping is well known to all baymen . . . comment on the success of the last breeding season is based on the size of these subdivisions of the flock." We can find no reference to family bonds in the Whistling Swan beyond the first winter and hence must turn to Banko's (1960) observations on the Trumpeter Swan (*Olor buccinator*). Banko makes no comment on the persistence of parental bonds beyond the first winter, but implies that sibling bonds may persist longer. He states (p. 121): "only two notes exist regarding the duration of family ties after the offspring's first winter." Both of these observations refer to the apparent persistence of bonds between brood mates beyond the first winter.

Returning to the identity of the secondary peaks in our Ripon data, if we assume that the parental bond is broken by the end of the first winter, it would follow that the peaks of three, four, and five bird groups would probably represent brood mates. This would be in reasonable agreement with Bent's (1925) statement of an average family size of six to seven in wintering swans on the Virginia and Carolina Bays. If, however, we assume that the parental bond persists beyond the first winter, the secondary peaks of three, four, and five could be considered to be family groups. This interpretation would more closely agree with the observations of Gabrielson and Lincoln (1959:112) in Alaska, who state: "most pairs will have from one to three cygnets at hatching time, . . ." In closing, it is interesting to note that McAtee (op. cit.) observed considerable variation in the size of family groups on Currituck Sound: ". . . the pairs of swans some years having from one to three cygnets each, and in others from three to five."

SUMMARY

A concentration of approximately 1,000 swans gathered on a vernal pool in east-central Wisconsin in early April 1962. Two observers obtained very close agreement with independent counts of the size of flocks and subflock groups departing and returning to the concentration area. Pairs were by far the most frequently encountered size group. The next most frequent groups were threes, fours, and fives, respectively.

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NEW YORK COOPERATIVE WILDLIFE RESEARCH UNIT, CORNELL UNIVERSITY,
ITHACA, AND RIPON COLLEGE, RIPON, WISCONSIN, 10 OCTOBER 1963

HOSTILE DISPLAYS OF ROSE-BREASTED GROSBEAKS TOWARDS A RED SQUIRREL

JAMES BAIRD

ON 25 June 1961 at 1150 (DST), I heard the harsh screaming of Rose-breasted Grosbeaks (*Pheucticus ludovicianus*) in a grove adjacent to my home in Wayland, Middlesex County, Massachusetts. After some searching I saw a Red Squirrel (*Tamiasciurus hudsonicus*) running down one of the upper limbs of a tall elm. It was carrying in its mouth a large but still downy nestling.

When the squirrel stopped on an exposed branch to eat the nestling, I was able to see a male grosbeak posturing about the squirrel at a distance of from 1 to 3 feet (Fig. 1d). In moving about the squirrel, the male sidled stiffly up and down the branches and flew from branch to branch with a fluttery flight. This display was accompanied by loud "chinks" which sounded like the normal call note, but were given much more frequently. The intensity of the male's display gradually lessened as the squirrel remained quiet while feeding, although it seemed to keep the squirrel in sight. The male postured again but with less intensity when the squirrel stopped eating at 1225 and moved higher into the tree.

At this time I first saw the female grosbeak, which seemed to be completely unresponsive to the squirrel's presence despite the posturing and calling of the male. Both squirrel and grosbeaks were lost to sight in the foliage of the upper branches at 1230.

At 1310 the grosbeaks started screaming again. As before, they were not easily located in the thick foliage and it took several minutes for me to find the female, which was posturing strongly (see Fig. 1b and beyond). She soon flew with a flutter flight to another branch; on landing her wings were held outspread briefly (Fig. 1c). She then closed her wings and hopped out of sight. Loud chinking was heard, both preceding and following this brief view, but it subsided relatively quickly.

I was again attracted by screaming grosbeaks at 1530 and once more could find only the female. She was observed by Andrew J. Meyerriecks (who joined me at 1500) and myself to not only posture (as above and Fig. 1b) but to spread her wings to their full extent and wave them back and forth slowly (Fig. 1a). This display lasted for less than a minute and ended when the bird flew higher into the tree. In these last two encounters, the presence of the squirrel was presumed.

Meyerriecks and I later saw what we believed to be the nest of this pair of grosbeaks. It was about 45 feet from the ground on one of the upper branches of the same elm where the displays were observed; when we found it at 1600, it appeared empty (we could see through the bottom of the nest).



FIG. 1. Displays of Rose-breasted Grosbeaks directed at a nest-robbing Red Squirrel (see text for details).

FEATHER POSTURES OF DISPLAYING BIRDS

Since all of this activity took place in the foliage between 30 and 40 feet overhead, I was not able to note every detail of the behavior or the feather postures of the displaying birds through my 7×50 binoculars. Since I can find only one reference to Rose-breasted Grosbeak display (Ivor, 1944), it seems advisable to present these observations in some detail.

Male—Upright threat (Fig. 1d).—The head was held high with the bill pointed up at about a 45° angle. The feathers of the head, neck, upper back, sides, and belly were not conspicuously fluffed and may even have been sleeked. On several occasions, I was able to detect a raising and lowering of the red feathers of the breast patch, a “flashing” movement which was apparently independent of the adjacent nonred feathers. This movement was first detected by the distinct deepening of the red color of the patch when the feathers were raised. The feathers of the lower back, rump, and upper tail coverts were

ruffled and the wings stiffly drooped. The tail was pointed down and sporadically fanned.

Female—Upright threat.—This was similar to that of the male. The bill pointed upwards, tail depressed (no fanning noted), and the wings drooped stiffly. Also, as with the male, the feathers of the head and upper body were not fluffed and the feathers of the lower back and rump were ruffled. *Wing-waving.*—In this display, the body was nearly horizontal with the head thrust forward and the bill open. The body feathers were fluffed and the tail spread (but not depressed). The wings were fully spread and tilted so that the underside was visible from the front, and the wings were waved slowly back and forth (Fig. 1a).

The brevity of these observations precludes lengthy speculation on their significance; however, their uniqueness warrants tentative interpretation.

DISCUSSION

The postures adopted by a threatening animal are generally considered by ethologists to be the result of the arousal of two incompatible tendencies: to attack and to escape: the intensity of the display seemingly controlled by the degree of conflict between these two tendencies (Simmons, 1952; Morris, 1956; Hinde and Tinbergen, 1958). Such agonistic displays are usually associated with courtship, but may also occur during alarm, violation of individual distance, or territorial encounters (Ficken and Ficken, 1962). The actions of the grosbeaks in the displays described above clearly demonstrate the ambivalence of their attack-escape response to the squirrel: half-sleeked-half-ruffled plumage, flutter flights, stiff-legged sidling, wing-waving, movements toward and away from the squirrel, etc. The flashing of the red breast patch by the male and the yellow underwing linings by the female were such a conspicuous part of the displays that one is tempted to assign them a "flash signal" function, but this may have been more apparent than real.

On the whole, it seems reasonable to assume that these displays were generally associated with alarm and released by the nest-robbing activity of the squirrel. But whether they were direct threat, demonstration, or distraction displays cannot be determined until more detailed information on Rose-breast behavior becomes available.

I wish to thank Dr. Andrew J. Meyerriecks for his valued assistance in the preparation of this paper.

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MASSACHUSETTS AUDUBON SOCIETY. LINCOLN. MASSACHUSETTS. 3 MARCH 1964

NEW LIFE MEMBER

Mr. William H. Pugh of Racine, Wisconsin is a new Life Member of the Wilson Ornithological Society. His principal ornithological interests are concerned with grouse and cranes, as well as raising birds in aviaries. He is a member of the Wisconsin Society for Ornithology, National Wildlife Federation, American Pheasant and Waterfowl Society (currently a director), and the Society of Tympanuchus Cupido Pinnatus. Mr. Pugh is married and has three teen-age children. He is president of the W. H. Pugh Coal Company and the W. H. Pugh Oil Company.



GENERAL NOTES

Cattle Egrets nesting in Mexico.—The Cattle Egret (*Bubulcus ibis*) is now a widespread bird of the Atlantic coastal lowlands of southern Veracruz and Tabasco, is spreading into the more arid interior of the country, and has reached the west coast. The only published account of the species in Mexico since its discovery in Quintana Roo (Denham, 1959. *Auk*, 76:359–360) is a series of sight records by Axtell and Andrle (1961. *Wilson Bull.*, 73:280).

Apparently the first specimen record for Mexico is an immature male I collected from a group of six, about 3 miles northeast of Tlacotalpan, Veracruz on 15 November 1958. New state records for the species on the Atlantic lowlands are: *Chiapas*, two immatures collected at Estación Suspiro, east of Pichucalco, on 20 January 1963; *Campeche*, groups of 2 or 3 to 30 plus individuals scattered along the coastal highway between Champotón and the Campeche border at the mouth of the San Pedro River, 15 and 16 November 1963 (3 specimens collected); *Yucatan*, 5 individuals seen feeding along the highway between Valladolid and Puerto Juarez (= Meco), ca. 10 miles east of Valladolid, 10 November 1963. Records for the arid interior of the country are: *Puebla*, 5 seen at Laguna del Carmen 19 November 1963; *Morelos*, an immature was collected from a flock of about 20, 3 November 1962; *Estado de México*, one observed feeding among burros at Lago Zumpango by Vincent Heig. The first record of Cattle Egrets on the west coast of Mexico is two seen, one collected, near El Quemado, Guerrero, 12 March 1964. El Quemado is a small village about 6 km north-east of Acapulco. A third individual was seen nearby on 15 March.

The large numbers of Cattle Egrets observed on every trip to the southern Atlantic lowlands indicated the probability of local nesting. An adult male taken near Teapa, Tabasco, 8 February, had testes measuring 7×3.5 mm and was in prealternate molt in the plume areas. An adult male taken near Tlacotalpan, Veracruz, 27 March, had testes measuring 11×7 mm and had completed the prealternate molt. An immature male without the nuptial plumes, taken with the second adult, had testes measuring 5×2 mm and was not molting.

On 13 May 1963, accompanied by Dr. William A. Wimsatt, I visited a heron colony near Minatitlán, Veracruz, found nesting Cattle Egrets, and collected the first nestlings taken in Mexico. We were unable to remain in the colony long enough to permit the adults to reoccupy their nests or to feed their young, and so no accurate estimate could be made of the numbers nesting in the colony. When we first entered the center portion of the diffuse colony, approximately 15–20 adults flushed but I do not know what portion of the total nesting population this number represented. The colony was inhabited by Green Herons (*Butorides virescens*), Great Egrets (*Casmerodius albus*), Snowy Egrets (*Egretta thula*), Black-crowned Night Herons (*Nycticorax nycticorax*), Boat-billed Herons (*Cochlearius cochlearius*), and by Anhingas (*Anhinga anhinga*). The young of the Black-crowned Night Herons and many of the Boat-billed Herons were completely fledged. The Green Heron had eggs only, while the other species were in all phases of nesting.

I was not familiar with the eggs and young of the Cattle Egrets and could not separate very small young from those of the Snowy Egret. Two ambulatory young of *Bubulcus* and one of *Egretta* were collected.

I would like to thank Vincent Heig for permitting me to include his Lago Zumpango record herein. This investigation was supported in part by United States Public Health Service Training Grant No. 5-T1-A1-231-02 from the National Institute of Allergy and Infectious Diseases.—ROBERT W. DICKERMAN, *Department of Microbiology, Cornell University Medical College, New York, New York, 1 June 1964 (Originally received 9 December 1963).*

Some waterfowl diving times.—On 30 November 1963 at Brigantine National Wildlife Refuge near Oceanville, New Jersey, we measured with a stopwatch the diving times of two Horned Grebes (*Podiceps auritus*), two Pied-billed Grebes (*Podilymbus podiceps*), and one Ruddy Duck (*Oxyura jamaicensis*). Our data are presented in the table.

Species	Number of diving observations	Diving time in seconds			Mean and SD (in sec)	SE (in sec)
		Minimum	Maximum	Mean		
<i>P. auritus</i>	11	8.2	25.8	19.24	19.24 ± 6.11	1.93
<i>P. auritus</i>	25	8.2	22.3	17.38	17.38 ± 3.80	0.77
<i>P. podiceps</i>	4	8.9	16.6	12.70	12.70 ± 2.77	1.60
<i>P. podiceps</i>	10	6.2	12.4	9.37	9.37 ± 1.82	0.60
<i>O. jamaicensis</i>	25	17.4	21.8	19.78	19.78 ± 1.14	0.23

The Horned Grebes which we timed remained underwater for less than half a minute during each of their dives. This closely approximates the data presented by Stone (1937. Bird Studies at Old Cape May. Vol. 1. p. 80) who, along coastal New Jersey, recorded them remaining "submerged for from thirty to thirty-five seconds." Conversely, Eaton (1910. Birds of New York. Vol. 1. p. 95) observed the species submerged for 3 minutes, and Bent (1919. *U. S. Natl. Mus. Bull.* No. 107, p. 24), quoting Charles W. Townsend, states that the bird can remain underwater for 30 to 50 seconds or longer. Palmer (1962. Handbook of North American Birds. Vol. 1. p. 79) records 1.25 minutes as the submergence time for Horned Grebes in deep dives. Localized ecological conditions are possibly responsible for these variations.

A review of several important North American ornithological books revealed no data concerning Pied-billed Grebe and Ruddy Duck diving times. No journal search was made.—DONALD S. HEINTZELMAN, 629 Green Street, Allentown, Pennsylvania, AND CAROLE J. NEWBERRY, 31 Lincolnshire Road, Webster, New York, 2 February 1964.

Mixed trio of a Shoveler drake and Blue-winged Teal pair.—On five occasions in the spring of 1962, a male Shoveler (*Spatula clypeata*) was observed attempting to displace the male of a Blue-winged Teal (*Anas discors*) pair. This behavior was observed at the same site on four different days between 21 May and 28 May while I was conducting a waterfowl nesting study at Lower Souris National Wildlife Refuge in North Dakota.

The first observation occurred between 9:40 and 10:48 AM on 21 May. I first observed the Shoveler between a female Blue-wing and two male Blue-wings on the water of a small bay. The Shoveler continuously head pumped. He rushed repeatedly with bill open at one male Blue-wing who persistently tried to reach the female. The other male Blue-wing, an unmated bird that had previously been captured and marked with plastic nasal discs, remained at a distance and took no part in the activities. This conflict continued for 20 minutes on the water and then for 50 minutes in a crested wheatgrass (*Agropyron cristatum*) meadow where the female Blue-wing was apparently searching for a nest site. The conflict was continuous during the observation except for three brief periods of rest and preening, amounting in total to slightly over 1 minute. Whereas the female Blue-wing had rushed at the Shoveler at 10:20 AM, she sat side by side with him during brief rest periods at 10:28 and 10:34 AM. Again on 21 May, at 5:15 PM, I observed the same behavior by this male Shoveler. One additional male Blue-wing besides the original contestants and the marked

male was present. The male Shoveler repeatedly chased a particular male Blue-wing, however, and I assume that this male was the original mate of the female Blue-wing. On 24 May, at 7:37 AM, my wife observed this male Shoveler directing his aggressive behavior toward one or two male Blue-wings of a group of four. Then, however, the female Blue-wing swam to the Shoveler whenever he got a short distance away. On 25 May, from 8:05 to 8:10 AM, the Shoveler was again associated with the female Blue-winged Teal. On this occasion, he threatened two male Blue-wings and two male Shovelers. He head pumped continuously and rushed at one male Blue-wing and a male Shoveler. The female Blue-wing did nothing but sit on the water. The Shoveler was able to keep all other males away from her. The last observation of this male Shoveler's aggressive behavior occurred on 28 May at 5:30 AM. At this time, I flushed him, a female Blue-wing, and a male Blue-wing from nesting cover. As they flew to water, the Shoveler was successful at keeping between the male and female Blue-wings, and repeatedly bumped the male Blue-wing in flight.

This series of observations is extremely similar to those reported by Dzubin (1959. *Blue Jay*, XVII (2):53-54) for an association between a Pintail drake (*Anas acuta*) and a Mallard (*Anas platyrhynchos*) pair. Nero (1959. *Blue Jay*, XVII (2):54) also reports an association between a male Green-winged Teal (*Anas carolinensis*) and a Mallard pair. Both authors cite these associations as possible explanations for the occurrence of hybrids in the wild. Childs (1952. *Condor*, 54:67-68) has recorded a hybrid intermediate between the Shoveler and the Blue-winged Teal. The aggressive behavior of this Shoveler resembles that described by Hori (1962. *Wildfowl Trust Fourteenth Annual Report*:129) for a paired drake of this species. He says, ". . . the paired drake attacks the pursuer and attempts to force him away by constantly interposing himself between his mate and the pursuer or by actually buffeting the latter." I concluded, therefore, that the drake Shoveler in question had formed a loose pair bond with the female Blue-wing.—GERALD F. MARTZ, *Wisconsin Conservation Department, Box D, Horicon, Wisconsin, 9 March 1964.*

Diagnosed diseases and parasitism in Rio Grande wild Turkeys.—During the course of Turkey trapping and banding activities in major winter roosting areas approximately 21 miles southeast of Sonora, Sutton County, Texas, three obviously diseased Turkeys (*Meleagris gallopavo intermedia*) were found out of 330 individuals trapped. These three birds were taken to the Sonora Sub-Station, Texas Agricultural Experiment Station, near Sonora, Texas, for examination and diagnosis. Veterinarians diagnosed the three diseased birds as having, respectively, infestation of scaly leg mites (*Knemidokoptes mutans*), enterohepatitis (*Histomonas meleagridis*), and fowl pox (*Borreliota* sp.).

There was only one published account of parasites or disease in the Rio Grande subspecies of the wild Turkey. This report concerned four species of lice found on a Turkey hen from Kleberg County, Texas (Hightower, Lehmann, and Eads, 1953. *J. Mammal.*, 34: 268-271).

This note is a contribution from the Texas Parks and Wildlife Department, Pittman-Robertson Project W-62-R.—JACK WARD THOMAS, *Texas Parks and Wildlife Department, Llano, Texas, 28 January 1964.*

A sound-triangulation method for counting Barred Owls.—During a study of population density of small mammals relative to surface water supply, certain related aspects have been observed. Among these is the presence, in the area of study (Section 31, Township 7 N, Range 5 E, Warren County, Mississippi) of a large number of predators. Especially noteworthy has been the Barred Owl (*Strix varia*).



FIG. 1. Sound reflector mounted on plane-table.

A technique has been developed to determine the number of Barred Owls within the study area which may be referred to as a "sound-triangulation" sampling technique. It involves the use of large parabolic sound reflectors with inset microphones mounted on the drawing boards of plane-tables. The sound reflectors are positioned 0.6 mile apart. Communication between the two positions is by radio. The direction of the "hooting" is determined with the aid of the sound reflectors and plotted on plane-table sheets. The exact position of the owl can then be determined by simple triangulation.

Each sound reflector (see Fig. 1) is equipped with a steel straightedge (0.5 inch wide by 1 inch thick by 39 inches long) mounted opposite the inset microphone in the same vertical plane as the microphone. A circular plane-table sheet, 20 inches in diameter, is attached to the drawing board of each table and the sound reflector-straightedge apparatus is attached to a circular drawing board (22 inches in diameter) by means of a pin so that the sound reflector may be rotated 360° about the center of the drawing board. The sound reflector, straightedge, and drawing board are mounted on a tripod approximately waist high

so that the operator may bend over the board without resting against it. The board is leveled, but no special attempt is made to see that it is perfectly level each time a measurement is taken.

A reference line is drawn on each plane-table sheet toward magnetic north. The direction of the "hooting" of the owl is determined with the sound reflectors by rotating the sound reflectors on the drawing boards until maximum intensity and clarity of the "hooting" is heard. A line, which represents the direction from the station to the owl, is drawn along the straightedge on the plane-table sheet. At each plane-table station the angle from which the "hooting" sound is directed is plotted. Lines are drawn through the plotted angles from the base line, and the intersection of the two lines reveals the exact position of the owl during vocalization.

Direct counting of all individuals and census by sampling in this study area are impractical because of the nature of the area and the behavioral characteristics of the Barred Owl. This species hunts mostly by night and prefers to nest in a hollow in a tree. It is consistent in its attachment to its chosen nesting site (A. C. Bent, 1938. Life histories of North American birds of prey. Part 2. Dover Publications, Inc., New York, N. Y., p. 183.) The nocturnal habits of the owl and the fact that the courtship of the Barred Owl consists mainly of loud, spectacular vocal efforts, which are emitted by both sexes, are utilized in this sampling technique. The sampling is done at weekly intervals and the sampling period is from 1 to 3 o'clock AM. Certain assumptions are made using this procedure. They are: (1) that each owl within the study area will make its presence known by its characteristic "hooting" notes; (2) that the owls will not move either into or out of the study area, nor within the study area during each of the 2-hour sampling periods; and (3) that the "hooting" sound from any particular location represents one owl rather than several birds together.

Within the latitude of these assumptions, it is probably possible to determine the home ranges of the owls and fluctuations in the number of owls from time to time. Such probability is greatly increased by the nesting site constancy of the species, and by the great number of samples taken.—RONDAL E. BELL, *Millsaps College, Jackson, Mississippi, 23 January 1964.*

Black-legged Kittiwake in West Virginia.—Early in the morning of 25 October 1963, a telephone call was received from the local State Road Commission Office informing me that a large bird had been hit by a worker's car that morning. The specimen was at the commission garage. The bird proved to be a Black-legged Kittiwake (*Rissa tridactyla tridactyla*). The identification has been verified by George M. Sutton, and Maurice Brooks assured me that this is the first positive West Virginia record supported by a specimen. This bird was killed on U. S. Route 52 near Dunlow, about 25 miles south of Wayne, in Wayne County. The only other West Virginia record is a sight record of two birds observed on the Ohio River in Wood County by Earle A. Brooks about 1902 (Brooks, M. G., 1944. Checklist of West Virginia birds. *W. Va. Agricultural Experiment Station Bull.* 316).

In the fresh specimen the bill was black, the iris was brown, the legs were black, the skull was ossified, and the bird was slightly fat. The region of the kidneys and gonads was so badly crushed that determination of the sex was impossible. Dr. Sutton, however, called it an immature bird, probably a female.

Dr. Sutton supplied the following description: "Some scapulars strongly tinged with brownish and tipped with grayish white: these are, I believe, of the outgoing juvenal plumage. Dark parts: region in front of, and almost surrounding, eye; spot on auriculars; hind neck; lesser wing coverts and areas on outer webs of scapulars and tertials; alula,

primary coverts, and primaries; tail tip. All these dark parts are noticeably blacker than in a male specimen in the University of Oklahoma collection (UOMZ 3735). Hallux more noticeable in West Virginia specimen than in Oklahoma specimen but not very noticeable in either." Measurements: wing, 295 (chord), 301 (flattened); tail, 125; exposed culmen, 34; tarsus, 34.

It is interesting to note the occurrence of this species in the neighboring states of Ohio and Kentucky. For Kentucky, Burt L. Monroe and Burt L. Monroe, Jr. (1961. *Kentucky Warbler*, 37:32) list one bird seen on the Ohio River at Louisville on 6 November 1960 (Wiley, Summers). For Ohio, Borror (1950. *Ohio J. Sci.*, 50:20) lists a bird taken at Buckeye Lake (now in the Ohio State Museum) on 7 November 1925; Williams (1950. *Birds of the Cleveland Region. Cleveland Mus. of Nat. History Bull.* No. 2) lists its status as "rare and accidental winter visitor," and gives three records: Winslow, three specimens in Cleveland Harbor (prior to 1880); Spare, one bird at White City, 3 November 1944; Piskac et al., one bird on the lake front, 71st Street, 21 December 1947.

The specimen, prepared by Lloyd F. Kiff, is in the Marshall University Collection, No. 116A-1/190.—RALPH M. EDEBURN, *Department of Zoology, Marshall University, Huntington, West Virginia, 12 March 1964.*

Black Swifts nesting in a limestone cave in Colorado.—On 7 July 1962, Gary Spurling and I flushed about six Black Swifts (*Cypseloides niger*) from a small cave at about 9,700 feet elevation, high up on the south side of the 1,500-foot-deep canyon of the South Fork of the White River, some 10 miles upstream from the South Fork Campground, Garfield County, Colorado.

The cave, in the thin-bedded limestone at the base of the Dyer member of the Chaffee formation of Devonian age, was the source of a torrential stream, about 10 feet wide and several inches deep, which cascaded from an opening about 10 feet wide by 15 feet high down a steep, largely treeless tributary gulch of the South Fork canyon. The passage, the floor of which was mostly covered by shallow water, extended horizontally southward into the canyon wall to a point about 80 feet from the entrance, where it was blocked by a mass of collapsed rock.

We found two nests, composed of damp moss or similar vegetable matter, in the twilight zone in niches in the west wall about 10 feet above the floor. One nest was about 20 feet from the cave entrance and the other about 40 feet from it. We did not have time to verify the identity of the nests by examining their contents, but they appeared essentially identical to Black Swift nests described and photographed by Knorr (1961. The geographical and ecological distribution of the Black Swift in Colorado. *Wilson Bull.*, 73:155-170) elsewhere in the Colorado Rockies; and this cave was only 17 miles northwest of the Dead Horse Creek nesting area discovered by Knorr.

To my knowledge, this is the only record of the nesting or roosting of the Black Swift in a limestone solution cave. However, the choice of this site should not be regarded as anomalous, since it included all the physical factors—water, high relief, inaccessibility, darkness, and unobstructed flyways—found by Knorr (loc. cit.:167-169) to characterize nest sites of the species. These cave nests were not so high above ground as is usual for surface nests, but this disadvantage was offset by the excellent overhead protection, awkward approach for predators, and invisibility of the nests from outside the cave.

Absence of previous records from caves may be attributed to the rarity of solution caves which spill water from sizable entrances directly onto steep slopes far above erosion base levels. The only similarly situated stream caves known to me are below the North Rim of

the Grand Canyon, Arizona, at much lower elevations than this Colorado cave. These have never been investigated for the presence of Black Swifts. Future visitors to any such sites should be alert for this little-known species.—DONALD G. DAVIS, *Route 3, Box 97, Fort Collins, Colorado, 17 March 1964.*

NEW LIFE MEMBER



Dr. Albert E. Allin, who has been a member of the Wilson Ornithological So-

ciety for over 20 years, has recently become a Life Member. Dr. Allin, a pathologist with three degrees from the University of Toronto, is presently director of the Regional Laboratory of the Ontario Department of Health at Fort William, Ontario. He is the recognized authority on the birds of western Ontario, and has published about 160 scientific articles in both medicine and natural history. He is an Elective Member of the AOU and a member of the Cooper Society, Federation of Ontario Naturalists, Canadian Society of Microbiologists, and Minnesota Ornithological Society. Besides ornithology his interests include ichthyology, gardening, and general conservation.

ORNITHOLOGICAL NEWS

It is with great regret that we learn of the sudden death on 11 August 1964 of Dr. Reuben M. Strong in his 92nd year. Dr. Strong was the last surviving Founder of our Society.

With the passing of Dr. Strong, and in recent months of Dr. Harry C. Oberholser and Dr. Arthur A. Allen, the two oldest members of the Society are now Charles H. Rogers and Alexander Wetmore, both of whom have been members for 61 years. Three other members, W. Lee Chambers, Ira N. Gabrielson, and W. E. Clyde Todd, have been members for 50 years or more, and Past President A. F. Ganier will join this group next year.

The Acting Secretary of the International Commission on Zoological Nomenclature informs us of the possible use of the plenary powers of the Commission in 11 cases. The only case in class Aves is the proposed suppression of the generic name *Cardinalis* Jarocki, 1821. Persons interested in commenting on these cases should write the Commission before 23 October 1964. All communications should be addressed to: The Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London, S.W.7, England.

Andrew J. Berger is currently holding a Fulbright Lectureship at the University of Baroda, India (address: c/o Dr. J. C. George, Head, Department of Zoology, Faculty of Science, M.S. University of Baroda, Baroda 2, India). Dr. Berger has recently completed a visiting Professorship at the University of Hawaii, and in May 1965 he will return to that institution as Chairman of the Department of Zoology.

FROM THE AOU

At its annual meeting in Lawrence, Kansas, on 31 August 1963 the AOU elected the following officers:

Dean Amadon, President	L. Richard Mewaldt, Secretary
Oliver L. Austin, Jr., First Vice-President	Robert J. Newman, Treasurer
Harold Mayfield, Second Vice-President	Robert M. Mengel, Editor

and elected members of the Council: Kenneth C. Parkes, Robert W. Storer, and Harrison B. Tordoff.

The Brewster Medal was awarded to Herbert Friedmann for his studies of blood parasitism in birds.

CORRECTION

The following corrections should be made in the article, "Comparative Behavior of the Yellow-headed Blackbird, Red-winged Blackbird, and other Icterids," *The Wilson Bull.* 75 (1963). Page 381, lines 12 and 13 should read: "Great-tailed Grackle (*Cassidix mexicanus*), Boat-tailed Grackle (*C. major*)," Page 382, line 14 should read: "In the Great-tailed Grackle, . . ." and line 21 should read: "In the Boat-tailed Grackle"

ORNITHOLOGICAL LITERATURE

BIRDS OF THE LABRADOR PENINSULA AND ADJACENT AREAS. By W. E. Clyde Todd. University of Toronto Press, Toronto, 1963: $8\frac{1}{2} \times 11$ in., xii + 819 pp., 9 col. pls., many photos. and maps. \$18.00.

Though the learned author of this book has made many other notable contributions to ornithological literature, it cannot be doubted that this monumental volume will be regarded in a special way as bringing together the results of his life's major effort. It will not be possible to give serious attention to Labrador birds without taking Todd's publication into account.

In addition to the Labrador peninsula as here defined, the region to which this book relates includes islands adjacent to the peninsula and the entire region east of the Missanabie and Moose Rivers and north of the mainline of the Canadian Pacific Railway as far as Lake Nipissing and thence north of a straight line from that lake to Lake St. John, in the Province of Quebec.

The main theme of the work is concerned with the problems of distribution, general and local, of the Labrador avifauna, but the study and consideration of various included bird species from the taxonomic standpoint form another important part of the book.

The volume is most appropriately dedicated to two men who were intimately associated with the fieldwork which was essential to its production, namely, Paul Commanda, head guide, of North Bay, Ontario, and John B. Semple, a Trustee of the Carnegie Institute, of Sewickley, Pennsylvania.

Prior to the annotated systematic list of species appear a number of limited sections of special interest. These include suitable acknowledgment to the human "angels" whose financial assistance made the field studies possible and to others who assisted in various ways; accounts of the geography and physiography, general geology, climate, population, resources, ecological conditions, and ornithological history of the region; consideration of seasonal occurrence; and sections dealing with the geographic history of the Labrador avifauna and conservation of birdlife. There is also a list of 22 new forms of birds described from the Labrador peninsula, 1789-1950.

Forty-five large pages are devoted to highly interesting records of the 25 Carnegie Museum Expeditions that penetrated various parts of the 600,000 square miles under study, in order to obtain the required information about the birds to be found there. The first expedition took place in 1901, while the concluding one was made in 1958. Seldom has an ornithologist been able to organize and direct research in the region of his choice over so long a period. For many years our author took a leading part in this fieldwork, obtaining essential firsthand acquaintance with the birds and the environment on which his investigations were concentrated and gradually building up a reputation among the residents of the north country until he assumed, in their eyes, the aspect of a legendary figure.

The annotated systematic list which forms the greater part of the work treats of no less than 315 species, of which at least two, probably three, are extinct. Families represented by the largest numbers of species are Anatidae (40 species), Fringillidae (36 species), Scolopacidae (30 species), and Parulidae (25 species).

On reading the lengthy specific accounts, one cannot but be impressed by the excellent and painstaking way in which the author has worked out details of distribution, evaluating the records of an earlier day, pointing out errors of various kinds, and generally setting to rights, with the aid of fresh data, the ranges of the species in the region under consideration. It is not to be expected that ornithologists of a century or more ago would

regard particulars of bird distribution in what was then a vast unexplored region as such data in that region would be regarded today, but scientific accuracy requires that their published reports be evaluated with the utmost care. In the present volume this task, often an unhappy one, has been ably performed.

Taxonomic discussions, often detailed and lengthy, are presented in connection with many species. The author tells us that the opinions expressed on taxonomic problems are his own, and that with them some other ornithologists may not agree. Thus it is not strange to find that in numerous instances the names and systematic arrangements that he believes to be correct, and therefore uses, differ from those used in the 1957 edition of the "A.O.U. Check-List." In this connection it should be mentioned that the author does not hesitate, with respect to various points, to revise, for reasons deemed sufficient, opinions to which he had previously adhered. A few new races are endorsed and others are discredited. In some instances there are differing conclusions as to which forms are species and which are subspecies.

Much new and significant information relating to life histories is incorporated, here and there, in the accounts of various species.

It is interesting to note that the nesting of the Surf Scoter in the Labrador peninsula is satisfactorily established by recorded instances, but it is held that there is no acceptable evidence of the nesting of either the White-winged Scoter or the American Scoter in the region. The present reviewer has no reason to suppose that White-winged Scoters, which summer in large numbers along the coast of the peninsula, breed within its borders, but is inclined to anticipate that American Scoters will eventually be found nesting there. This view with respect to the American Scoters arises from the fact that, on 26 May 1925, and again on 29 May 1935, he saw, in the vicinity of Seven Islands, flocks of whistling American Scoters that seemed to be courting. It is reasonable to think that active courtship at that time of year indicated that nesting grounds were probably not far distant.

This reviewer also dissents from the expressed view that, on the north shore of the Gulf of St. Lawrence, the Chipping Sparrow "is scarcely more than casual." Though its numbers along that coast are assuredly small, it is believed that, at Natashquan in particular, it is a regular, though scarce, breeding bird.

Readers will appreciate an interesting sidelight on the author's personality that is revealed on page 451. Concerning a Saw-whet Owl, a very rare bird in the Labrador peninsula, that was brought to him alive at Fort George, on the east coast of James Bay, he says, "Although it was the first of the species I had ever seen alive, and although it was high on my list of desiderata, I simply did not have the heart to kill it for a specimen, so I took it out into the woods and let it go."

In addition to full lists of references in the account of each species, a bibliography of 53 pages is provided as an appendix.

Another very useful appendix is a Gazetteer of Localities, containing more than 1,500 entries. The entry which refers to Seven Islands, situated on the north shore, west of the Gulf of St. Lawrence proper, as a village serves to draw attention to the rapidly changing conditions in parts of the region covered by this work. In the past 15 years Seven Islands has grown from a village to a city of some 25,000 inhabitants.

An index to families and names of birds concludes this notable volume.

It is a cause for general rejoicing that the author was able, not only to complete the long-continued researches that he describes, but also to prepare this exceptional report thereon and to see it, through publication, become available to all.—HARRISON F. LEWIS.

THE BIRDS OF COLOMBIA AND ADJACENT AREAS OF SOUTH AND CENTRAL AMERICA. By R. Meyer de Schauensee. Livingston Publishing Company, Narberth, Pennsylvania, 1964: $6\frac{1}{2} \times 9\frac{1}{4}$ in., xvi + 427 pp., 20 pls. (12 col.) by E. L. Poole, 88 line drawings by G. M. Sutton; endpaper maps, \$10.00.

This book marks an important step in the development of Neotropical ornithology, for it is the first popular guide, written in English, for any region in continental South America. It will doubtless be a great stimulus to amateur ornithologists, particularly short-term visitors who heretofore were intrigued by the abundance of species but, by the same token, were bewildered because there was no convenient method by which they could be identified. Because Colombia has an immense avifauna, encompassing nearly 60 per cent of all species occurring in South America, this volume will be of value throughout the northern part of the continent.

The introduction to the volume briefly summarizes the history of ornithological studies in Colombia and describes the geography, the seven faunal regions, and the four altitudinal zones of the country.

In the body of the book, each family is prefaced by an account of its world distribution, its habitat preferences and behavioral characteristics, a generalized description of its nests and eggs, and the total number of species found in Colombia, in the New World, and throughout the world. A drawing of a typical Colombian member of the family heads the section. This introductory summary is followed by an elimination key entitled "Aid to Identification," in which the Colombian species are divided into several broadly characterized morphological groups, such as "Underparts uniform gray, black, or white; Underparts uniform or mostly uniform buff to chestnut"; etc. Each group is followed by a series of numbers which refer to the positions of the species as they are arranged in the text. Although omitting the names of the birds makes for brevity, it causes the use of the keys to become a tedious, frustrating game. One has no hint of which species are included in a given group until they are tracked down in the text.

For each species an English vernacular name is employed, chosen with the aid of Eugene Eisenmann, who has long been interested in the standardization of vernaculars, and this is followed by the scientific name. Under "Description" is given the length of the bird in inches and a rather detailed description of the species, obviously taken from museum specimens rather than based on the characters one is most likely to see in the field. Next is outlined the total range of the species and its distribution within Colombia, including a broad indication of its habitat (e.g., "forest"). If there is more than one race in the country these are named, their distribution is noted, and any obvious morphological distinctions are described. In all 1,556 species are treated and 2,640 subspecies are cited, some in detail.

An English-Spanish glossary precedes a chronological list of important publications on Colombia. An index to scientific and vernacular names concludes the volume.

Twenty plates, 12 of which are in color, depicting 259 species and 87 line drawings of a representative member of each family, illustrate the book. The plates, by Poole, are meticulously prepared. The birds are portrayed in careful, crisp detail rather than in the generalized "identification" style of the familiar Peterson guides. The frontispiece, illustrating some of the small, brilliantly colored, tanagers, is inferior. The colors are muted and the details fuzzy. The drawings, by Sutton, are excellent; many have been taken from Van Tyne and Berger's "Fundamentals of Ornithology" (1959).

With a pioneering work of such broad scope as this, one must avoid comparisons with works written about better-known avifaunas. Nevertheless, there are certain features of this volume which seem less than satisfactory. A notable inconvenience is the failure

to provide a list of the families in the table of contents. In order to locate a given family one must wade through the lengthy index. Another deficiency concerns the use of names. Opposite each plate is a page on which the species are identified; the vernacular names are in large boldface, the scientific names in small italics. Unfortunately, the generic names are abbreviated to a single letter. If the species is polytypic, the specific name is also represented by only a single letter while the subspecific name is spelled in full. If one is not familiar with the vernaculars, which is almost certainly true if one speaks no English and probably is generally true of those English speakers without a prior interest in South American birds, the subspecific name is of little assistance. Even an ornithologist would probably be hard put to recall that *X. p. rostratus* and *X. p. picirostris*, both of which appear on the same page, stand for *Xiphocolaptes promeropirhynchus rostratus* and *Xiphorhynchus picus picirostris*, respectively. All mention of subspecies, unless morphologically very distinct, would seem better omitted from a book which is designed to assist identification rather than serve as a checklist.

Another disappointment is the complete lack of reference to song, behavior, and precise habitat preference. While it is granted that such information is unknown for many species, there are data for a substantial proportion of the avifauna, perhaps not specifically for Colombian forms but for birds which range into other areas of South America and into Central America. For example, the forest-inhabiting, melodious-voiced wren *Henicorhina leucosticta* may not have been closely observed in Colombia, but it is reasonably well known in Mexico and Central America and doubtless has similar habits in Colombia.

In summary, one has the impression that this guide is in reality a checklist of Colombian birds upon which has been superimposed descriptions of museum specimens. It is a useful book, although not easily used, but even without further ornithological work in Colombia could have been improved in many ways.—RAYMOND A. PAYNTER, JR.

BIRD SONGS FROM THE TROPICS: The Voices of 40 Tropical American Birds Recorded in the Field and Forests, Lowlands and Highlands of Venezuela. Recording, production, and narration by Paul Schwartz. Produced by the Instituto Neotropical, Caracas, Venezuela, 1964: 12-inch high-fidelity record, 2 sides, 33 $\frac{1}{3}$ rpm, jacket with table of contents. \$7.75. (Order from the Laboratory of Ornithology, Cornell University, Ithaca, New York).

Paul Schwartz presents, in this record, a wide variety of songs and calls of Venezuelan birds, all well recorded, with a minimum of extraneous sounds, and discerningly selected for maximum interest. This is a record which may be equally enjoyed as sheer entertainment, as an informal abstract of the subject of the sounds produced by tropical birds, or as a precise technical production.

The record includes 40 species of 8 orders and 22 families and presents high-pitched songs and low-pitched songs, extremely complex songs and simple songs, some well-known sounds and some poorly known sounds, some nocturnal species as well as diurnal species.

It is a record which unobtrusively informs the listener in many ways, even while holding his attention by its interesting content. Schwartz himself announces the common name of each species in turn, and calls attention succinctly, yet not pedantically, to many of the informative aspects of the record. These include a sampling of the wide variety of songs within a single family, the Troglodytidae (climaxed by the strikingly beautiful song of the Musician Wren), a comparison of the rather similar performances of two antshrikes (Barred Antshrike and Great Antshrike), an indication of the variety of songs to be found in populations of one species (Rufous-collared Sparrow) in different

parts of Venezuela, a sample of the "dawn songs" of a flycatcher (Great Kiskadee), and some examples of "duets" in tropical wrens and fringillids. Schwartz has presented a sequence of a wren "duet" as one might hear it from a moderate distance, when it seems to be a performance by a single bird, and then has followed this with a sequence in which the microphone has been cleverly placed in such a way that the relative loudnesses of the two parts of the song indicate clearly that it is a precisely timed, antiphonal song by two individuals. The listener may also learn that some tropical hummingbirds give well-developed vocal performances, that a Rufous-bellied Antthrush can deliver a series of rather loud, musical notes at a rate of four or five per second for 45 seconds without a pause, that the calls of some tropical caprimulgids are very high pitched, while others more nearly resemble the calls of the nightjars of the United States.

Six of the species, the Short-billed Marsh Wren, the House Wren (if the tropical forms are not separated as a distinct species), the Pauraque, the Great Kiskadee, the Green Jay, and the White-tipped Dove, range all the way to the United States, and at least 12 others range as far north as Mexico, so that most listeners will not be moving into a completely strange environment. Thus almost all of us will have the pleasure of comparing some of the performances with what we remember of the same species outside of Venezuela.

The high-pitched songs of the Blue-backed Conebill and the Blue-gray Tanager come through surprisingly well as do the shrill notes of the hummingbirds. The loudness level of the bird sounds and of the commentary is reasonably well balanced so that there is little necessity for changing the volume controls, although this may vary with the individual listener's sensitivity to various frequencies.

With only 20 species on each side, the listener has a chance to dwell upon the recordings of each species in turn and to get some idea of the variations and different types of performances by the same species. The birds are not arranged in taxonomic order, nor is there any obvious rigid arrangement of species, such as by habitat or type of call or song, except that all of the regular night birds are placed together. The result is a pleasing variety of sounds. The recordings are grouped into five bands on each side, for ready reference, with from two to six species included in each band. The jacket lists each species in order by common name and scientific name under side number and band number.

The record is obviously not intended as a complete field guide to the bird songs of Venezuela, but it could help the listener to learn some of the more common species of the New World tropics. In the case of the potoo, the owls, the nightjars, and the Little Tinamou, which are so difficult to see as they call, it presents recordings of very widely distributed species, and thus can be a great aid in identification of these birds in the field in many countries.

Among the highlights not already mentioned are the surprising vocal performances of the Laughing Falcon, the Lance-tailed Manakin, and the Black-winged Bellbird.

This is a welcome addition to the list of high-quality published recordings of bird songs from outside of the United States.—ERNEST P. EDWARDS.

NAMING THE BIRDS AT A GLANCE. By Lou Blachly and Randolph Jenks. Guide drawings by Sheridan Oman. Alfred A. Knopf, New York, 1963: $4\frac{1}{2} \times 7\frac{1}{2}$ in., xvii + 331 pp. \$3.95.

The enormous success of Roger Tory Peterson's field guides must surely stand as a constant temptation and challenge to other authors: Is there a better system? One criticism of any field guide which follows a strict systematic order is the difficulty the

beginner has in quickly finding the right family, much less the right species. An imaginative and successful alternative was demonstrated by Fitter and Richardson in 1952, with their Collins Pocket Guide to British Birds, in which identification was aided by groupings according to size, color, distinctive features, behavior, habitat, etc. Now two Americans have developed a system designed to aid the beginner with birds classified according to "whatever you notice at first sight," the field marks that might catch the eye in a quick or distant glimpse.

Let us state at the outset that the authors have demonstrated their point. It is indeed possible to use this guide as promised, quickly to identify birds in the field from the fleeting glance and the salient feature. In a cleverly devised series of keys, one is quickly referred to the section that might pertain: black head; blue, with wing bars; tail chestnut or rufous; red underparts; etc. From there it becomes a simple matter to narrow down the choices to the obvious answer. But there is one fatal flaw.

We are told on the title page that this is a pocket guide to the eastern land birds from South Carolina west to the Rocky Mountains and north to the Arctic. Which surely it is not. What it is, with certain extensions, is a guide to the identification of the *male birds of most of the landbird species in this area, in spring*. In their introduction, the authors state that "rare, unusual, and immature birds and birds in changed fall and winter plumage are not included." Not included also are pictures or identification keys to females, not even for strikingly dimorphic species. Thus the system rules out about 75 per cent of all the individuals the bird watcher will see throughout the year! And obviously any system that singles out the easy 25 per cent and ignores the rest simply does not work. The fact that this system takes 321 pages to treat 214 species would suggest that, to cover all the species and all the plumages in Peterson's Eastern Guide, three books this size would be required. The prodigality of space demanded is evident. To treat many species, the same illustration and description must be repeated three or four times in different sections. For example, one finds identical treatments of the Red-breasted Nuthatch on page 5 (Cap Black), page 65 (No Wing Bars), page 103 (Underparts Solid Chestnut or Brown), and page 137 (Black Eye Stripe or Mask). Meanwhile, if the first bird one spots after buying this guide happens to be a female Indigo Bunting, one might search all morning before discovering the cryptic, useless description "generally brownish and spotted below." But alas, so many individual birds have *no* field mark diagnostic at a glance that, beyond the birds treated here, the system becomes unworkable. Warblers in autumn and other such "problem birds" are simply ignored.

Other failings include very sketchy or totally absent habitat notes, some key identification marks missed (as in the House Finch), size wrong (Tree Sparrow), prevalent plumage not shown (winter Lapland Longspur), voice wrong (Fish Crow), birds missing from key group (Blue-winged Warbler not included in "Underparts Clear Bright Yellow"), and several frequently seen species missing altogether (Western Kingbird, Swainson's Warbler, Brewer's Blackbird, Clay-colored Sparrow).

On the plus side are the handsome and very much alive pen-and-ink drawings of Sheridan Oman, the sections on ground birds, owls, and hawks with views of birds perched and in flight. In summation, while this is not the answer to Peterson, it can be a helpful though tantalizing introduction for the complete neophyte—in perhaps his first spring migration. After that, he is going to demand information about family and generic relationships, about female, immature, and autumn plumages, and far more information on habitat, habits, and other attributes that help in identification, beyond that first quick glance.—ROBERT S. ARBIB, JR.

ULENDO. By Archie Carr. Alfred A. Knopf, New York, 1964: $5\frac{3}{4} \times 8\frac{1}{2}$ in., xviii + v [index] pp., map, photos. \$5.95.

There are eight chapters in this book, and only one of these deals to any significant extent with birds. It might thus seem somewhat marginal as the subject for a review in an ornithological journal. But any reader of *The Wilson Bulletin*, or anyone interested in conservation, in Africa, or in the finest natural history writing extant, will be the poorer if he fails to read Archie Carr's new book.

It purports to be a travel book, based chiefly on the author's experiences in Africa (*Uleno* means "journey" in one of the languages spoken in Nyasaland), but it is far more than that. Dr. Carr is an unashamed follower of sidetracks. His book is filled, as a pudding with raisins, with delightful little essays peripheral to his main topics. Some music heard in Nyasaland, for example, stimulates a five-page discussion of the marimba, in both its African and its Central American manifestations. A net haul in Lake Nyasa, with its yield of many closely related species of cichlid fishes, leads into a commonsense discussion of speciation and adaptation. And Carr's entire bird chapter follows from his having watched a Florida Snowy Egret following a dragline to glean food from the spilled mud. He embarks on a most thought-provoking speculation on the origin of the cattle-following habit in egrets—but not without getting sidetracked into writing about the soaring of vultures, the use of tools by animals, and native methods of hunting the hippopotamus.

Although the general tone of the book is light, there are also serious treatments of important conservation problems, especially the future of African wildlife in the context of the human "population explosion" and of African nationalism.

All too seldom does a publisher's blurb on the dust jacket of a book bear a one-to-one relationship to the truth. However, of Archie Carr the publisher writes "his literary gifts equal his scientific gifts." Dr. Carr, who is on the faculty of the University of Florida, is a herpetologist, and I am not qualified to assess his professional capability. But if his *scientific* gifts equal his *literary* gifts, then Archie Carr must indeed be one of the country's most outstanding herpetologists. Don't miss this book!—KENNETH C. PARKES.

PUBLICATION NOTES AND NOTICES

A Field Guide to the Birds of Texas and Adjacent States. By Roger Tory Peterson. Houghton Mifflin Company, Boston, 1963: $4\frac{1}{2} \times 7\frac{1}{2}$ in., xxxii + 304 pp., 60 full-page pls. (36 col.), numerous text-figs., 2 maps, 13 pages of silhouettes. \$4.95.

This is essentially a reprinting of the book (see review in *The Wilson Bulletin*, Vol. 73, pp. 108-110, 1961) published in 1960 and available only from the Texas Game and Fish Commission. Besides a differently colored jacket (now blue) and an increase in price, there are a few changes, all minor: the words "and Adjacent States" have been added to the title. The introduction on page xi concludes with a statement that Pettengill's "Guide to Bird Finding West of the Mississippi" provides a useful coverage of New Mexico, Oklahoma, Arkansas, and Louisiana as well as Texas. Page xii, instead of carrying a statement about conservation, shows a map of the area where the book is useful, gives a list of accidentals in Oklahoma and Louisiana not described in the book, and suggests that persons looking for birds west of the Rio Grande may also wish to use Peterson's "Field Guide to Western Birds." Pages xxx and 267 have the word "Texas" added to the titles relating to accidentals.

"I NAME THIS PARROT . . .": Brief Biographies of Men and Women in Whose Honour Commemorative Names Have Been Given. By Arthur A. Prestwich. Second edition. Privately printed, Edenbridge, Kent, England, 1963: [iv] + 118 + [43] pp. Paper covered. About \$3.00.

This booklet, as explained in the first (1958) edition, is concerned "with those members of the great Family Psittacidae named in honour of persons, the great majority very real, just a few almost legendary."

The Geese Fly High. By Florence P. Jaques. Second printing. University of Minnesota Press, Minneapolis, 1964: $7\frac{3}{4} \times 10\frac{1}{2}$ in., [vi] + 102 pp. Illustrations (line drawings) by Francis Lee Jaques. \$4.50.

First published in 1939 and long out of print.

Where Is That Vanished Bird?: An Index to the Known Specimens of the Extinct and Near Extinct North American Species. By Paul Hahn. Royal Ontario Museum, University of Toronto, 1963: [vi] + 347 pp. Paper covered. \$3.50.

This publication places on record the extant skins, mounts, and skeletons of the Passenger Pigeon, Eskimo Curlew, Great Auk, Ivory-billed Woodpecker, Whooping Crane, Carolina Parakeet, and Labrador Duck. Included is a detailed list of specimens in the various institutions and in the hands of private individuals, followed by whatever history was provided by the owners.

Sundial of the Seasons: A Selection of Outdoor Editorials from The New York Times. By Hal Borland. J. P. Lippincott Company, 1964: $5\frac{5}{8} \times 8\frac{1}{2}$ in., 350 pp. \$5.95.

From the author's foreword: "I doubt that anyone thought, back in the Fall of 1941 when I wrote an editorial about oak trees, that *The New York Times* and I were planting an acorn from which would grow a forest. I certainly didn't. But from that first outdoor editorial have grown more than a third of a million words about wind and weather, time and the seasons, man and his natural environment. In this volume I have chosen 365 out of a total of close to 1,200 of those pieces to assemble into a kind of almanac of the outdoor year—any outdoor year—as seen through one countryman's eyes and mind."

ANNUAL REPORT OF THE CONSERVATION COMMITTEE

The 75th anniversary year report presented at the Charleston, South Carolina meeting was so comprehensive in coverage that this 1964 report can limit itself to reporting on current matters and viewing a few perennial problems in slightly different perspective.

It is growing increasingly doubtful that a piecemeal attempt to keep the Earth productive and attractive can succeed. Almost any reading of current analyses of conservation needs—whether in the perpetuation of threatened species, environmental pollution, the control of depredations by birds, legislation, or whatever—will reflect the intricate and often obdurate socioeconomic conditions that influence all decisions in this allocation of priorities to resource use which we call conservation. Our nation of nearly 200 million people, if it is to exercise its tremendous new technological power without crowding all other forms of life from the landscape, needs a maturity and a sense of humility that is today anything but characteristic of the United States. This is the challenge to education.

It is therefore appropriate to call particular attention to the fine basic studies into the state of our material resources conducted in recent years by Resources for the Future, Inc., of Washington, D.C. These physical and economic appraisals and projections are fundamental to sound work in almost all land utilization. Fortunately, also, these studies are now being presented in a new series of brief popular reports. With the basic studies well along, RFF now wants to stimulate public discussion in these areas (Clawson, 1963). The Conservation Foundation of New York is also playing a valuable role in providing ecologically oriented discussions of many problems.

LAND-USE PROBLEMS

To appreciate their impact, the magnitude of modern regional management schemes must be visualized in terms of Rampart Dam and the Trinity River projects. The Alaska dam would inundate 9 million acres, creating a reservoir larger than Lake Erie. The Trinity River project, near Galveston, Texas, calls for "full development and beneficial public use of the water and related land resources of the Trinity River Basin." It is the first of a series of comprehensive land-use and development programs that would harness every one of the few waterways that nourish the Texas coast. It is obvious that such drastic remakings of the landscape will affect regional birdlife, enhancing conditions for a few species, but bringing disaster to many others *unless* the needs of a balanced wildlife population are specifically considered in the planning stage. Another such project is the proposal for a new regional water plan for the Southwest which includes two large dams at Marble and Bridge Canyons. The Marble Canyon dam would back water into the Grand Canyon National Park. Attempts to make the desert bloom, we too often forget, have a high price tag.

Economic and political pressures on the Department of the Interior squeezed the Kenai National Moose Range (Alaska) in two during 1963. Some 290 square miles were excluded from the refuge to allow intensive lumbering and oil and gas development, but even this did not satisfy Senator Gruening, who wanted 715 square miles. There would seem to be two object lessons in this development. "Kenai's difficulties began in 1958, when in an effort to get along with people, the department amended its regulations to permit oil and gas leasing on more than 90% of the stratified rock in the moose range certified by the U. S. Geological Survey as having potential. The department was under no mandate to open the moose range.

"But industrialization and human invasion of the moose range on a large scale is now accomplished fact. Belatedly . . . the department now admits that 'Although operations

have been carefully controlled to minimize destructive effects, and the oil companies have exhibited a high degree of cooperation, long-term scarring effects to the environment, the disturbance of wildlife, pollution dangers to fisheries and waterfowl waters, increased fire hazards, and human occupancy foreign to a natural habitat has resulted in serious detriment to the range's original objectives, invalidating earlier thoughts to the contrary.' 'Thoughts to the contrary' congressional records of several years ago make clear, were not the thoughts of biologists and interested conservationists. They were the thoughts of the politicians and petroleum interests and those who sought to appease them" (Poole, 1963).

In August 1963 Carl W. Buchheister, President of National Audubon Society, wrote to President Kennedy protesting a Budget Bureau proposal that the Hawaiian Islands National Wildlife Refuge be transferred to the State of Hawaii. This refuge includes famous Laysan Island, home of the endemic Laysan Duck, the drepanid *Psittirostra*, albatrosses, etc.; and Nihoa, home of the Miller-bird (*Acrocephalus*). Not too happily received in Washington, the protest was nevertheless timely and the U.S. Fish and Wildlife Service is at long last now in the process of doing something for this chain of islands (Buchheister, 1964).

Still very much worth fighting for is the Kentucky Woodlands National Wildlife Refuge which is seriously threatened by a Tennessee Valley Authority "Land-Between-the-Lakes National Recreation Area" in Kentucky and Tennessee. At the November 1963 convention of the National Audubon Society, Roger Tory Peterson challenged Dr. Edward C. Crafts, Director of the new Bureau of Outdoor Recreation, to "coordinate" these federal approaches to recreation in such a way as not to impinge on existing wildlife refuges. He said, "To me, coordination—which is one of BOR's assigned responsibilities—means avoiding conflict and overlapping in programs, and it is obvious that if BOR is to do a constructive job it must find new recreational opportunities without itself destroying existing wildlife values, and help prevent other agencies from trampling on these values. . . . If this kind of unilateral development can continue in our government, BOR will be superfluous from the start" (Peterson, 1963).

It is with some relief that conservationists received news of the Atomic Energy Commission's cancellation of "Project Chariot" in June 1963. The project had withdrawn a million acres of tundra in the Cape Thompson, Alaska area and proposed the experimental blasting out of a harbor. Rumor had it that the project was made necessary by the test-ban treaty between the U.S. and U.S.S.R., since the AEC's earth-moving contractors had been idled thereby. Some good biological studies of the area were a desirable by-product.

Wilderness.—Howard Zahniser, 58, scholarly, gentle, widely loved executive director of the Wilderness Society, principal leader of the movement to secure enactment of a national wilderness conservation law, died peacefully at his home in Hyattsville, Maryland early on the morning of May 5. Prospects had never looked brighter for final Congressional action on the wilderness bill. The House Public Lands Subcommittee had completed hearings on the bill the previous week, and its leaders were speaking hopefully of early agreement on an acceptable, compromise measure" (Callison, 1964b).

HABITAT POLLUTION

Pesticides.—Twenty-five years from now, when the present debacle involving pesticides policy is looked back upon as an embarrassing chapter in the history of the age of technology, 1964 may stand out as the turning point in our return to sanity.

It was, unfortunately, the year that Rachel Carson died (14 April) of cancer at age 56.

Perhaps the generation that does this looking back will know more about the role of chemical insult to replicating cells that today is only one of many clues to this disease of civilization.

On 15 May 1963 President Kennedy's Science Advisory Committee had issued its anxiously awaited report on the *Use of Pesticides* (Weisner, 1963). Industry spokesmen and agricultural officials quickly declared it "vague" and "unsatisfactory on many points." The rest of us were delighted that it had moved so far in recognizing the gravity of the situation and courageously advocated, in its Recommendation No. B 5, "elimination of the use of persistent toxic pesticides" as the goal of official policy. This is now a basic document.

Testifying before a senate subcommittee on 22 April 1964, Roger Tory Peterson again warned that food-chain poisoning was a serious threat to such end-of-the-chain fish-eaters as the Bald Eagle and the Osprey, among others, since it has been found that in both these raptors, eggs that fail to hatch contain significant amounts of DDT and DDE (Ames, 1964).

The scope of this problem, and the biggest news of the year, is obvious in the belated publicity given massive fish kills that have plagued the lower Mississippi River basin for three or four winters. This at last brought the U.S. Public Health Service into the middle of the pesticides controversy. The USPHS said that the insecticide endrin was responsible for these fish kills, but the manufacturer of endrin denied this and accused the bureaucrats of major scientific blundering. The case was unfortunately complicated by the fact that a manufacturing plant at Memphis, Tennessee had apparently dumped endrin wastes in the river. The Department of Agriculture gladly accepted USPHS testimony on this score since this allowed them to juggle the issue of environmental contamination resulting from "approved" agricultural uses of endrin. The accused industry, of course, denied all.

During April and May 1964 the Agricultural Research Service held a series of hearings on the question of revising the registration of endrin, aldrin, and dieldrin. The official attitude seemed to be "violations have been alleged, but even though we don't think anything is wrong, we're willing to be democratic and listen to complainants." Secretary Freeman finally announced that "none of the evidence presented at the hearings—or at a four-state conference in New Orleans—was scientifically adequate to justify withdrawal of endrin, aldrin or dieldrin for farm use."

Meanwhile, though the Public Health Service was apparently having trouble getting a special \$800,000 appropriation for a continuation of the studies on fish kills in the Mississippi and other rivers, the USDA was said to be seeking \$85,000,000 to "field monitor, on a scientific basis, the normal use of pesticides on farms and forests." Senator Ribicoff's subcommittee decided to inquire into why "science" seemed to be marching off in so many directions at once.

This was also the year when Philip Marvin, a chemical manufacturer turned ornithological analyst, launched a hoax since given wide endorsement and distribution by various farm magazines, chemical trade publications, and by no less eminent a biochemist than Dr. Thomas H. Jukes in the pages of *American Scientist* (Jukes, 1963).

Mr. Marvin's analysis of bird population data from *Audubon Field Notes'* Christmas counts purported to show that there had been a population explosion among birds, not only despite the increasing use of chemical insecticides, but apparently because of it (Marvin, 1964)! Dr. Frank E. Egler fortunately helped take *American Scientist* off the hook (Egler, 1964), but it is impossible to counter the false impressions which were broadcast by farm magazines and the newspapers who copied them.

Even so, new trends in official policy can be seen in New Hampshire Governor John W. King's 3 April 1964 directive asking all his state agencies to stop using DDT as an insecticide. In New York, the State Department of Conservation directed that no DDT be used in treating state forests that include lake trout watersheds, and a bill was passed setting up a Pest Control Board. On 7 May Secretary Udall directed the several bureaus and offices of the Interior Department to use pesticides "in a manner fully consistent with the protection of the *entire environment*. The guiding rule for the Department shall be that when there is a reasonable doubt regarding environmental effects of the use of a given pesticide . . . no use should be made."

MIGRATORY BIRD HUNTING

One continues looking in vain for the scientific justification of such unlimited bags as that imposed on the Common Merganser by the State of Washington in 1963. Protecting fish hatcheries, which may be a special problem in Washington, is not sufficient cause for declaring an unlimited open season on a fish-eating bird. The U.S. Fish and Wildlife Service's regional director (Northeast) John S. Gottschalk led the way in a 19 March 1964 directive to all hatchery managers in his region requiring (1) dependence on nonlethal methods of control as a first step, (2) consultation with a professional depredations control agent if necessary, and (3) application for a special permit from the Regional Office to use lethal control methods where none other could be shown to be effective. Copies of the directive were sent to all other regional directors by Mr. Gottschalk, himself a fisheries biologist.

The difficulty of holding the line on waterfowl limits during these years of low water levels on the breeding grounds, and low productivity, was made apparent when Congressman T. A. Thompson of Louisiana called an open hearing in Washington 18 July "to find out if duck hunters have been given full consideration." He also called on Wildlife Service officials to stand ready for questioning by his Subcommittee on Fisheries and Wildlife. Since these two quizzes barely preceded the National Waterfowl Advisory Committee meeting in Washington, at which season length and bag limit are discussed, the intent of these unexpected hearings was obvious (Callison, 1963). These events point up the importance of alert conservation groups to counter political pressures for unwarranted relaxations in the annual regulations.

ENDANGERED SPECIES

Raptors.—The National Audubon Society's cooperative study of Bald Eagle populations continues as planned and interim reports are made at the Society's annual conventions (Sprunt, 1963). It is expected that a full-scale report on the California Condor studies of the past 2 years will be made at the Tucson, Arizona convention on 7 November 1964.

Dr. Walter R. Spofford, who studied the Golden Eagle problem in Texas and New Mexico during the past two winters, reported on the first phase of these studies at the Audubon Convention in Miami (Spofford, 1963). He reported that "The shoot-off of Golden Eagles in the Texas-New Mexico sheep and goat ranching country, which became regular and drastically efficient with the employment of gunners shooting from airplanes, has resulted in the destruction of over 20,000 Golden Eagles between 1942 and 1962. These were not resident eagles, as some ranchers believed, but migratory eagles from northern parts of the continent congregating upon southern wintering grounds." Heavy pressure continues on Secretary Udall to remove the restrictions on the use of airplanes to control eagle depredations (Callison, 1964a).

Kites.—The discovery, in 1963, that Florida Everglades Kites were using the Loxahatchee National Wildlife Refuge, southeast of Lake Okeechobee, led to the observation of at least 15 kites there during the 1964 breeding season (A. S. Sprunt, IV, in correspondence). The initiative of Gilbert Cant deserves commendation. He convened an Emergency Committee for the Everglades Kite in May 1964, and his petition to Secretary Udall led to "closing to entry" that portion of the refuge being used by the kites.

Attwater's Prairie Chicken.—The publication of Lehmann and Mauermann's (1963) status review was an important catalyst to action in attempting to save this Gulf Coast race of the Greater Prairie Chicken from extirpation. An 85% decline in numbers since 1937 has brought the population down to some 1,335 birds! "In October, 1964 Richard H. Pough, acting for the Nature Conservancy, and Val Lehmann negotiated an option to buy 3428 acres for \$364,000. The full purchase price remains to be subscribed" (Buchheister, 1964).

Whooping Crane.—The 1963 production of seven young birds was a pleasant surprise to everyone, because aerial reconnaissance had uncovered nothing by way of breeding territories. In April 1964, also, the New Orleans Zoo provided two eggs to the Wildlife Service. These were hatched successfully at the private aviary of John J. Lynch, a Service biologist at Lafayette, Louisiana. The two young subsequently died, however. In a further, somewhat belated move to improve on the production of the existing captive flock, the lone San Antonio Zoo bird was brought to New Orleans, but no mating occurred.

On 15 November 1963 the Wildlife Service distributed Wildlife Leaflet 456 on Special Permits, enunciating a new policy which would make the Service a partner in an expanded program of artificial propagation of migratory game birds, perhaps even including the Whooping Crane and the Eskimo Curlew. In April 1964 the Service announced what appeared to be a commitment, rather than a proposal, to take eggs of wild Whooping Cranes from the northern breeding grounds in 1965 in an attempt to start a new captive flock. The National Audubon Society's deep reservations about such attempts were voiced in *Audubon Magazine* (Clement, 1964).

Eskimo Curlew.—Observers on the Texas coast, especially in the Galveston Island area, failed to find migrants in the spring of 1963 and 1964, as they had between 1959 and 1962.

CONTROL OF BIRD POPULATIONS

On 20 October 1959 representatives of ornithological and conservation organizations in the New York City area held a public meeting to protest the U.S. Navy's plan to continue killing albatrosses at Midway Island, in the mid-Pacific, because these birds were a hazard to radar patrol aircraft using this atoll as an operating base. As a result of this meeting, the Navy was induced to put off killing birds until recommendations made by the U.S. Fish and Wildlife Service to reduce the hazard had been fully implemented.

In late 1963 it became obvious that the Navy, not satisfied with an 85% reduction in bird-plane strikes, proposed to eliminate some 20,000 more albatrosses. Protesting this failure to consult in advance with all interested conservation groups, the National Audubon Society was invited to send its President to Midway at the expense of the Navy to evaluate the hazard and observe the steps being taken to reduce it. The Society (Buchheister, 1964) thereupon recognized the need of some control but made a number of suggestions for improving the welfare of Midway's albatross population that should, if developed, help counterbalance the heavy losses which have been imposed on this population in the past two decades.

The appearance of the report of Secretary Udall's Advisory Board on Wildlife Management, "Predator and Rodent Control in the United States," on 9 March 1964, is a landmark in the continuing fight to keep control programs under control. The report is basic reading for everyone in the least interested in this multifaceted problem—to ornithologists as well as others—because it discusses the bird control problem and because many mammal control programs affect birds, especially raptors, indirectly.

Last year's report provided a two-page review of the bird control problem. It ended on the theme that here was a challenge to ornithological science. And so it is, of course. One of the obstacles to the public discussion of these matters, and to obtaining continuing support for so mundane an effort in science, is the popular notion that we already know all about birds.

Fortunately, there remains a very lively awareness of the basic nature of research needs among many of the professionals in our federal and state services who must cope with the man-bird relation. A good example is the recent action of the Department of Natural Resources in the State of Washington. They have initiated a field study to determine the status of "birds as forest protection agents." Almost all the northern European nations, as well as the Soviet and our friends in Canada, are far in advance of the United States in this area of research and application. Perhaps the very success of our chemical pesticides industry since World War II has blinded us to the needs and opportunities in this area of *natural* insect control.

There is, however, a real danger in doing anything but a thorough and perceptive job of investigation and experimentation. Population biology is a subtly complex challenge, and if premature discouragement with current attempts should lead to abandoning the program, this fundamental approach might be set back another generation.

Ornithologists need reminding that our own U.S. Fish and Wildlife Service pioneered this approach at the turn of the century and, under the leadership of one of the finest scientists it has ever attracted—W. L. McAtee—was making great strides in demonstrating the role of birds in controlling insects (Clement, 1960). The exigencies of World War II, and the subsequent population explosion, unfortunately shifted interest to quantitative efficiency in agriculture, creating the pesticide dilemma and multiplying the conflict between man and birds. The U.S. Department of Agriculture, which led us into this dark alley, now seeks \$85,000,000 to investigate what really happens to pesticides they have enthusiastically induced the farmer to use these 20 years past. It would make good sense to spend a fraction of this amount investigating how we can fit agriculture back into the ecosystem instead of allowing it to anastomose like a cancer.

Fortunately, again, though federal research in this area was shelved some 20 years ago, others have continued probing (Pimentel, 1961*a, b*) and the future holds as much promise as it ever did. If you think such approaches are as promising as the investment we now make on the space race or other billion-dollar ventures, you had better help fight for the rounded effort suggested here. Congressional appropriations do not come from reasonable deliberation so much as from competitive haggling over how the pie shall be sliced.

The committee owes thanks to Dr. John W. Aldrich and Erwin W. Pearson of the U.S. Fish and Wildlife Service, who sent thoughtful comments. Ours was a "lame duck" session, and the chairman had to assume full responsibility for selection, emphasis, and wording. There was not time to review the manuscript.

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WOS CONSERVATION COMMITTEE
ROLAND C. CLEMENT, CHAIRMAN
WALTER W. DYKSTRA
DANIEL A. POOLE

PROCEEDINGS OF THE FORTY-FIFTH ANNUAL MEETING

PERSHING B. HOFSLUND, SECRETARY

The Forty-fifth Annual Meeting of the Wilson Ornithological Society was held Thursday, 30 April, to Sunday, 3 May 1964 in Kalamazoo, Michigan. The meeting was sponsored by Western Michigan University, Kalamazoo College, Kalamazoo Nature Center, Audubon Society of Kalamazoo, and the Michigan Audubon Society. The meeting was hosted at the Western Michigan University, the local committee being under the direction of Dr. Richard Brewer from the host university. The meeting was attended by 190 registered members and guests.

The meeting opened with a showing of the film "The Secret Spring" by William Dyer on Thursday night. The first of four papers sessions was inaugurated on Friday by a welcoming address given by Dr. Gerald Osborn, Dean of the School of Liberal Arts, Western Michigan University, and a response on behalf of the Society by President Phillips B. Street. On Friday evening the Kalamazoo Audubon Society hosted Wilson Society members and guests at an informal reception and an exhibition of ornithological paintings and photography. The annual dinner, held in the Morris Motor Hotel on Saturday night, was emceed by Dr. H. Lewis Batts, Jr. The guests were presented with a portfolio of four sketches (two by Robert Mengel and two by George Sutton) as favors. Highlights of the meeting were the President's address and a slide and movie presentation of "The Cranes of Africa, Europe and Michigan" by Past President Lawrence H. Walkinshaw.

There were early morning trips to the Wolf Lake Fish Hatchery and Cooper's Glen plus a tour of the Kalamazoo Nature Center. On Sunday those members who were able to participate took part in field trips to Warren Woods and Warren Dunes or the Baker and Kellogg Sanctuaries.

The success of the 45th Annual Meeting is largely due to the hard work and planning of the local committee.

FIRST BUSINESS SESSION

President Street called the meeting to order at 9:30 AM, Friday, 1 May. Following Dean Osborn's welcome and President Street's response the business session was opened with approval of the Proceedings of the Forty-fourth Annual Meeting as published in *The Wilson Bulletin* for September 1963.

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 last year's decision to hold the 1965 meeting at Sylvan Lake in the Black Hills of South Dakota. The dates of this meeting have been set for 17 through 20 June.
2. The Council voted to accept the invitation from Pennsylvania State University to hold the 1966 meeting in University Park, Pennsylvania.
3. The Council voted to approve the recommendation of the Louis Agassiz Fuertes Research Committee and award Robert E. Gobeil of Biddeford, Maine the 1964 grant.
4. Dr. George A. Hall of West Virginia University was reelected editor of *The Wilson Bulletin*.
5. In order to meet the spiraling costs, the Council authorized the increase of the following dues and charges effective after 31 December 1964.
 - a. Regular memberships and subscriptions from \$4.00 to \$5.00.

- b. Life memberships from \$100 to \$150 with installment payments set at \$37.50 per annum for 4 years.
- c. Sustaining membership from \$6.00 to \$10.00.
- d. Annual meeting registration fee from \$2.00 to \$3.00.
- e. Changes in the prices quoted for back issues to read, the same cost as for current issues, except where quantity numbers are ordered, wherein prices will be quoted.

Treasurer's Report

Treasurer, C. Chandler Ross, summarized the following report of the finances of the Society:

REPORT OF THE TREASURER FOR 1963

GENERAL FUND

Balance as shown by last report dated 31 December 1962 \$ 4,265.76

RECEIPTS

Dues:

Active Memberships	\$4,764.00	
Sustaining Memberships	1,068.00	\$5,832.00
Subscriptions to <i>The Wilson Bulletin</i>		1,123.25
Sale of back issues of <i>The Wilson Bulletin</i>		514.57
Interest and dividends on savings and investments		1,331.47
Miscellaneous income and gifts		27.95
Total Receipts		\$8,829.24

DISBURSEMENTS

The <i>Wilson Bulletin</i> (printing and engraving)	\$7,508.75	
Less donation for color plate	247.48	\$7,261.27
The <i>Wilson Bulletin</i> (mailing and maintenance of list)		1,111.51
Editor's expense		90.66
Secretary's expense		51.41
Treasurer's expense		444.51
Canadian discount on checks and money		15.98
Annual Meeting expense		305.15
Committee expense		18.52
International Council for Bird Protection (1963 dues)		25.00
Total Disbursements		\$ 9,324.01

Excess of expenses over receipts for year 1963 494.77

Balance on hand and in Girard Trust Corn Exchange Bank, Philadelphia, Pennsylvania 31 December 1963 \$ 3,770.99

JOSSELYN VAN TYNE MEMORIAL LIBRARY BOOK FUND

Balance as shown by last report dated 31 December 1962 \$ 765.53

RECEIPTS

Sale of duplicates and gifts	\$147.85	
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DISBURSEMENTS

Purchase of books and postage	247.67	\$ 99.32
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Balance in Girard Trust Corn Exchange Bank, Philadelphia, Pennsylvania
31 December 1963 \$ 665.71

LOUIS AGASSIZ FUERTES RESEARCH FUND

Balance as shown by last report dated 31 December 1962	\$ 100.00
RECEIPTS	
Contributions	\$23.00
Total	\$ 123.00
DISBURSEMENTS	
Award to Nicholas Verbeek	\$ 100.00
Balance in Girard Trust Corn Exchange Bank, Philadelphia, Pennsylvania 31 December 1963	\$ 23.00

ENDOWMENT FUND

Balance in Savings Account as shown by last report dated 31 December 1962	\$2,165.66
RECEIPTS	
Life Membership payments	\$3,100.00
Stock dividends received (included below)	
110 shares Fireman's Fund Insurance	
Total	\$5,265.66
DISBURSEMENTS	
Purchase of \$5,000. Bankers Trust Co. 4½% Notes due 15 December 1988	5,000.00
Balance in Savings Account, Girard Trust Corn Exchange Bank, Philadelphia, Pennsylvania 31 December 1963	\$ 265.66
SECURITIES OWNED (listed at closing prices 31 December 1963)	
\$5,000. U.S. Treas. 4% Bonds due 1 October 1969 at 99 ²⁸ / ₃₂	\$ 4,993.75
\$5,000. U.S. Treas. 4% Bonds due 15 August 1972 at 99 ³ / ₃₂	4,954.69
\$3,000. Phillips Petroleum 4½% Cvt. Bonds due 15 February 1987 at 111½	3,345.00
\$5,000. Bankers Trust Co. 4½% Notes due 15 December 1988 at 100	5,000.00
15 shares Kaiser Aluminum & Chemical Co. 4¾% cum. cvt. pfd. (1957 series) at 105	1,575.00
25 shares Owens-Illinois Glass Co. 4% cum. pfd. at 99	2,475.00
70 shares M. A. Hanna Co. at 38¼	2,668.75
416 shares Massachusetts Investors Trust at 15.46	6,431.36
210 shares Fireman's Fund Insurance Co. at 35½	7,455.00
Total securities owned	\$38,898.55
Total Endowment Fund, 31 December 1963	\$39,164.21

Respectfully submitted,
C. CHANDLER ROSS
Treasurer

Research Grant Committee

In the absence of Harvey I. Fisher, Chairman of the Louis Agassiz Fuertes Research Grant Committee, the Secretary summarized the committee's report.

The committee received 11 inquiries about the grant, these inquiries coming from California (2), Illinois, Indiana, Kansas, Maine, Michigan, Utah, Virginia, Wisconsin, and Wyoming. However, only three applications were completed. The committee recommended that the award be given to Robert E. Gobeil, Cole Road, Biddeford, Maine, who requested the grant for work on the arterial system of the Herring Gull.

Dr. Fisher tendered his resignation as chairman of the committee. His resignation was accepted with regret by the Executive Council at the Thursday night meeting.

Conservation Committee Report

The absence of Roland Clement, chairman of the Conservation Committee, and a delay in the receipt of the committee's report necessitated the omission of the report at the meeting. The report of the committee appears elsewhere in this issue of the *Bulletin*.

Membership Committee Report

The committee reported an increase of 32 new subscribers and 143 new members. Chairwoman Hazel Bradley Lory reported that her committee of 14 sponsored or cosponsored 42 of the new members.

Library Committee Report

Chairman William A. Lunk reported that "the storage problem of *The Wilson Bulletin* back issues was considerably alleviated through disposal of excess numbers."

The new book fund has been augmented by the sale of duplicates and contributions. Surplus books and reprints were offered for sale at the meeting.

Another increment of the late Josselyn Van Tyne's library was formally accepted as a gift from Mrs. Van Tyne—this comprising 105 more volumes from the "General Ornithology" section.

Total acquisitions for the year—57 separate donations by 49 donors—were: 129 books, 757 reprints, 134 journals, 7 translations, and 2 pamphlets. The number of journals regularly received remained about the same as last year: 110, 84 of these through exchange.

Fifty-five out-of-town loans were made, 107 items going to 46 individuals. Constant on-the-spot use, of course, continues to be made of the collections by the many individuals working permanently or temporarily in Ann Arbor.

Since the recent completion of the new Museum of Zoology wing, all library facilities in the building have been greatly expanded. The Josselyn Van Tyne Memorial Library, too, has profited greatly, with increased room for expansion and much better organization of materials. As in the past, Norman Ford of the Bird Division, Museum of Zoology, has done the bulk of the actual handling of books and records; as of this date, moves have been essentially completed, and the materials are readily accessible for use.

We can ask no better support and cooperation. But we would urge the membership to make greater use of this superb reference collection, which is maintained as a tool for the Society and for all interested workers.

Endowment Committee

The Secretary read the report of the Endowment Committee in the absence of its Chairman, Stephen W. Eaton.

During 1963, 86 letters were written by the committee to prospective life members. About 14 new life members were added to the membership.

President Street at the annual meeting at Charleston, South Carolina suggested an appeal for life members be sent out with the annual dues notice in the fall. The wisdom of this move, to include the appeal with the dues notices, paid off because following this up until 1 April 1964, 42 new life members were added to the roster.

An additional report at the Council meeting indicated that eight members were becoming patrons now plus ten additional ones who are signifying their intention by contributing towards this goal on the installment basis. When all of these are paid up, the endowment fund will show a 25 per cent increase.

All of the above reports were approved by majority vote.

Temporary Committees

President Street appointed the following temporary committees:

Auditing Committee

Alan Crawford, Jr., Chairman
Edward L. Altemus
John H. Foster

Nominating Committee

O. S. Pettingill, Chairman
Lawrence H. Walkinshaw
Harold Mayfield

Resolutions Committee

Harrison B. Tordoff, Chairman
William A. Lunk
William E. Southern

SECOND BUSINESS SESSION

The final business session was called to order at 3:05 PM, Saturday, 2 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 following report was read by the Secretary:

"We have examined the balance sheet and accounts of the Wilson Ornithological Society for the year ended December 31, 1963. Our examination was made in accordance with generally accepted auditing standards and included such tests of the records as we considered necessary under the circumstances.

"In our opinion the statements of account fairly represent the financial condition of the Society. We wish to commend the Treasurer for his precise and detailed accounting, his performance and methods being of the highest order."

Report of the Resolutions Committee

The following report was read by the Chairman, Harrison B. Tordoff:

WHEREAS, the Wilson Ornithological Society has been privileged to hold its Forty-fifth Annual Meeting in Kalamazoo, Michigan, and

WHEREAS, the members and guests of the Society have been warmly welcomed and entertained,

THEREFORE, be it resolved that the Society expresses its sincere appreciation to our hosts, the Audubon Society of Kalamazoo, Kalamazoo College, Kalamazoo Nature Center, Michigan Audubon Society, and Western Michigan University.

BE IT FURTHER RESOLVED that the Society give special thanks to Dr. Richard Brewer, Chairman of the Local Committee for Arrangements, and to the members of his committee, Dr. and Mrs. H. Lewis Batts, Jr., Mrs. Richard Brewer, Ray Deur, Letha Culver, Monica Ann Evans, Frank Hinds, Jack W. Kammeraad, Charles E. Mohr, Dr. and Mrs. Harold O. Wiles, Jack S. Wood, and A. Verne Fuller, for making our visit to this successful meeting memorable and pleasant.

The Secretary of the Society is requested to convey these thanks to appropriate individuals.

Election of Officers

The Nominating Committee proposed the following officers for the coming year: President, Roger Tory Peterson; First Vice-President, Aaron M. Bagg; Second Vice-President,

H. Lewis Batts, Jr.: Secretary, Pershing B. Hofslund; Treasurer, C. Chandler Ross; Elective Members to the Council, William W. H. Gunn (term to expire in 1967) and Harvey I. Fisher (term to expire in 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, 1 May

1. H. Lewis Batts, Jr., Kalamazoo College. *The Kalamazoo Nature Center.*
2. Lawrence H. Walkinshaw, Battle Creek, Michigan. *The Birds of Southwestern Michigan.*
3. Elden W. Martin, Bowling Green State University. *A Preliminary Report on the Total Carcass Constituents of Spizella arborea Following Controlled Environmental and Dietary Treatments.*
4. Margaret M. Nice, Chicago, Illinois. *Displays of a Hand-raised Meadowlark.*
5. Harold Mayfield, Waterville, Ohio. *Distribution of Cowbird Eggs.*
6. Donald J. Borror, Ohio State University. *Studies of Song Sparrow Songs.*
7. Ralph W. Dexter, Kent State University. *Pairing Behavior and Rate of Survival in Nesting Colony of Chimney Swifts, 1945-1963.*
8. Maurice L. Giltz, Ohio State University. *A Comparison of the Utilization of Meadows and Marshes for Nesting by the Redwinged Blackbird.*
9. William E. Southern, Northern Illinois University. *Is Avian Navigation a Reality? A Progress Report.*
10. Richard D. Porter, Wisconsin State College, Whitewater, Wisconsin. *The Ecological Distribution of Some Raptores in the Desert Area of Western Utah.*
11. John O. L. Roberts, Point Pelee (Ontario) Bird Observatory. *Studies of the Fall Migration of Sharp-shinned Hawks at Point Pelee.*
12. William W. H. Gunn, Canadian Wildlife Service. *Migration Over Lake Ontario on Radar.*
13. George A. Hall, West Virginia University. *Studies on the Diurnal Migration of Passerines in the Allegheny Mountains.*
14. Terrence N. Ingram, Wisconsin State College and Institute of Technology, Platteville, Wisconsin. *Backtag Markers for Red-tailed Hawks.*

Saturday, 2 May

Symposium, *The Migration of Hawks with Relation to the Great Lakes.* Olin Sewall Pettingill, Jr., Cornell University, Chairman.

Introductory Remarks by the Chairman

15. William W. H. Gunn, Clarkson, Ontario. *The Canadian Shores of Lake Ontario, Erie, Huron and Superior.*
16. John R. Haugh, Syracuse University. *The Eastern-Southeastern Shore of Lake Ontario.*
17. Allan S. Klonick, Rochester, New York. *The Rochester Area on the Southern Shore of Lake Ontario.*
18. Edward L. Seeber, State University of New York, College for Teachers, Buffalo, New York. *The Buffalo Area at the Eastern End of Lake Erie.*
19. Neil Henderson, Hudson, Ohio. *The Cleveland Area on the Southern Shore of Lake Erie.*

20. Charles E. Mohr, Kalamazoo Nature Center. *The Lower Michigan Shores of Lakes Huron and Michigan.*
21. Helmut C. Mueller, Ornithological Station, Cedar Grove, Wisconsin. *The Western Shore of Lake Michigan.*
22. Pershing B. Hofslund, University of Minnesota, Duluth. *The Duluth Area at the Western End of Lake Superior.*
Discussion
23. Aaron M. Bagg, Dover, Massachusetts. *Some Aspects of the History of the Dickcissel East and West of the Alleghenies Over the Past 130 Years.*
24. Joseph T. Armstrong, Monteith College, Wayne State University. *The Significance of Breeding Home Range in the Nighthawk and Other Birds.*
25. Bertram G. Murray, Jr., University of Michigan. *Migration of the Yellowthroat at Island Beach, New Jersey.*
26. William L. Thompson, Wayne State University. *Territorial Behavior of the Indigo and Lazuli Buntings.*
27. Kenneth C. Parkes, Carnegie Museum. *Speculations on the Origin of Feathers.*
28. Larry C. Holcomb, University of Toledo. *The Development of Grasping and Balancing Coordination in Fledglings of Seven Species of Altricial Birds.*
29. Douglas E. Gill, Marietta College, and Wesley E. Lanyon, American Museum of Natural History. *Establishment, Growth and Behavior of an Extralimital Population of House Finches at Huntington, New York.*
30. N. R. Whitney, Rapid City, South Dakota. *Introduction to the Black Hills of South Dakota and Wyoming.*

ATTENDANCE

Members and guests who registered totaled 190 persons. Eighteen states, plus the District of Columbia, Ontario, Canada, and England were represented.

From **Connecticut**: 1—*Old Lyme*, Roger Tory Peterson.

From **Illinois**: 8—*Blue Island*, Karl E. Bartel; *Chicago*, Constance Nice, Leonard B. Nice, Margaret M. Nice, A. L. Rand; *Danforth*, Herman Smith; *Momence*, Mr. and Mrs. W. T. Lory.

From **Indiana**: 14—*Chesterton*, Mrs. A. L. Rand; *Fort Wayne*, Edith Paul, Mabel Thorne; *Hamlet*, Dorothy M. Buck; *Huntington*, Mayretha Plasterer; *Indianapolis*, Robert F. Buskirk, Mildred Campbell, Mrs. S. G. Campbell, Allen Roberts, Henry C. West; *La Porte*, Mrs. May L. Nicholson, W. W. Nicholson; *South Bend*, Elinor Vesey, George W. Vesey.

From **Iowa**: 3—*Davenport*, Mr. and Mrs. Peter C. Peterson, Jr.; *Grinnell*, Mildred Stewart.

From **Kentucky**: 1—*Louisville*, Thane S. Robinson.

From **Maryland**: 1—*Annapolis*, H. E. Savely.

From **Massachusetts**: 2—*Dover*, Mr. and Mrs. Aaron M. Bagg.

From **Michigan**: 71—*Ann Arbor*, Stephen T. Emlen, Norman L. Ford, William A. Lunk, Robert W. Storer, Heather Thorpe, H. B. Tordoff, Dr. and Mrs. Leonard Wing; *Atlas*, Edward M. Brigham III; *Battle Creek*, Edward M. Brigham, Jr., Gilbert Twiest, Dr. and Mrs. L. H. Walkinshaw, Richard K. Wolf; *Bellevue*, Donald R. Altemus; *Bloomfield Hills*, David B. Crockett; *Bridgeport*, Edward M. Scharrer; *Detroit*, Joseph T. Armstrong, Mrs. Lynn Armstrong, Robert Raikow, Elsie W. Townsend; *East Lansing* (and *Lansing*), C. T. Black, Dr. and Mrs. Donald W. Douglass, Mr. and Mrs. W. R. Freeman, M. D. Pirnie, Lawrence A. Ryel, Dr. and

- Mrs. George J. Wallace; *Grand Rapids*, Joseph H. Martin; *Highland Park*, Grover Niergarth, Pat Niergarth; *Holland*, Jan Bopp, Laurence Dayton, Eldon Greij; *Kalamazoo*, Dr. and Mrs. H. Lewis Batts, Jr., Dr. and Mrs. Richard Brewer, Helen E. Burrell, Ray Deur, Monica Ann Evans, Anne V. Fuller, Edna M. Gary, Lorena M. Gary, Mr. and Mrs. Richard D. Hedberg, Frank J. Hinds, Margaret Hinds, Lawrence W. Lossing, Charles E. Mohr, Mike Van Stratton, Marie E. Thompson, Bob Van Blaricom, Mr. and Mrs. Harold O. Wiles; *Leonard*, Mrs. Alice D. Miller; *Marquette*, Edwin C. Weiland; *Mount Pleasant*, Larry O. Caldwell, N. L. Cuthbert, William O. Sheldon, Judy Sheldon; *Muskegon*, George Wickstrom; *Otsego*, M. D. Ismund; *Pleasant Ridge*, William L. Thompson; *Spring Lake*, Bernard Baker; *Union City*, Mr. and Mrs. William A. Dyer; *Warren*, Dorothy Buchan, Sergej Postupalsky; *White Pigeon*, Oscar McKinley Bryens.
- From **Minnesota**: 8—*Duluth*, Joel K. Bronoel, Mira Childs, Dr. and Mrs. John C. Green, P. B. Hofslund, Mr. and Mrs. Harvey H. Putnam, Helen F. Seymour.
- From **New Jersey**: 4—*Bound Brook*, Bertram G. Murray, Jr.; *New Brunswick*, Jon S. Greenlaw, Efre Rosen, Jeff Swinebroad.
- From **New York**: 11—*Buffalo*, Mr. and Mrs. Edward C. Ulrich; *Ithaca*, Dr. and Mrs. O. S. Pettingill, Jr., William E. Southern; *Kennon*, Mr. and Mrs. Edward L. Seeber, Gary M. Seeber; *Rochester*, Allan S. Klonick; *Syracuse*, Margaret Rusk, W. R. Spofford.
- From **North Carolina**: 1—*Greensboro*, Charlotte A. DuBois.
- From **Ohio**: 34—*Ashtabula*, H. E. Blakeslee; *Berea*, Marge Fitzgerald; *Bowling Green*, Elden W. Martin; *Chardon*, Marjorie Ramisch; *Columbus*, Dr. and Mrs. Donald J. Borrer, Edwin Franks, Mrs. E. C. Franks, Dr. and Mrs. Maurice L. Giltz, Barbara Giltz, Robert C. Murray, Thomas C. Rambo; *East Cleveland*, Vera Carrothers; *East Liverpool*, Mr. and Mrs. John Laitsch; *Gahanna*, Robert L. Kondik; *Hudson*, Neil Henderson; *Kent*, Dr. and Mrs. Ralph W. Dexter; *Lakewood*, William A. Klamm, Nancy R. Klamm; *Marietta*, Douglas E. Gill; *Massillon*, Arnold W. Fritz; *Put-in-Bay*, George R. Maxwell, III; *Rocky River*, James Cristine; *Steubenville*, Earl W. Farmer; *Toledo*, Larry C. Holcomb, J. M. McCormick; *Warrensville Heights*, Eleanore Hudgeon; *Waterville*, Mr. and Mrs. Harold Mayfield; *Wellsville*, John R. Haugh; *Worthington*, L. S. Putnam.
- From **Pennsylvania**: 4—*Chester Springs*, Mr. and Mrs. Phillips B. Street; *Philadelphia*, C. Chandler Ross; *Pittsburgh*, Kenneth C. Parkes.
- From **South Dakota**: 3—*Rapid City*, N. R. Whitney; *Sioux Falls*, Mr. and Mrs. Scott Findley.
- From **Tennessee**: 1—*Maryville*, Ralph J. Zaenglein.
- From **West Virginia**: 2—*Morgantown*, Dr. and Mrs. George A. Hall.
- From **Wisconsin**: 7—*Cedar Grove*, Helmut C. Mueller; *Madison*, Dr. and Mrs. John T. Emlen; *Milwaukee*, Clarence Jung; *Platteville*, Terrence N. Ingram; *Whitewater*, Richard Pladies, Richard D. Porter.
- From **District of Columbia**: 1—*Washington*, Orville Crowder.
- From **England**: 1—*Benstead*, Clemence M. Acland.
- From **Ontario, Canada**: 12—*Clarkson*, Dr. and Mrs. W. W. H. Gunn; *Don Mills*, James Waveford; *Fort William*, Dr. and Mrs. A. E. Allin; *Hamilton*, Eric W. Bastin, James S. Pringle; *Ida*, D. C. Sadler, Joan Sadler; *Toronto*, Mr. Baldwin, Maureen Baldwin, J. O. L. Roberts.

EDITOR OF THE WILSON BULLETIN

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SUGGESTIONS TO AUTHORS

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CONTENTS

SPRING AND SUMMER SPARROW HAWK FOOD HABITS	
	<i>Donald S. Heintzelman</i> 323
THE TRUMPETER SWAN AS A BREEDING BIRD IN MINNESOTA, WISCONSIN, ILLINOIS, AND INDIANA	<i>A. W. Schorger</i> 331
RECENT RANGE EXPANSION OF THE AMERICAN OYSTERCATCHER INTO NEW YORK	<i>Peter W. Post and Gilbert S. Raynor</i> 339
THE GALÁPAGOS SWALLOW-TAILED GULL IS NOCTURNAL	<i>Jack P. Hailman</i> 347
THE AFRICAN CROWNED CRANES	<i>Lawrence H. Walkinshaw</i> 355
GENERAL NOTES	
A HYBRID SCALED \times DOUGLAS QUAIL	<i>Richard C. Banks and Lewis Wayne Walker</i> 378
AGGRESSIVE BEHAVIOR OF HEN PHEASANT WHILE PROTECTING CHICKS	<i>Larry C. Holcomb</i> 380
NOTES ON COLOR ABERRANCIES IN RIO GRANDE WILD TURKEYS	<i>Jack Ward Thomas, Calvin Van Hoozer, and Rodney G. Marburger</i> 381
ROOSTING HABITS OF RED-BELLIED WOODPECKERS	<i>David W. Stichel</i> 382
THE NEST OF <i>GRANATELLUS VENUSTUS</i> DU BUS	<i>P. R. Grant</i> 384
WILD TURKEY BEHAVIOR AFFECTED BY THE PRESENCE OF GOLDEN EAGLES	<i>Jack Ward Thomas, Calvin Van Hoozer, and Rodney G. Marburger</i> 384
REUBEN MYRON STRONG	<i>W. J. Beecher</i> 386
ORNITHOLOGICAL NEWS	388
ORNITHOLOGICAL LITERATURE	390
<i>Kenneth E. Stager, The Role of Olfaction in Food Location by the Turkey Vulture (Cathartes aura), reviewed by Douglas A. Lancaster.</i>	
THE WILSON ORNITHOLOGICAL SOCIETY MEMBERSHIP ROLL	393
INDEX TO VOLUME 76, 1964	427

SPRING AND SUMMER SPARROW HAWK FOOD HABITS

DONALD S. HEINTZELMAN

THE order Falconiformes contains some of the most interesting members of the bird world. Despite the work reported by Bendire (1892), Sherman (1913), Bent (1938), and Roest (1957), the life history, including food habits, of one of the most common American falconiform birds, the Sparrow Hawk (*Falco sparverius*), is still not known intimately.

This paper, therefore, explores spring and summer food habits of nestling and adult Sparrow Hawks in Albany Township, Berks County, Pennsylvania, during the years 1960 to 1963 inclusive. This information also is compared with a general food survey representing North American subspecies of the Sparrow Hawk during various seasons of the year.

SPRING-SUMMER FOOD HABITS

Introduction.—In Berks County, Pennsylvania, the Sparrow Hawk is “a common resident, nesting in all the larger valleys” (Poole, 1947:40). It is common in Albany Township.

The zoogeography of Albany Township is characterized by an overlapping of the Carolinian and the Alleghanian life zones (Poole, 1947:3). The northern boundary of the township is formed by the Kittatinny Ridge which reaches a maximum elevation of 1,657 feet above mean sea level.

In 1959 I selected Charlex Farm and adjacent land as a study area. Located in the northern portion of the township, it covers an area of approximately 0.5 square mile. Elevations range from 500 to 600 feet above mean sea level. It is almost entirely agricultural in land use. Domestic cattle and sheep are pastured, and wheat, oats, and corn are cultivated. Bicolor lespedeza, Russian olive, bayberry, highbush-cranberry, and multiflora rose are planted in odd land corners (Nagy, 1962:15-16). Seven ponds are on the area.

Animal populations.—From 1960 to 1963, 13 Sparrow Hawk nests were on the study area; 11 of these are shown in Fig. 1. Seven of these, in nest boxes, were used for this food habits study. Nest densities per 0.5 square mile ranged from an extreme high of seven in 1961 (Nagy, 1963:93)¹ to a low of one in 1963. The overall 4-year mean was 3.25 nests per 0.5 square mile.

About 45 species of birds, at least three species of mammals, and several reptiles and amphibians, all characteristic of the Carolinian-Alleghanian life zone, were potential vertebrate prey species. Numerous insects were potential invertebrate prey species.

¹ Stockard (1905:153) records a similarly high nesting density in Mississippi.

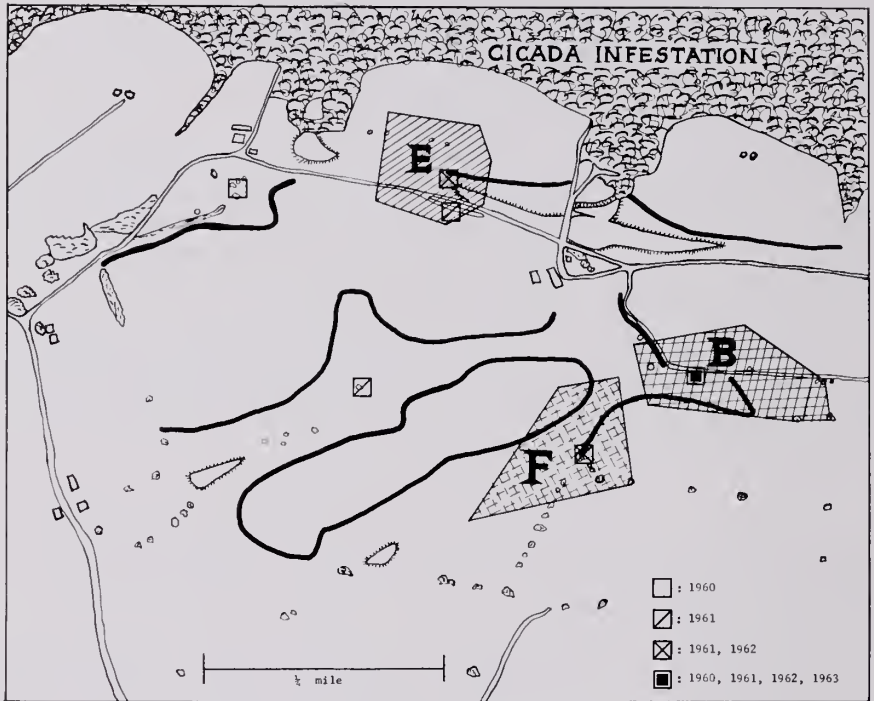


FIG. 1. The Charlex Farm study area showing locations of 11 Sparrow Hawk nest sites during the period 1960 to 1963, and the relationship of the 1962 nest territories B, E, and F to the cicada infestation. In 1961 two additional nests were slightly outside the area covered by this map. Heavy black lines are multiflora rose plantings.

Bird populations were sampled qualitatively but not quantitatively. One rodent population was determined, on 8–10 June 1962, by saturation trapping small mammals for 192 trap nights on a sample plot measuring 40,000 square feet. An unusually low density of three *Microtus p. pennsylvanicus* and two *Zapus h. hudsonius* was obtained. Reptiles and amphibians were not censused.

During June and July 1962, a major outbreak of Brood II of the Periodical Cicada (*Magicicada septendecim*) occurred on the Kittatinny Ridge. This population exceeded, in density, all other potential prey during that period. Although the forest supporting the cicadas acted as a barrier preventing most of the long-winged, open-field-oriented falcons from hunting there, some of the Sparrow Hawks being studied did enter the forest to kill a few cicadas. No cicadas were found beyond the Kittatinny Ridge, and no Sparrow Hawk nest territories overlapped onto the mountain (Fig. 1), in spite of the fact that Sparrow Hawks (and other falcons) have definite hunting ranges centered around their nests (Bond, 1936:72).

TABLE I
ANALYSIS OF SPARROW HAWK PELLETS AND REMAINS OF PREY FOR 1960-63

Prey	Number in	
	Pellets	Prey remains
Insects		
Short-horned Grasshopper (<i>Acrididae</i>)	0	6
Periodical Cicada (<i>Magicicada septendecim</i>)	0	11
Libellulid Dragonfly (<i>Libellulidae</i>)	0	3
Beetles (<i>Coleoptera</i>)	0	5
Ground Beetles (<i>Carabidae</i>)	54	7
	54	32
Total		86
Reptiles		
Five-lined Skink (<i>Eumeces fasciatus</i>)	0	1
	0	1
Total		1
Birds		
Passeriformes	0	12
Icteridae	1	7
Eastern Meadowlark (<i>Sturnella magna</i>)	0	1**
Common Grackle (<i>Quiscalus quiscula</i>)	0	8*
Cowbird (<i>Molothrus ater</i>)	0	3*
Fringillidae	1	2
Cardinal (<i>Richmondia cardinalis</i>)	0	1**
Grasshopper Sparrow (<i>Anmodramus savannarum</i>)	0	1**
	2	35
Total		37
Mammals		
Short-tailed Shrew (<i>Blarina brevicauda</i>)	0	1
Microtinae	118	5
Meadow Mouse (<i>Microtus pennsylvanicus</i>)	7	14
Meadow Jumping Mouse (<i>Zapus hudsonius</i>)	0	2
	125	22
Total		147
Grand Total		271

* Prey remains of an immature bird.

** Prey remains of an adult bird.

Collection and analysis of prey data.—During May, June, and July 1960-62, and during June 1963, I made 103 trips to Sparrow Hawk nests and collected 125 pellets and 23 prey samples consisting of 90 prey remains. Analysis of all of these materials represents 271 prey items.

Sparrow Hawk pellets are small and compact, and contain broken bones, tufts of hair, and pieces of feathers and insects. I limited identification of this

material to subfamily, although the Microtinae listed in Table 1 were probably *Microtus pennsylvanicus*. Prey remains consisted of partially eaten mammals, reptiles, and insects, along with bird tarsi, skeletons, and feathers. I identified much of this material to genus or species, although the identification of some was limited to family or order.

Mosby (1963:320) states that relatively small samples are accurate for evaluation of food habits of individual species on small homogeneous areas. Since Charlex Farm meets these specifications, I followed this technique in collecting pellets and prey samples.

Prey taken.—Food consumed by the Sparrow Hawks studied is shown in Table 1. These data differ somewhat from the general account of Sparrow Hawk food habits for Pennsylvania (McDowell and Luttringer, 1948:22), and for New Jersey (Hausman, 1927:33). This is particularly true in respect to insects and mammals. No doubt local variations in prey density and in vulnerability account for these variations. Bent (1938:112) points out that Sparrow Hawk diets vary “considerably according to season and locality.”

The appearance of the Five-lined Skink (*Eumeces fasciatus*) in the form of one prey remain was totally unexpected, since the species was not known to inhabit the area. However, the habits of this species are such that it could easily have been overlooked.

CONCLUSION

The great variations which occur in Sparrow Hawk diets can be seen by comparing Table 1 with Table 2, which summarizes food habits for the species in North America. From 1960 to 1963, the Sparrow Hawks which I studied restricted their predation to a few species of animals, in comparison with the wide variety of food items known to form the diet of the species in North America. This illustrates the importance of seasonal and geographical conditions in dictating the diet of this falcon. In Albany Township, Microtinae (probably *Microtus pennsylvanicus*) were the principal animals taken. Icteridae and Carabidae appeared less frequently. In 1962, the Periodical Cicada formed only 16.5 per cent of the Sparrow Hawk diet, although present locally in great abundance. The falcons did not penetrate the forest to exert great predation pressure on the cicadas.

Prey species possibly not previously reported in the literature include the following animals: Periodical Cicada (*Magicalcada septendecim*), Five-lined Skink (*Eumeces fasciatus*), Cowbird (*Molothrus ater*), Common Grackle (*Quiscalus quiscula*), Cardinal (*Richmondena cardinalis*), Grasshopper Sparrow (*Ammodramus savannarum*), and Meadow Jumping Mouse (*Zapus hudsonius*).

TABLE 2
GENERAL FOOD SURVEY OF SPARROW HAWKS

Prey	Authority
Insects	
Orthoptera	Breckenridge and Errington (1938)
Lesser Migratory Grasshopper (<i>Melanoplus atlantis</i>)	McAtee (1932:378)
Grasshopper (<i>Melanoplus devastator</i>)	Bryant (1918:127)
Crickets (<i>Gryllus</i>)	Breckenridge and Errington (1938)
Jerusalem Crickets (<i>Stenopelmatus irregularis</i>)	Bryant (1918:127)
Hemiptera	Knowlton and Telford (1947)
Periodical Cicada (<i>Magicicada septendecim</i>)	This study
Aeshnic Dragonflies (Libellulidae)	Locke (1961:342)
Libellulid Dragonflies (Libellulidae)	Locke (1961:342)
Lepidoptera	Breckenridge and Errington (1938)
Acraea Moth (<i>Estigmene acraea</i>)	Locke (1961:342)
Coleoptera	Breckenridge and Errington (1938)
Ground Beetle (Carabidae)	This study
Click Beetle (Elateridae)	Knowlton and Telford (1947:311)
Ants (Hymenoptera)	Brødtkorb (1928:213)
Diptera maggots	Knowlton and Telford (1947:311)
Reptiles	
Lizard (<i>Anolis</i>)	Danforth (1934:357)
Six-lined Racerunner (<i>Cnemidophorus sexlineatus</i>)	Lamore (1963:461)
Five-lined Skink (<i>Eumeces fasciatus</i>)	This study
Birds	
Ground Dove (<i>Columbigallina passerina</i>)	McAtee (1935:35)
Passeriformes	This study
Horned Lark (<i>Eremophila alpestris</i>)	Lamore (1963:461)
Cliff Swallow (<i>Petrochelidon pyrrhonota</i>)	Bonnot (1921:136)
Winter Wren (<i>Troglodytes troglodytes</i>)	McAtee (1935:35)
Carolina Wren (<i>Thyothorus ludovicianus</i>)	Fisher (1893:125)
Robin (<i>Turdus migratorius</i>)	Lamore (1963:461)
Eastern Bluebird (<i>Sialia sialis</i>)	Drinkwater (1953:215)
Vireo (Vireonidae)	Fisher (1893:121)
Warbler (Parulidae)	McAtee (1935:35)
Hermit Warbler (<i>Dendroica occidentalis</i>)	Grinnell (1933:236)
English Sparrow (<i>Passer domesticus</i>)	Sage (1893:207)
Icteridae	This study
Cowbird (<i>Molothrus ater</i>)	This study
Meadowlark (<i>Sturnella</i>)	McAtee (1935:35)
Eastern Meadowlark (<i>Sturnella magna</i>)	This study
Red-wing (<i>Agelaius phoeniceus</i>)	Fisher (1893:125)
Common Grackle (<i>Quiscalus quiscula</i>)	This study
Cardinal (<i>Richmondia cardinalis</i>)	This study
Grasshopper Sparrow (<i>Ammodramus savannarum</i>)	This study
Vesper Sparrow (<i>Poocetes gramineus</i>)	Fisher (1893:122)

TABLE 2
(Continued)

Prey	Authority
Birds (Continued)	
Junco (<i>Junco</i>)	Fisher (1893:122)
Sparrow (<i>Spizella</i>)	McAtee (1935:35)
Tree Sparrow (<i>Spizella arborea</i>)	Wharton (1930:141)
Chipping Sparrow (<i>Spizella passerina</i>)	McAtee (1935:35)
Field Sparrow (<i>Spizella pusilla</i>)	Fisher (1893:124)
Gambels Sparrow (<i>Zonotrichia leucophrys gambelii</i>)	Michener (1930:212)
Sparrow (<i>Melospiza</i>)	McAtee (1935:35)
Song Sparrow (<i>Melospiza melodia</i>)	Broun (1932:119)
Mammals	
Shrew (Soricidae)	Fisher (1893:122)
Short-tailed Shrew (<i>Blarina brevicauda</i>)	Fisher (1893:126)
Big Brown Bat (<i>Eptesicus fuscus</i>)	Stoner (1939:474)
Mexican Free-tailed Bat (<i>Tadarida brasiliensis mexicana</i>)	Baker (1962:500)
Striped Ground Squirrel (<i>Citellus tridecemlineatus</i>)	Breckenridge and Errington (1938:669-670)
Gopher (Geomyidae)	Fisher (1893:123)
Mice (<i>Peromyscus</i>)	Breckenridge and Errington (1938)
Deer Mouse (<i>Peromyscus maniculatus</i>)	Tordoff (1955:140)
White-footed Mouse (<i>Peromyscus leucopus</i>)	Fisher (1893:126)
Cotton Rat (Cricetinae)	Fisher (1893:126)
Wood Rat (Cricetinae)	Widmann (1896:222)
Microtinae	This study
Mice (<i>Microtus</i>)	Breckenridge and Errington (1938)
Meadow Mouse (<i>Microtus p. pennsylvanicus</i>)	Poole (1932:56)
Prairie Vole (<i>Microtus ochrogaster</i>)	Tordoff (1955:140)
House Mouse (<i>Mus musculus</i>)	Fisher (1893:122)
Meadow Jumping Mouse (<i>Zapus hudsonius</i>)	This study
Rabbit (Leporidae)	Fisher (1893:123)
Miscellaneous	
Bread	Warburton (1952:85)

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629 GREEN STREET, ALLENTOWN, PENNSYLVANIA, 21 MAY 1964 (ORIGINALLY
SUBMITTED 19 SEPTEMBER 1963)

THE TRUMPETER SWAN AS A BREEDING BIRD IN MINNESOTA, WISCONSIN, ILLINOIS, AND INDIANA

A. W. SCHORGER

THE Bureau of Sport Fisheries and Wildlife, U. S. Fish and Wildlife Service, has concerned itself with reestablishing Trumpeter Swan (*Olor buccinator*) populations in the United States and is therefore interested in the former breeding and wintering ranges of this bird. Winston Banko of the bureau suggested the present paper to the author so that the breeding status of the Trumpeter Swan east of the Mississippi River would be more completely understood. Search of the literature was extensive and included all of the county histories of the respective states with the exception of Minnesota.

The Trumpeter Swan is so similar to the Whistling Swan (*Olor columbianus*) that it would be hopeless to identify it in the historical literature as a breeding bird were it not for the fact that the Whistling Swan has always nested far north of the region under consideration. Accordingly, swans present in summer may be accepted as Trumpeters. The information gleaned is by no means commensurate with the time expended in searching the literature; its meagerness suggests that the Trumpeter Swan was exterminated early in certain areas or that only a small amount of effort was made to penetrate its breeding grounds in the treacherous marshes and swamps.

Minnesota.—It is unnecessary to repeat the breeding records given by Roberts (1932:204) for the central and southern parts of the state. A record which extends the breeding range into northeastern Minnesota had been overlooked. The fur traders in passing from the Mississippi to Lake Superior started from Sandy Lake. After going up the Prairie River a short distance, the West Savannah River was entered and followed upward for 8 to 10 miles, as variously stated, then a portage of 6 miles in length was reached. The portage ended at East Savannah River which was followed to the St. Louis River and down to Lake Superior.

On 7 May 1798, a member of the party headed by David Thompson (1916:284) shot a swan at a large swamp on the West Savannah River. It contained 13 eggs from the "size of a pea to that of a walnut." The date and size of the ova show imminence of nesting. On consulting Alex Dzubin, who has studied ovicular development in waterfowl, I was advised that this swan would have ovulated probably within 3 to 6 days. The editor of Thompson's narrative was undoubtedly correct in identifying this swan as a Trumpeter.

Thompson stated that the swamp was 4.5 miles across. The best description of the route which I have read is by Joseph G. Norwood (Owen, 1852:300), who surveyed the area in 1848. He stated that the West Savannah River "winds through extensive swamps covered with aquatic grasses." The

significance of place-names in the area should not be overlooked. There is a Swan Lake (not to be confused with the Swan Lake in Nicollet County) drained by Swan River. On Owen's map this stream is called West Swan River; and he shows an East Swan River, Modern Floodwood River, flowing southeast into the St. Louis River.

Wisconsin.—There is no satisfactory record of the breeding of this swan in Wisconsin. Most of the early accounts of swans are for spring and fall, or no season at all is given. When the English geologist Featherstonhaugh (1847: 18-19) entered Lake Pepin on the Mississippi on 23 October 1835, he saw hundreds upon hundreds of swans with their cygnets floating on the lake. He mentioned: "The cygnets were still of a dull yellow colour, and all the birds were very shy." Audubon (1838:542) states that the body plumage of the Trumpeter cygnet is grayish white slightly tinged with yellow, and quotes Sharpless (1832:86) that that of the Whistling cygnet is plumbeous gray. The same distinctions are given by Kortright (1942:69, 77). Accordingly, it could be inferred that the swans on Lake Pepin were Trumpeters, possibly assembled from surrounding breeding areas. On the other hand, H. A. Hochbaum and W. E. Banko, both familiar with Trumpeter cygnets, have informed me that their color is gray, though sometimes stained with ferruginous compounds.

It is stated by Grundtvig (1895:99) that this bird was said to breed in northwestern Wisconsin. The U. S. National Museum has an adult male, No. 81,290, taken at Lake Koshkonong on 20 April 1880. The date falls within the period of the spring migration of this swan. The best information on possible breeding is by Kumlien and Hollister (1903:31-32): "In the early forties 'swan' were reported as nesting in southern Wisconsin (Dane and Jefferson Counties), and if this is true it was no doubt this species. Thure Kumlien had a juvenile specimen obtained somewhere between 1842-45 in Jefferson County, with down on the head and primaries still soft, color a dingy ash. This specimen was still in existence in 1900, and doubtless is yet. . . . In the past fifteen years we have handled but two specimens. One was mounted for a hunter, who procured it from a flock of three on Lake Koshkonong May 6, 1893! This specimen contained *ova* the size of an ounce leaden bullet." If Thure Kumlien's juvenile is extant, I do not know of its location.

Illinois.—In Illinois we are on firm ground. Marquette and Joliet, after descending the Wisconsin River, entered and started down the Mississippi on 17 June 1673. Of the country about 42° N, Marquette (1903:242, 257) wrote: "We see only deer and cows [buffaloes], bustards [Canada geese] and flightless swans, because they lose their pinions in this country." (*Nous ne voyons que des chevreils et des vaches, des outardes et des cygnes sans aisles, parcequ'ils quittent leurs plumes en ce pays.*) Marquette fixed the latitude

of the mouth of the Wisconsin one-half degree low; hence the above remark applies to 42°30' N, the boundary between Wisconsin and Illinois. Banko (1960:72) states that the primaries are usually shed in July but the annual molt may be completed as early as June or delayed until August, September, or even October. (Early shedding is to be expected for the more southern latitudes.) On the return journey in August, Marquette entered Lake Michigan via the Illinois River, the banks of which, he states, were incomparable for the abundance of game, including geese, swans, ducks, and parakeets. Hennepin (1903:644, 666) did not see the Mississippi until 1680. His contribution on swans is so like that of Marquette that it must have been borrowed.

A memoir written from Illinois by Liette (1947:130) in 1702 informs us: "However, I did not regret my failure to shoot the bustards. This game bird is very common here as well as swans, French ducks, musk ducks, teals and cranes both white and gray." He mentions that in autumn the marshes become dry, and that all the kinds of waterfowl mentioned then resort to the Illinois River and the lake (Peoria). Their numbers were so great, he remarked, that if they remained on the lake it would have been impossible to travel over it in a canoe without pushing the birds aside with a paddle. Since the dry period in this area is usually August, there can be no question that the swans and other species of birds were local breeders. The mention of white (Whooping) cranes should raise no doubt as to the validity of nesting of all the birds enumerated. Kennicott (1855:587) stated that a few Whooping Cranes still nested in middle and southern Illinois; a score of years later, a few still bred in the large marshes in the center of the state (Nelson, 1876:133). Rale (1900:167) wrote in 1723 that none of the Canadian Indians compared with the Illinois tribes in abundant living. The Illinois streams were covered with swans, geese, and ducks.

A trading trip to Illinois was made by Kellogg (1903:60-62) in 1710. His party reached the Illinois River by way of the Chicago River and: "As they went to the River Illinois they rais'd an infinite number of wild fowl, such as Cranes, Geese, Duck; and Swans in great abundance that feed upon wild Oats. . . ." On the Illinois the men found wild apples and plum trees, the apples bitter and sour but the plums good. Since the plums were edible, the time was the last of August or early September. No migratory swans would arrive near Chicago this early so that they must have been resident Trumpeters.

The Long Expedition on 5 June 1819, found a swan at the mouth of the Kaskaskia (38° N). According to James (1823:46) it was unable to fly, having shed its feathers. Peale (1946:157, 284), naturalist of the expedition, gives the date 4 June for meeting with a flightless swan. In his notes he

states definitely that the bird could not fly due to molting. Musselman (1921:12, 41) states that an occasional Trumpeter Swan was reported to have nested in the early days at Lima Lake, a huge swamp in the northwestern corner of Adams County. Here swans fed for days during the periods of migration.

An important contribution has been made by Parmalee (1958:171). Bones of the Trumpeter Swan were among the bird bones found at prehistoric Indian sites at Cahokia, St. Clair County, the Fisher Site, Will County, and the Snyders Site, Calhoun County. This bird, according to Parmalee, "must have been exceedingly abundant" since at Cahokia 375 bones of the Trumpeter Swan were found in comparison with only a few of the Whistling Swan. During the migrations there should have been at least equal opportunities to take both species. I believe that the preponderance of bones of the Trumpeter Swan is strong indication that this bird was taken mainly during the breeding season when molting of the primaries would make it a relatively easy prey.

Indiana.—The Kankakee marshes in Indiana once covered about 600,000 acres and should have provided many favorable nesting localities. Very few accounts of these marshes go beyond mentioning swans among the waterfowl to be found in the area. Ball (1885:153) stated, on the authority of E. W. Dinwiddie, that the Trumpeter Swan was rare in Lake County and that no nest had been found. Later he informed Butler (1898:642) that it bred formerly. Cooke (1906:86) stated that it probably had bred as far south as Indiana in the early days.

Ball (1900:453) interviewed H. Seymour, who came to the vicinity of Hebron, Porter County, in 1833. He thought that the "white cranes and the swan" nested in the Kankakee marshes at that time but was not certain. It would seem that these birds must have been present in summer to leave with him an impression of nesting.

Beaver Lake and its marshes, in northern Newton County, occupied about 36,000 acres (Fig. 1) prior to drainage. Thomas Rogers Barker settled at Beaver Lake in 1840 to trade with the Indians. On 31 July 1937, Barce (1938:71-76), a drainage lawyer, interviewed a son, Lanier Barker, on the nesting of the Trumpeter Swan. Lanier was born in 1861. He informed Barce that one of the former breeding places of this swan was the Black Marsh, about 3 miles south of the present village of Roselawn. In Beaver Lake was a submerged aquatic plant sometimes known as "swan celery" (*Vallisneria spiralis?*), a favorite food of the bird. He had seen a hundred acres of swans at a time. They would feed in one locality for a month before repairing to the marshes to nest. The bird laid from five to seven eggs. It was easily tamed, and settlers along the lake would sometimes take

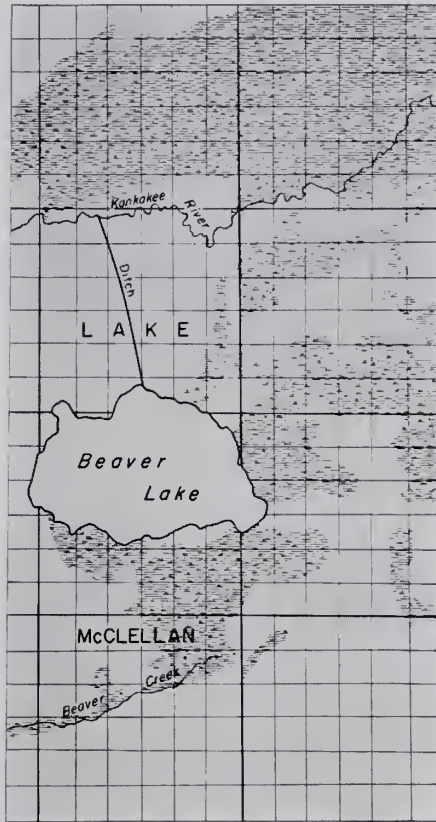


FIG. 1. Former Beaver Lake, Newton County, Indiana. After G. H. Adams & Co. Map (1871).

some of the eggs and hatch them under a hen or goose. The bird had to learn to eat corn which was soaked in water. The average weight given by Lanier Barker, 20 pounds, is that of the Whistling Swan, but this species is ruled out for the reason given previously.

Whatever its deficiencies, it is doubtful if another or better account of the nesting of this swan in the southern latitudes will be found. About 1869 or 1870, Lanier and an older brother took two eggs from a nest in "the Black Marsh, near one of the three great crossing places of the lake known as 'The Narrows.' It was one of the most treacherous bogs on the face of the earth. It was a quagmire of floating moss or turf where one could easily sink into the ooze and slime and the decayed vegetation beneath. This ooze was eight or ten feet in depth, and one who disappeared here might never come to light.

"The nest of the swan was always in a position where the water could seep up through the soil from below. Occasionally the mother bird would thoroughly drench her feathers, stand up over the nest and shake herself, so as to sprinkle the eggs. I believe that there were no swans hatched out in the swamp after 1872 or 1873."

It is impossible to reconstruct the original ecology of Beaver Lake since drainage began in the 1850's and was practically completed by the 1880's. It may be assumed that this lake, famous for its waterfowl, was favored as a breeding place because of its aquatic plant life. The lake and its surrounding marshes may be considered for all practical purposes to have been a part of the Kankakee marshes. Notes on the original survey show that the land surrounding the lake consisted of wet prairie (probably sedge), dry prairie, and oak openings (Rohr and Potzger, 1950). The recent vegetation, including that of the bottom of old Beaver Lake, is treated by Rogers et al. (1955) in a soil survey report. Very few aquatic plants receive mention.

The principal genera of plants on which the swan feeds in Montana (Banko, loc. cit.) are the mosses *Chara*, *Fissidens*, *Amblystegium*, and the flowering plants *Sparganium*, *Potamogeton*, *Sagittaria*, *Elodea* (*Anacharis*), *Scirpus*, *Carex*, *Lemna*, *Nuphar*, *Ranunculus*, and *Myriophyllum*. These are, or were, common aquatic genera in northwestern Indiana (Coulter, 1899; Peattie, 1930; Deam, 1940). In addition, *Vallisneria spiralis* and *Zizania aquatica* were common. *Zizania* "grew to perfection" (Woods, 1938:138). All of the above genera of flowering plants, except *Nuphar*, are represented from Newton County in herbariums and the exception is known for adjoining Lake County (Deam, 1940:453).

It may be concluded that the Trumpeter Swan bred formerly in Minnesota east to the St. Louis River, in Illinois south to 38°, and in northwestern Indiana. While there is high probability of its having bred in Wisconsin, clear proof is lacking.

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RECENT RANGE EXPANSION OF THE AMERICAN OYSTERCATCHER INTO NEW YORK

PETER W. POST AND GILBERT S. RAYNOR

THE American Oystercatcher (*Haematopus palliatus*) formerly bred on the Atlantic coast as far north as Labrador (Audubon, 1835). Although this report has been questioned (Bent, 1929), other records (Baird, Brewer, and Ridgway, 1844) document its occurrence as far north as New England. During the mid-nineteenth century this species disappeared from the northern part of its range, and by 1910 Virginia was listed as the northernmost breeding limit (American Ornithologists' Union, 1910). For several decades this limit remained static but in 1939 the first recent Maryland breeding record was obtained (Stewart and Robbins, 1958). In the early 1940's the species increased on the beaches of southern New Jersey and in 1947 the first nest was found (Kramer, 1948). The species now breeds regularly in the three southernmost coastal counties of New Jersey. During the early 1950's a number of breeding season occurrences of the oystercatcher were recorded on Long Island, New York and in 1957 the first nest was found (Post, 1961). It is hoped that this paper will contribute to an understanding of this range expansion.

NESTING LOCALITIES

Oystercatchers have now bred in three areas on Long Island and were observed for two summers in a fourth. Since these stations are geographically and ecologically distinct, they will be described separately and in some detail to facilitate comparison with former and possible future breeding locations.

Area 1 (Gardiner's and Cartwright Islands).—Gardiner's Island is located in Gardiner's Bay which separates the north and south forks of eastern Long Island and is about 2.25 miles from the nearest point on the mainland. The southern tip of the island, the oystercatcher breeding site, consists of a sandy spit nearly separated from the island itself by Great Pond, a tidal bay about 0.5 by 0.25 mile in area. The spit is fairly well covered with grasses, weeds, and bushy growth (Fig. 1). A thriving gull and tern colony is located here.

Cartwright Island was, until recent years, a low, sandy island about a mile south of Gardiner's Island. It formerly supported large tern and gull colonies. Within the last few years, the island was broken by wave action into four segments which may be designated as the Cartwright Islands. In 1962, the southern island, about 800 by 100 feet and perhaps 6 feet high, supported about 15 pairs of Great Black-backed Gulls (*Larus marinus*). The second and fourth segments from the south, narrow and low, were empty of breeding birds. The third island, about 1,000 by 100 feet in size and only 3 to 4 feet above water level, was occupied by about a dozen pairs of Herring Gulls (*Larus argentatus*), 100 pairs of Common Terns (*Sterna hirundo*), a few Roseate Terns (*S. dougallii*), a pair or two of Black Skimmers (*Rynchops nigra*), and a pair of oystercatchers.



FIG. 1. The southern tip of Gardiner's Island showing the characteristic oystercatcher nesting habitat of Area 1, 11 July 1964. Photo by Peter W. Post.

The Cartwright Islands consist largely of water-worn pebbles, coarse sand, and broken seashells. The first and third islands support a minor amount of very sparse vegetation. The small amount of driftwood present is important as shelter for juvenile birds. The western side of the island drops off rather steeply into deep water whereas the shoreline on the east descends more gradually. Mean tidal range is 2.3 feet.

Both Gardiner's and Cartwright Islands are accessible only by boat, so the nesting areas are relatively undisturbed. Both are normally visited once or twice each season by bird banders and other ornithologists while fishermen and boaters infrequently land on the beaches.

Area 2 (Moriches Bay).—Moriches Bay, about 10 miles in length from east to west and 1 to 2 miles wide, is located near the center of the south shore of Long Island.

In 1958 dredging formed a large island almost inside the inlet. Although officially unnamed, this may be designated here as West Inlet Island. This island, the oystercatcher breeding site, is roughly rectangular, about 800 feet from north to south, 2,000 feet from east to west, and as much as 20 feet high in places. To the north and west of the island the bay floor slopes very gently, becoming exposed as extensive mud flats for nearly half a mile at low tide, but to the south and east are relatively deep, swift-flowing tidal channels leading to the inlet. Mean tidal range is 0.5 foot.

When first formed the island was mostly fine to medium sand mixed with some shells and a few pebbles. Vegetation was completely absent during the first year but by 1962, the north and east shores had a rim of *Phragmites* averaging 20 feet wide just above high water mark while inside of this and along the south shore were extensive areas of beachgrass (*Ammophila brevigulata*). The interior of the island was nearly one-half covered by beachgrass, seaside goldenrod (*Solidago sempervirens*), and a variety of other

forbs. Considerable driftwood and other debris had accumulated above high tide level.

This island played host in 1962 to about 6,000 pairs of terns and about 200 pairs of Black Skimmers in addition to the oystercatchers. Human disturbance is much more common here than at Area 1. The adjacent waters are popular fishing grounds, and over 100 boats can sometimes be counted within 1 mile. During the summer fishermen, boaters, picnickers, and rarely campers land on the island daily. Bird banders work the nesting areas intensively and birders visit the island and adjacent flats weekly. These activities, however, are not known to have caused any important disruption of nesting.

During the winter of 1962-63 the island was joined to the barrier beach by dredging. This eliminated the tern and skimmer colony, allowed predators such as rats and foxes free access to the area, and increased human disturbance. The oystercatchers, however, returned to nest.

Area 3 (Shinnecock Bay).—Shinnecock Bay is located about 13 miles east of Moriches Bay and is rather similar habitat, having an inlet to the ocean and containing several islands as well as flats and sand bars inside the inlet. The oystercatcher nesting area here, however, was on a sandy portion of the bay side of the barrier beach about 2 miles west of the inlet. Human disturbance is minor in the immediate nesting vicinity but predators (rats, cats, and foxes) are present in the area and a large gull colony is on a nearby island.

Area 4 (Jones Inlet).—This inlet has existed considerably longer than Moriches and Shinnecock Inlets, is wider and deeper, and has similar sandy stretches of barrier beach on each side. It is quite subject to human disturbance and has only one small sandy island possibly suitable for an oystercatcher breeding site.

NESTING OCCURRENCES

Area 1.—Gardiner's and Cartwright Islands and other nearby localities have attracted a large percentage of the oystercatchers that have been observed on Long Island. Between the years 1915 and 1936 oystercatchers were recorded in this area seven times. Single birds were seen on the southern tip of Gardiner's Island on 24 May 1952, 22 July 1955, and 1 and 19 July 1956.

On 13 July 1957 (not 13 June as listed in Post, *op. cit.*) an oystercatcher's nest containing three addled eggs was discovered on the southern tip of Gardiner's Island. This is the first known nesting of the American Oystercatcher in New York in this century.

On 17 June 1960 a pair of oystercatchers was observed at Springs and on 15 July 1961 a pair was seen at Napeague. These two locations border on Gardiner's Bay near the Cartwright Islands. On 22 July 1961 five adult birds were on Cartwright Island but gave no evidence of breeding. On the southern tip of Gardiner's Island one adult was seen which flew about the observers calling excitedly and carrying food. No young were found although at least one was probably somewhere in hiding. On 17 August two adults were still present on Cartwright.

On 23 June 1962, two adult oystercatchers and a nest containing five eggs were found on the third Cartwright Island (Fig. 2). On 14 July a flock of six additional adults which gave no indication of breeding was on the southern tip



FIG. 2. Oystercatcher nest containing five eggs, Cartwright Island, 14 July 1962. Photo by Klaus D. Kallman.

of Gardiner's. On 22 July the Cartwright Island pair was still incubating five eggs. On 28 July the nest was found washed out, apparently by a heavy thunderstorm which occurred a few days previously, and both adults were gone. In view of the lengthy incubation, the nest may have been abandoned before being washed out.

In 1963, a grown young was seen on the south tip of Gardiner's Island on 13 July. Two to four adults were seen on Cartwright Island on 6 and 13 July but no nest or young were found.

Area 2.—Moriches Inlet has also been favored by oystercatchers for some time. This species was recorded here in the breeding season at least three times between 1937 and 1939 and again in 1950. On 6 June 1960, two adults were observed on West Inlet Island. On 10 June, the nest containing three eggs was located. The first egg hatched on 2 July and the second by 4 July. By 6 July all three eggs had successfully hatched but the young apparently survived only a few days. Only one adult could be found on 7 July and no oystercatchers were present from 15 July on.

In 1961, a nest containing three eggs was found on 3 June. Young were first observed on 22 June, two birds estimated to be 10 to 14 days old. The next day only one could be found as well as "one dead young about a week old." Therefore, all three eggs apparently hatched, one bird dying when

quite young and the second between 22 and 23 June. By 11 July the surviving young was flying freely. Both adults and the remaining young were still present on 2 September but were not seen on 9 September or later.

In 1962, the adults were first seen on 26 May. The nest was not found so the number of eggs laid is unknown. However, on 9 June three young were seen and estimated to be 10 to 14 days old. On 15 June all were still present but by 23 June only two could be located. On 1 July one young was flying and the other was almost able to fly. Both adults and the two young were still present on 30 September, after which no further visits were made to the island.

In 1963, a nest with three eggs was found on 25 May. On 1 June, one young had hatched and another egg was pipped. This egg and the third, however, never hatched. The single young survived to flight stage. The group left the area in mid-August.

Area 3.—At Shinnecock Bay in 1963 a nest with three eggs was found in early June. Only one egg hatched and the young disappeared within a few days.

Area 4.—At Jones Inlet a pair of adult oystercatchers was observed during the breeding season in 1960 and 1961, but apparently no breeding attempts were made.

ECOLOGY

Feeding and nesting habits have been reported by a number of writers but Tompkins (1947, 1954) has presented the most detailed discussion of the ecological requirements of the American Oystercatcher. He stressed the importance of beds of oysters or clams uncovered daily by the tides, for food and open ground with good visibility, access to feeding areas, and distance from other nesting birds for nesting sites.

Along the coasts of Long Island and New Jersey, these criteria are not completely met in any known breeding area. Oysters are normally found only in waters too deep to allow their utilization by oystercatchers, although other bivalves which do occur in the intertidal zone appear to offer acceptable substitutes. Most outer beaches are either developed for human occupancy or bathing or are too heavily disturbed to form suitable breeding sites. The few suitable islands are heavily occupied by gull, tern, and skimmer colonies.

Food.—Few observations of the food of the Long Island breeding birds have been obtained, but food is not judged to be a limiting factor in any potential breeding area since bivalves of one species or another are common and well distributed. During 1962, at Moriches, the adults were observed feeding the young in the vicinity of the nest with ribbed mussels (*Modiolus plicatus*) which were brought from the flats and opened as the young were fed. This habit of bringing food to the chicks has also been reported for the European

Oystercatcher (*Haematopus ostralegus*) (Dircksen, 1938) and the Black Oystercatcher (*H. bachmani*) (Webster, 1941). Over a period of time quite a quantity of shells accumulated in this spot. On 10 June they covered an area about 8 to 10 inches but subsequently spread to several square feet. In addition to mussels, razor clams (*Ensis directus*) and hard clams (*Venus mercenaria*) were fed. These are all common to abundant in the immediate area while oysters (*Ostrea virginica*) are very scarce to absent.

Nesting sites.—The chief limitation on the oystercatcher population along the coasts of the mid-Atlantic states seems to be the scarcity of suitable nesting sites and the prior occupation of the best areas by gulls and terns. Observations in southern New Jersey in 1962 suggest that the current population may be near the maximum the region can support. This, we believe, is one of the principal factors in the current northward range expansion.

REPRODUCTIVE SUCCESS

Clutch size.—The number of eggs laid by the New York breeding birds seems somewhat above the average for the species farther south although the sample size is still small. The most complete published data on clutch size are by Burleigh (1958) from the Georgia coast where 56 clutches had an average of 2.6 eggs. Some of these may not have been complete, however. Sprunt and Chamberlain (1949) quote Wayne to the effect that clutch size "invariably" numbers three, but sometimes two eggs are laid. The only previous record of a nest containing five eggs apparently laid by only one female is given by Tompkins (1954). Dircksen (1932), who studied the European Oystercatcher in Germany, found a mean of 3.01 eggs and a standard deviation of 0.68 in 84 clutches. Of the seven known New York clutches, six held at least three eggs and one five, giving a mean of about 3.3.

Hatching success.—Hatching success of the New York birds is about 48 per cent. The 1957 Gardiner's Island nest had all three eggs addled. The 1962 Cartwright Island nest of five eggs was washed out but may have been previously abandoned. All three eggs laid in the 1960 and 1961 Moriches nests hatched as did three from the unknown number laid in 1962. However, only one of three hatched in 1963 at both Moriches and Shinnecock.

Survival of young.—Of the 11 young known to have hatched at Moriches and Shinnecock, only 4 (36 per cent) survived to the flight stage, one in 1961, two in 1962, and one in 1963, all at Moriches. The writers believe that all mortality at Moriches was caused by Common Tern attacks. Both young and adult oystercatchers were constantly attacked by terns whenever they stood erect within or near the nesting colony. At Moriches the family group was seen ducking repeatedly as terns dived at them. At Cartwright Island the incubating adults had great difficulty returning to their nests after they

had been flushed because of the repeated "dive-bombing" of the associated terns. Kramer (1948) reported a similar situation at the first known New Jersey nesting location. The young at Moriches were most likely killed directly by the terns although some may have starved to death due to the inability of the adults to care for them adequately while under incessant attack. The young were observed to remain in the vicinity of the nest for 2 weeks or more before moving to the nearby mud flats where they were no longer bothered by the terns.

The increasing success of the oystercatchers at Moriches in raising young seems to be due to two factors: (1) the earlier nesting in successive years. In 1960 the young hatched during the first week in July, in 1961 during the second week in June, and in 1962 and 1963 about the last week in May. This enabled the adults to get the young away from the terns before the latter reached their peak of aggressiveness. (2) The increasing vegetative cover of the island which gives the adults and young more shelter from aerial attack.

OUTLOOK

The outlook for future population increase on Long Island is unfavorable. The Cartwright Islands are in the process of washing away and even now, due to their slight elevation above tide level, are marginal habitat. The only suitable breeding areas on Gardiner's Island are heavily occupied by gulls and terns. Both former islands at Moriches are now open to predation and human disturbance. Few other suitable breeding areas exist on Long Island. Therefore, little increase and probably an eventual elimination of the present breeding population is anticipated unless the species can adapt to closer association with humans than in the past. The prognosis for expansion into New England seems similar.

SUMMARY

A northward expansion of the breeding range of the American Oystercatcher began from Virginia in about the late 1930's and reached New York two decades later. The species has now nested in three distinct areas of Long Island. These breeding areas which differ from each other and from breeding areas in the species' southern range and the nesting occurrences are described. The ecological suitability of the Middle Atlantic coastline for this species is discussed and reproductive success is reported.

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THE GALÁPAGOS SWALLOW-TAILED GULL IS NOCTURNAL

JACK P. HAILMAN

GULLS (Larinae) are thought to be diurnal birds. This paper reports the nocturnal habits of the Galápagos Swallow-tailed Gull, *Larus* (*Creagrus*, *Xema*) *furcatus*, and discusses briefly its adaptations to, and the selective advantage of, its nocturnal behavior.

The Swallow-tail is unusual among gulls because of its cliff-nesting habits and pelagic tendencies, in which it is surpassed only by the Kittiwakes, *Larus* (*Rissa*) *tridactylus* and *brevirostris*. Unique is the Swallow-tail's diet of squid, known from regurgitation by captured birds, which led Gifford (1913:76) to write "I have never for a certainty seen them feeding, and rather suspect that as a rule they do so at night." This suggestion went virtually unnoticed (e.g., Murphy, 1936; Alexander, 1954), although Moynihan (1962:101) noted that the species' unusually large eyes could be adapted to life in low light intensities (see Fig. 1). Bailey (1961), who reviewed the Swallow-tail's habits from the literature and his own field observations, failed to mention the possibility of nocturnal existence. Previous authors seem to have been influenced strongly by the report of Streets (1912) that *furcatus* at sea flew "always in the direction of the islands—in the evening going to and in the morning going away from them." [However, Bailey (1961) misquotes Streets as having said that the gulls always go *towards* the islands.]

In hopes of getting new evidence relating to this unsettled question, I studied the habits of *L. furcatus* during a research trip to the Galápagos Islands in November–December 1962.

CONFIRMATION OF NOCTURNAL HABITS

Possible effects of dark nest cavities.—At Plaza Island to the east of Santa Cruz (Indefatigable) Island I noted that some nests of *L. furcatus* were placed well back in dark crevices below rock ledges. It was hypothesized that such cavities provided the dark environment in which large eyes would be particularly advantageous. In a census of 33 nests there, 27 were on open ledges, 6 partly covered by a rock overhang above, and only 5 truly placed under ledges. Subsequent observations on Tower Island indicated an even lower proportion of nests in cavities there. Thus, the suggestion of adaptation to dark nest cavities seemed unlikely.

Observations on the daily cycle.—Observations of the undisturbed colony during the day demonstrated that adults ordinarily have but two activities: sleeping and preening. No adults (and but a few young at the base of the



FIG. 1. Profile of an adult *Larus furcatus* showing the light markings on the tip and at the base of the bill. Note the enormous eye.

cliff) could be seen on or over the sea during the day. Therefore, I placed my sleeping bag at the side of the cliff on the nights of 13–14 and 14–15 November, and repeatedly set an alarm clock throughout the night so that I would awaken at least at the beginning of each hour in order to sample activity of the colony. A nearly full moon for much of both nights allowed general observation when skies were clear; activity at certain nests was checked by flashlight.

The results of these night observations were clear cut. At dusk the gulls begin flying upward in groups of 2 to 20 and circling above the cliffs. As it grows darker, they leave the island and fly to sea, usually to the east of Plazas, but occasionally southward. By the time it is fully dark the only individuals remaining in the colony are birds incubating eggs, brooding young chicks, or (only occasionally) “guarding” chicks too old to be brooded. At these nests, a mate may return between midnight and 0300 to relieve the bird on duty; the bird that has been sitting apparently goes immediately to sea. Prior to first light in the morning, birds begin returning. By the time the dawn provides enough light for a human observer to distinguish colors, all birds have returned.

Displaying, both between mates and to members of other pairs, begins upon arrival in the morning and may last up to 1 or 1.5 hours after sunrise.

[Notes on specific displays will be communicated separately; see Moynihan (1962) for a preliminary description.] Occasionally, birds display briefly during the day. I observed one pair copulating in the evening just prior to sunset on Tower Island on 23 November. The feeding of young birds is done from shortly after midnight until an hour or so after sunrise by the returning parent. All these activities confirm that nesting adult *L. furcatus* are fully nocturnal in habits while they are on the breeding grounds.

POSSIBLE ADAPTATIONS TO NOCTURNAL EXISTENCE

Some of the peculiarities of *L. furcatus* appear to be related to its nocturnal habits.

White colors in plumage and soft parts.—Several areas of white on *L. furcatus* may have evolved because they render the gull or its movements more conspicuous at night. Large white triangles on the upper surfaces of the wings are evident when the bird lands, and could be useful as a social attractant during nocturnal feeding. The white ventral surface may be useful in reflecting light into the nest (say, during nocturnal feeding of the chicks), but as it is found throughout the gulls it cannot be considered a special adaptation to nocturnal feeding.

The head has two white areas. The grayish white tip of the dark bill (Fig. 1) elicits and directs the pecking response of the young chick (a more complete discussion of this in a comparative context is in Hailman, 1964*b*). A unique white tuft of feathers at the base of the bill (Fig. 1) accentuates head movements during displays. The relative position of the gray bill tip to the white basal tuft signifies the position of the bird's head, even in such low light intensities that the rest of the head is not visible.

Finally, the young birds prior to fledging possess a white plumage (Fig. 2) unique among gulls. The white head, in particular, is conspicuous at night when the young bird is giving its "head tilting *cum* begging call" to the parent. (Newly hatched chicks, although colored a cryptic gray, are nevertheless easy to find since they do not leave the nest.)

The eye.—The eye of *L. furcatus* is extraordinarily large, both absolutely and relative to body size, when compared with eyes of other gulls. The functional advantage of large eyes in nocturnal animals is a rather complicated story (Walls, 1942:210–212), but no less important for that.

The dissected eye (of a newly hatched chick) contains a reduced pecten, with few folds and very little pigmentation. Although the function(s) of the avian pecten is a matter of dispute, nocturnal birds typically have small ones (Walls, 1942:365, 657). Adults, however, have well-developed pectens, so that the species may be in the process of losing the pecten through retarded development rates (Hailman, 1964*b*).

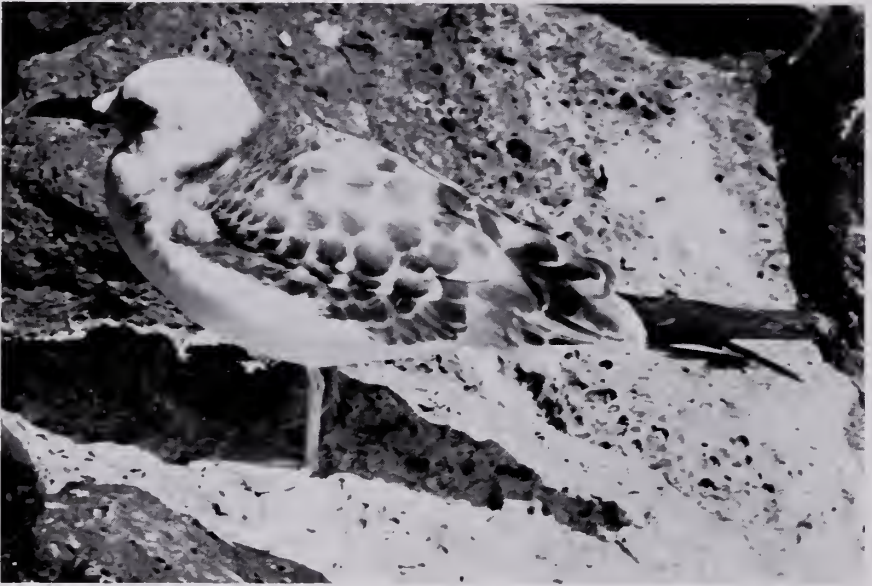


FIG. 2. An immature Swallow-tailed Gull. In diurnal gull species, birds of this age are usually dark brown over most of the plumage.

When the beam of a flashlight is directed into the eye of a Swallow-tailed Gull, the eye shines brightly, similarly to the way in which a cat's eye shines. Similar experiments on the diurnal Laughing Gull (*Larus atricilla*) failed to elicit eyeshine. Eyeshine usually indicates that the eye has a special structure which reflects instead of absorbs light behind the retina, although the structure itself differs widely in various vertebrates (Walls, 1942:288 ff.). Eyeshine is a typical trait of nocturnal animals where it functions to "lengthen the exposure" of the retina to a dimly lit object.

The eye of a newly hatched *furcatus* chick shows a bluish tinge in the interior of the eye. This blue is evident in live or dead chicks and adults, whereas night eyeshine appears yellowish or white. I dissected the eyes of several chicks and found that a blue layer coats the eye between the retina and the chorioid. Similar coatings in many vertebrates are well-differentiated tapeta, which may be retinal or chorioidal (as in *furcatus*). However, I did not know at the time of my dissections that no tapetum has been found in birds' eyes (Walls, 1942:230), and so did not make extensive examinations of the bluish coat. Eyeshine in birds has been attributed to the lamina vitrea layer between the pigment epithelium and the chorioid. Without more complete histologic data it is impossible to state the origin and exact nature of this

reflecting coat in the eye of *furcatus*. It is certainly functionally similar to the chorioidal tapetum in many mammals.

Miscellaneous.—The Swallow-tail's diet of squid, which rise to the sea's surface at night, was confirmed by Dr. A. Brosset on Tower Island during our trip there in November. All of the 17 birds that regurgitated when caught in a net for banding brought up squid. These captured birds included adults and young at about the fledging age. One time I did see a whole fish being fed to a younger bird on Plaza Island, but this may be exceptional. J. Hatch found shells of a marine gastropod about the nests of *furcatus* on Hood Island; the shells were identified by Dr. Harald A. Rehder of the U. S. National Museum as the floating planktonic species *Janthina ianthina*. However, nocturnal squid seem to be by far the main staple.

The calls of the Swallow-tailed Gull are unique among gulls, several involving clicking sounds that reminded me of a rapidly creaking door. The superficial resemblance of features of these calls to those given by other animals living in low light intensities (e.g., bats and porpoises) suggests a possible special function such as echo location. Sonograms of recordings (made by J. J. Hatch) of the calls revealed no energy in very high frequencies, such as might be expected if the call were used for echo location.

DISCUSSION

Possible selective advantage of nocturnal habits.—Why has such an “ungull-like” habit as nocturnal activity been evolved? Perhaps the abundance of squid at night provided an open ecological niche near the Galápagos Islands. There are certainly a number of fish-eating, diurnal species present with which a “typical” gull would have to compete (an albatross; several storm-petrels, shearwaters, boobies, terns; etc.), and several species, including a gull, apparently compete for refuse as scavengers (Hailman, 1963). Certain observations lead me to propose another possibility. Man-o-war Birds (*Fregata magnificens* and *minor*) constantly sail above the colonies of *L. furcatus*: at Tower, where all three species nest, and at Plazas, where only the gull nests. Gifford (1913:36) notes that Man-o-wars chase adults, making them disgorge food. I saw such an incident at sea about 300 miles east of the Galápagos on 5 November. Gifford (loc. cit.) further reports that the diurnal Galápagos Hawks (*Buteo galapagoensis*) take young birds, as I believe Man-o-wars try to do. It is interesting that the gathering of Swallow-tailed Gulls in the evening on Plazas begins just after the last Man-o-war departs for its nesting islands (the closest one is Daphne, about 25 miles to the northwest). Furthermore, nearly every *furcatus* has returned in the morning by the time the first Man-o-war is observed. My suggestion, then, is that the Swallow-

tailed Gull has evolved habits which allow both members of the pair to stand continual guard against predators at the nest during the day, and to feed unmolested at night.

Comments on the observations of Streets.—My observations appear to contradict those of Streets (1912), in that mine predict that gulls at sea should be heading *toward* the islands at dawn and *away* at dusk, not the converse. En route from Peru to Mexico by boat in 1835, Streets passed within sight of Chatham, the easternmost island of the Galápagos. He noted "gulls with a forked tail" apparently only when the boat was 300–400 miles away from the islands, although coordinates of his position are not given. Streets observed the gulls morning and evening for 3 days. He was not able to collect the birds, but noted that they had "a forked-tail, a black head, the entire under part of the body white, the back of a darker color . . . and with streaks of black and white on the wings." The dates are not given.

One possible explanation of Streets' observations is that he observed Malpelo Island individuals. Smith (see Bond and de Schauensee, 1938) found a small colony of *furcatus* nesting on a rock called Malpelo Island, located about 800 miles northeast of the Galápagos Archipelago. Streets may well have been closer to Malpelo than to the Galápagos at the time of his observations taken northeast of the Galápagos. Thus, birds flying southwest at dusk would be coming from Malpelo, those going northeast at dawn, returning to the rock. If such an explanation is correct, it is consistent with the observations on the gull's nocturnal habits reported here. However, this explanation fails to explain Streets' observations made southeast of the Galápagos Islands.

Another explanation might be that Streets saw nonbreeding individuals, and that these birds are diurnal, not nocturnal. A further assumption would have to be made that such diurnal individuals congregate somewhere other than in breeding colonies which I visited in the Galápagos, since I never saw birds arriving at dusk or leaving at dawn. However, even nonbreeding birds are probably nocturnal (see below).

Furthermore, Streets fails to mention the diagnostic field mark of *L. furcatus*, the white tuft of feathers at the base of the beak. The morphologically similar Sabine's Gull, *L. (Xema) sabini*, which lacks the white tuft, migrates to the South American coast during the winter (Alexander, 1954:101), although its status at sea is poorly known. Thus the possibility of misidentification may exist.

Finally, assuming Streets' identifications were correct, is it not possible that during the 27 years which elapsed between his observations and their publication that some errors were incorporated? It seems wisest to accept Streets' (1912) published report only with caution until further observations can be made or the details of his original notes can be found.

Behavior outside the breeding season.—My observations refer to breeding individuals only. *L. furcatus* is known to visit the Humbolt current off the coast of South America (Murphy, 1936). Moynihan (1962:104) watched them in Paracas Bay, Peru, in the mornings where “they were probably just resting in the calm waters of the bay after periods of active feeding.” This report suggests, then, that even outside of the breeding season—for individual gulls, since the species breeds year-round in the Galápagos (Hailman, 1964a)—*furcatus* is still nocturnal.

SUMMARY

Larus furcatus is the only nocturnal gull. Nesting adults fly to sea at night, only returning to feed young or guard and incubate at the nest. They display mostly at dawn and dusk.

Possible adaptations to nocturnal existence include: white plumage prominent in displays, including a white “releaser” on the bill for the chick’s pecking; large eyes with a tapetum-like coating and reduced pecten; the primary diet of squid (which surface only at night); and, possibly, the unique clicking calls.

Nocturnal habits may have evolved to allow adults to stand guard at the nest during the day when the diurnal Frigate Birds (*Fregata*) patrol the colonies.

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The Duke University expedition to the Galápagos was conducted for studies on Mockingbird vocalizations by Jeremy J. Hatch and my investigations of chick-feeding behavior in the endemic gulls. This report is a by-product of the latter study. The research was sponsored by National Science Foundation Grant GB98 to Dr. Peter H. Klopfer of Duke University, to whom I am much indebted for his help and criticism of the manuscript. Drs. A. Brosset and R. W. Risebrough were very helpful in making field arrangements in the Galápagos. My particular thanks go to Jeremy Hatch for his help and companionship in the field and for criticizing the manuscript. I am also grateful for comments by various persons following the presentation of this paper at the forty-fourth annual meeting of the Wilson Ornithological Society. This study was completed during the tenure of a U.S.P.H.S. predoctoral fellowship. Dr. C. Beer helpfully read the final manuscript.

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NEW LIFE MEMBER



A recent addition to the list of Life Members of the Society is Dr. Jack P. Hailman of the Institute of Animal Research of Rutgers University at Newark, New Jersey. Dr. Hailman holds a baccalaureate degree from Harvard University and a doctorate from Duke University, and recently completed postdoctoral studies at the University of Tübingen, Germany. While at Duke he participated in an expedition to the Galápagos Islands and the picture shows him holding a chick of the Swallow-tailed Gull and the model used to check pecking responses of chicks. A by-product of this expedition was the paper on the Swallow-tailed Gull published in this issue of the *Bulletin*. Dr. Hailman's principal ornithological interests are in the ontogenetic, physiological, and cybernetic aspects of avian behavior and he has published several papers on these and other subjects. He is married and has one child.

THE AFRICAN CROWNED CRANES

LAWRENCE H. WALKINSHAW

FOUR Crowned Cranes have been described, all from Africa. They belong to the family Gruidae and the subfamily Balearicinae which contains only one genus, *Balearica*. The characters are: bill shorter than the head; nostrils oval; a tuft of straw-like feathers on the nape; no convolutions of the trachea within the sternum.

Brasil (1913, *in* Wytsman), Jackson (1938), Chapin (1939), Roberts (1951), and Vincent (1952) classified the Crowned Cranes of east and South Africa as *Balearica regulorum*. Peters (1934) and Benson (1960) classified them all under *Balearica pavonina*. I am separating the two groups (see Fig. 1).

Allan Brooks, Jr. (verbal) stated that there is a gradual intergradation in general body plumage and face markings of cranes across Uganda, from Lake Victoria to the Sudan border, but I have been unable to find enough specimens to show this. The cranes about Entebbe, Uganda, and from Kenya, however, are much larger and lighter colored than those in Sudan. In the Sudan Crowned Crane about one-third of the upper portion of the cheek patch is colored white while the lower portion is pink or reddish. In the East and South African Crowned Cranes, often the cheek patch is entirely white, and again there is a narrow half-moon shaped upper portion of bright red, possibly an age character.

In many ways the Sudan and West African Crowned Cranes are similar to those from East and South Africa; in many other ways, they are much different.

KEY TO THE CROWNED CRANES

- A. Upper one-third to one-half of the bare cheek patch white, the lower portion pink. Throat wattle small. Feathers of the neck dark slaty gray. The bird is smaller.
 - a. General color lighter. Bill horn-colored at tip.
White part of bare cheek patch larger. *B. pavonina pavonina*
 - b. General color darker. Bill wholly black. White part of bare cheek patch smaller. *B. pavonina ceciliae*
- B. Cheek patch white with small upper portion red. Throat wattle large and pendant. Neck feathers pearly gray. The bird is larger.
 - a. Upper margin of bare cheek patch rounded. *B. regulorum regulorum*
 - b. Upper margin of the bare cheek patch with a knob-like process.
..... *B. regulorum gibbericeps*

THE WEST AFRICAN CROWNED CRANE

Balearica pavonina pavonina

This is the only crane found in West Africa between the equator and the Sahara Desert. It was first described by Linnaeus (1758) from "Africa."



FIG. 1

AFRICAN CROWNED CRANES

Ranges of subspecies: (1) *Balearica pavonina pavonina*, West African Crowned Crane. (2) *Balearica pavonina ceciliae*, Sudan Crowned Crane. (3) *Balearica regulorum gibbericeps*, East African Crowned Crane. (4) *Balearica regulorum regulorum*, South African Crowned Crane.

Mackworth-Praed and Grant (1952) gave the type locality as Cape Verde, Senegal. Its range has been established from Senegal to Lake Chad, south to Sierra Leone, Ghana, northern Nigeria, to the middle Chari River.

Blyth and Tegetmeier (1881) wrote that this bird had only once been found on the Sahara, on the dry sands of the Guerah-el-Tharf by Canon Tristram. They also wrote that it was found rarely on the River Volta, but more commonly on the Gambia and Niger Rivers. It was also found in the countries of the Gambia and the Gold Coast, in Fida, at Cape Verde, in Whida, and along the River Ponny, in Guinea.

Bannerman (1931) wrote that it was common in certain places in Gambia, and that it bred at Niamina. At Sallikenni and other similar places it was often found in flocks of a hundred or more. In Sierra Leone the first and

only record at that time was during April 1930, on the Little Scarcies River. It was more common in Nigeria and Gambia than in the Gold Coast but was increasing there. In Nigeria it was generally and plentifully distributed north of 10° lat., yet nowhere so common as in Hausaland, where great flocks occurred.

Bannerman (1951) wrote that huge flocks of birds occurred at Bornu and near Lake Chad but it was less common from August to November in the inundation zone of the Niger River. In the dry areas of the Bauchi Plateau the birds can be seen at all seasons.

There are specimens in the British Museum from Portuguese Guinea (Gunnal); Nigeria (11 miles N of Kafanchan, Zaria) (northern Nigeria); Ghana (Accra, Nr. Tamale).

Description.—Adult: The sexes appear similar in plumage but the male is larger. General color; dark slaty gray passing into black, especially on the upperparts, where the feathers are pointed and more or less falcated. Wing coverts white; the inner greater coverts straw-colored and composed of distintegrated plumes; primary coverts and alula white. Primaries black; secondaries maroon-chestnut, the innermost ones a little broadened and lengthened and slightly decomposed. Tail black. Crown covered with velvety-black, short feathers. Occiput with a tuft of straw-like bristles; each bristle is a spiral, white on one side, brown on the other, and black at the extreme tip. These bristles all radiate from a small spot and spread in all directions out from the back of the head. Lores, sides of face, and cheeks bare; the upper one-third white; the lower part pink. Throat covered with black down; the middle portion bare, covered with red skin in two very small wattles about 2 cm long with a fold between. Neck feathers, especially those of the lower portion in front, elongated and lanceolate and a little lighter than the back. Bill and legs black. Iris white, or very light blue.

Six specimens in the British Museum are listed in Table 1 giving the measurements of all four forms. Many of the other birds were in the U. S. National Museum, Museum of Comparative Zoology, and The University of Michigan Museum of Zoology. Those in the British Museum were measured by Shane Parker.

THE SUDAN CROWNED CRANE

Balearica pavonina ceciliae

The Sudan Crowned Crane, first described by Chalmers Mitchell (1904a, b), is smaller and darker than *B. p. pavonina*. The tip of the beak is supposed to be black and the white cheek patches red below and with a much smaller white area above. The West African bird is supposed to have a horn-colored bill tip and a larger white area on the cheeks. However, I noted many of the wild Sudan birds had horn-colored bill tips in February, apparently from their feeding on the dry baked soil.

Although the type was taken at Khartoum, this bird now rarely, if ever, occurs there. It is found on the Upper White Nile and its tributaries south of Kosti, and in Ethiopia and northern Uganda. In Sudan it has been found in the Provinces of Darfur, Khartoum, Blue Nile, Upper Nile, Bahr el Ghazel.

TABLE 1
MEASUREMENTS OF CROWNED CRANES

Number measured	Sex	Wing	Tail	Tarsus	Bare tibia	Middle toe	Exposed culmen	Crest	Weight
<i>Balearica pavonina pavonina</i>									
1	Male	585	275	203	156	116	64		
1	Female	506	241	196	156	107	53		
6	Both	547.5	244.3	196	146.5	115.3	56.5		
	Extremes	506-585	233-275	190-203	123-156	107-122	53-64		
<i>Balearica pavonina ceciliae</i>									
4	Male	511.7	220	192.5	156.7	113.6	56.2	107 mm	3628.8 g
9	Female	491.1	222.5	187.8	132.1	118.1	54.8	94	3628.8 g
17	Both	496.7	224.3	188.0	134.5	116.4	56.1	100	
	Extremes	470-565	207-252	172-205	100-161	100-129	49-62	94-100	
<i>Balearica regulorum regulorum</i>									
9	Male	560.7	241	205.1	128.6	115.6	63.3	111	
2	Female	523		223		116	62	105	
22	Both	565.2	238.7	207.1	121.2	115.2	61.9	110	
	Extremes	523-642	212-256	183-234	104-142	109-120	57-68	99-122	
<i>Balearica regulorum gibbericeps</i>									
16	Male	565.4	258.6	205.4	133.6	120.5	60.9	123	
14	Female	543.5	250.0	196.8	129.1	120.6	59.7	122	
44	Both	559.4	250.1	201.1	133.8	117.6	59.4	122	
	Extremes	458-615	224-270	170-234	113-161	100-126	52-71	102-132	

and Equatoria (Cave and MacDonald, 1955. and Sudan Natural History Museum). It has also been found in Uganda at Dufile near Numile (Jackson, 1938) and in Ethiopia (Mackworth-Praed and Grant, 1952).

Specimens in the British Museum, Chicago Natural History Museum, and The University of Michigan Museum of Zoology were taken from Sudan from White Nile at Abou Zeit, Fashoda, Kaka, Kodok, Khartoum, Malakal, 12 miles NW of Sengo and Tonga. One in the British Museum was taken in Ethiopia.

These birds spend much of the year in flocks in the Nile Valley. They begin to congregate after the breeding season, in November, reaching a peak in late February and March. We spent 7 days, 3 to 9 February 1962, at Malakal, Sudan observing these birds. At, or shortly after, daylight, the Crowned Cranes flew in small groups out onto the open or semiopen plains where they fed. Sunrise was between 0610 and 0613. Flights out onto the plains began (3-9 February) at 0617, 0607, 0609, 0610, 0541, 0535, and 0558. The numbers increased from 21 on 3 February to 99 on 9 February, and by late February there were several thousand (Stas Wujastyk). The birds were

in small groups, usually one to four (the groups were: 14 flocks of one; 24 of two; 22 of three; 22 of four; 3 of five; 1 of nine; and 1 of 33). In 87 groups there were 273 individuals. The chief departure was between 0540 and 0700. On many days, the flight back to the marshes began at 0710 and lasted until 0800 or later.

Seldom did they fly out in the late afternoon as other cranes do, but there were exceptions. On 2 February, I saw a lone crane flying to the roost at 1806, 9 minutes after sundown. On 4 February, I heard three calling as they flew in the late evening, and on 7 February a small flock was flying down the Nile in the dark at 2200.

On the ground these cranes were rather quiet, but once in the air they began calling, *Ka-wonk—ka-wonk—ka-wonk*. They flew between 100 and 200 meters above ground and usually about 2 or 3 km from the river. They dropped onto the dry, cracked ground, which was like baked clay. They then fed on small grass and other plant seeds. Few insects were to be found. Harry Hoogstraal in a letter (15 March 1962) wrote, "We have not seen the tremendous flocks near the Nile, many of them with mating groups, that we saw in 1961. After having often crawled on the ground among the flocks, searching for the minute seeds that they peck at hour after hour, I have marvelled at how they get enough nourishment to support their large bodies."

THE SOUTH AFRICAN CROWNED CRANE

Balearica regulorum regulorum

This crane was described by Bennett (1834) from "South Africa." Chapin (1939) wrote of its distribution: "Eastern Cape Colony north of the Cunene River, Lake Kabamba on the Lualaba, the eastern Congo border to the vicinity of Mahage, Uganda, and Kenya Colony. Two races are recognized, typical *regulorum* living in the southern part of the range, northward presumably to the southeastern Congo and the vicinity of Zanzibar. *B. r. gibbericeps* of the more northern parts of eastern Africa is closely similar, but the bare skin of the cheeks extends farther upward in the point toward the hind-crown. The species does not seem to extend north of the Cunene valley (in Angola)." Roberts (1951) said it is found: "South of the Congo and Tanganyika to Ngamiland on the west, and eastern Cape Province on the east." Vincent (1952) gave its range in South Africa as: "General except south-west."

There are specimens of *B. r. regulorum* in the British Museum from Nyasaland (Lake Shirwa, Karonga); from Bechuanaland (Mababe Flats, NE of Lake Ngami); Northern Rhodesia* (Kafue River); Southern Rhodesia (Salisbury); the Zambezi River; from

* Since 1964 officially known as Gambia.

South Africa (Transvaal). In the Durban Museum there are two South African specimens, one from Griqualand, East Cape. While in the Pietermaritzburg Museum there is one from Natal and there is one from NW Rhodesia in the Transvaal Museum.

In Northern Rhodesia the Wattled Crane (*Bugeranus carunculatus*) is often more abundant than the Crowned Crane, while in other areas this is reversed. About equal in numbers, neither form is common in Southern Rhodesia. In South Africa, the Crowned Crane is considered the most common crane. However, in many areas, the Stanley Crane (*Tetrapteryx paradisea*) is the most abundant.

Description.—Adult: Similar to *Balearica pavonina* but a lighter gray. The feathers of the neck are much more pearly gray instead of slaty gray. The crest and the inner greater wing coverts are generally of a paler yellow than with *B. pavonina*. Each bristle of the crest is ringed with white and yellow with black at the tip. Throat naked, with a large red, pendant wattle the base of which is black and continuous with the black velvety feathers around the bare cheek patch. The bare cheek patch varies in color, but the majority are always white. Sometimes there is a small half-moon-shaped, bright red border at the top; sometimes the cheek patch is entirely white. Bill and legs black. Eye grayish-white.

Immature: General color gray with the feathers of the upperparts broadly edged with rufous and those of the underparts with sandy buff margins. The ends of the maroon secondaries darker than in the adult. Head and neck rufous. Crown chestnut with dark bases on the feathers. Lores bare. Remainder of the sides of the face and ear coverts covered with yellowish-white down. Crest small, chestnut. Legs black. Eye light ash color.

Downy young at hatching: Young cranes always appear pot-bellied when newly hatched and they are usually quite weak. Down, about 10 mm long, on back of head, on the back and belly, shorter, about 5 mm, on cheeks. Front of head pale umber; back of head darker; forehead, superciliary area, cheeks, and throat with short pale ivory down shading to light buff. Skin of eyelid pale greenish-yellow. Back; dorsal stripe umber brown with flank spots darker and a caudal spot, shield shaped and darker; shoulder spots darker; general color pale buff. Distal edge of wing light umber; anterior edges buffy, a dark spot at the bend. Belly very pale buff. Chest darker buff. Bare skin above eye slaty tinged with pink. Bill slaty gray, buffy flesh color at base of lower mandible. Base of bill and skin of lower mandible light horn color. Egg tooth pale ivory. Legs generally flesh colored, brightest at heel. Soles of feet pale yellow; each scale on tarsus had a dark base with an outer edge of pale flesh. Nails pale horn color. Eye dark brown.

THE EAST AFRICAN CROWNED CRANE

Balearica regulorum gibbericeps

The East African Crowned Crane was described by Reichenow (1892) from Lake Jipe near Kilimanjaro, Tanganyika. The upper portion of the bare cheek patch is supposed to extend into the black velvety feathers of the top of the head in a more or less swollen knob-like area. Blaauw (1897) pointed out that some specimens show it on one side but not on the other, depending on how the specimen is prepared. If the skin is pulled down

equally on both sides, it does not appear as prominent. The top of the bare cheek patch is red as in *B. r. regulorum*. It is possible that *gibbericeps* might be not separable from *regulorum*.

In the United States National Museum there are specimens from British East Africa: from the head of the Guaso River (9 January 1909); Sotex, Telex River (13 May 1911); Solik, Kabalot Hill (5 July 1911); S. Guaso, Nigiro, Nigara Marsh (6 February 1911); Jekyundu River, Maru (no date); Thika (11 January 1909); Lake Nyanza, Tanganyika (28 February 1920). In the Museum of Comparative Zoology there are specimens from Unyanganyi, Tanganyika (four on 6 December 1929); Nyga za Lake, Victoria (4 March 1910); Sindam Goma, Rutshura, Congo (male, female, and eggs, 11 November 1938); Nyakabande, Ruocda, Uganda (27 January 1939); and Labago, Mwanja, Nairobi, Kenya (17 October 1922). In the Coryndon Museum there are four Kenya specimens from: Kabete, near Nairobi (1 July 1944); Nairobi (17 February 1961); Nakuru Rift Valley (12 January 1958); and Limuru (17 January 1957). There are two female specimens in The University of Michigan Museum of Zoology taken at Lake Manyara (elevation 3,000 feet, 914 m), Tanganyika, in June 1939.

In the British Museum there are specimens from Kenya: Gilgil (9 October 1903, two specimens); Kiboka Swamp (14 August 1899); Loita Plains (6 November 1909); Sattima (30 January 1903, two specimens); Thika (25 August 1914). From Uganda there are specimens: Ihunga, SW Ankole (10 December 1910); Kigezi, Mfumbiro (17 November 1910); Lake Albert Edward Nyanza: Lake George at south end (4, 5, and 6 December 1910); Lake Ruaketenge, Ankole (November 1903). There is one specimen labeled Tanganyika and another from Iringa Uplands (16 February 1932).

Chapin (1939) wrote that Emin found that the Crowned Cranes at Wadelai, on the Bahr el Jebel, had the long neck feathers light ashy-gray and the bare cheek patch pure white with a red border above. Emin also reported Crowned Cranes common around Lake Albert and at Mahagi. *B. p. ceciliae*, he wrote, apparently does not occur south of Lake No. *B. r. gibbericeps* has also been found at the eastern base of Ruwenzori, Lake Edward; throughout the Kivu Highlands; to Lake Bunyoni, 6,700 feet (2,042 m); and in a small marsh on the western slope of Mt. Mikeno, at 7,200 feet (2,195 m).

Jackson (1938) wrote that *B. r. gibbericeps* avoids localities above 7,500 feet. I found this to be the case with *B. r. regulorum* in South Africa. Jackson gave the following localities where *gibbericeps* has been found: Ankole, Athi River, Bombo, Buddu, Elmenteita, Entebbe, Gilgil, Il-poloshat, Jinga, Juja, Kendu, Kigezi, Kisumu, Kyagwe, Lekundu River, Mt. Elgon, Mpumu, Mumias, Nairobi, Naivasha, Nakuru, Nandi, Njoro, Pesi Swamp, Rombo, Ruatenge, Ruibale, Thika, Toro, and Tsavo. Dean Murray (verbal) found the species common at Arusha, Tanganyika.

The discussion that follows pertains chiefly to the South African Crowned Crane with which I did the most work.

HABITAT AND ASSOCIATES

Plants.—Plants on the Crowned Crane breeding grounds in Natal, South Africa, were: (Gramineae): *Pennisetum thunbergii* Kunth., *Andropogon appendiculatus* Nees., *Arundo donax* L. (probably escaped), *Miscanthidium* (sp.). (Cyperaceae): *Carex* (sp.), *Cyperus denudatus* Linn. f.; *Cyperus fastigiatus* Rottb., *Scirpus inclinatus* (Del.) Aeschers et Schweinfurth ex Boiss [= *S. corymbosus* (Roth ex Roem. et Schultes) Heyne], *Pycreus unioides* (R. Br.) Urban = [*P. angulatus* Nees.], *Pycreus oakfortensis* C. B. Cl., *Ascolepis capensis* Ridley. (Orchadaceae): *Disa cooperi* Reichb. fil. (Gentianaceae): *Chironia krebsii* Griseb. (Iridaceae): *Dierama* (sp.) and another plant, probably *Cyrtanthus* (sp.).

Plants were identified by Colonel Jack Vincent and his men of the Natal Parks and Fish Preservation Board.

In Northern Rhodesia some grasses found were: (generic names), *Panicum*, *Sporobolus*, *Chloris*, *Hyporrhinia*, *Setaria*, *Brachiaria*, *Digitaria*, and *Echinochloa*. These were in the vicinity of where I found two Crowned Crane nests in January. W. L. Robinette aided me in their identification. Robinette found a Crowned Crane nest on 18 February 1962 in this same area (Lochinvar Ranch, near Monze) and wrote (letter, 12 July 1962) that the grasses around the nest were *Setaria*, *Eragrostis*, and *Sporobolus*. Acacia trees in the general vicinity were *Acacia sieberiana*.

Other birds using same marshes.—Species of birds found on the marshes inhabited by the Crowned Cranes in South Africa included Black-necked Heron (*Ardea melanocephala*), Yellow-billed Egret (*Mesophoyx intermedia*), Cattle Egret (*Bubulcus ibis*), Cape Bittern (*Botaurus stellaris capensis*), White Stork (*Ciconia ciconia*), Sacred Ibis (*Threskiornis aethiopicus*), Hadedah (*Hagedashia hagedash*), Yellowbill Duck (*Anas undulata*), Red-billed Teal (*Anas erythrorhyncha*), Spurwing Goose (*Plectropterus gambensis*), Secretarybird (*Sagittarius serpentarius*), Marsh Harrier (*Circus ranivorus*), Wattled Crane (*Bugeranus carunculatus*), Stanley Crane (*Tetrapteryx paradisea*), Stanley Bustard (*Neotis denhami stanleyi*), an unidentified rail, Ethiopian Snipe (*Capella nigripennis*), Marsh Owl (*Asio capensis*), several species of swallows, crows, starlings, and widow-birds. In the Rhodesias there were more shore birds, storks, and herons, as there were in East Africa and Sudan.

During the breeding season the Stanley Crane occupied a different niche in the environment than the Crowned Crane. The majority of Wattled Cranes, even though they used the same marshes, nested during a different season. Usually the Crowned Cranes nest in the summer, December to February, while the Wattled Crane during the drier winter months, April to October. On one occasion Rudyerd Boulton found the nest of a Wattled

Crane in April and during the January following this nest was being used by a pair of Crowned Cranes. Although the Wattled Cranes are larger and more dominant, they allowed the Crowned Cranes to approach or to feed fairly close to them at times.

Other life.—A crab (*Potamon* sp.) was found on all crane areas, and I found remains of it on several crane nests where they had been fed to newly hatched young. A frog (*Rana fasciata*) was also found on the same regions. Two unidentified snakes were observed, one of which tried repeatedly to swallow a Crowned Crane egg in Northern Rhodesia as we worked in a blind 15 m away. The cranes soon discovered the snake and drove him away. Under normal circumstances this probably would not have happened because the birds would not have been away from their eggs very long. Probably in most areas now mammals do little damage to the Crowned Cranes. In South Africa large herds of cattle pasture around and through the nesting marshes. On one occasion I watched a pair of cranes drive two steers from their nest site. When the cattle peered through the sedges surrounding the small nest clearing, the incubating crane rose and began calling. Immediately its mate flew to its side and the two of them, side by side, advanced with outspread wings towards the cattle, which retreated rapidly.

ROOSTING AND FLOCK SIZES

The Crowned Cranes were breeding at Lochinvar Ranch, Monze, Northern Rhodesia, when we were there 22–25 January 1962. Consequently, they were mostly to be seen in pairs, 17 of which we saw, but three lone birds were also seen. At Salisbury, Southern Rhodesia, 3–4 December 1961, a pair of Crowned Cranes were roosting at Rainham Dam area in nearby trees. This, as was found later, was just prior to their breeding season. There were three cranes here. On 3 December, one crane went to roost at 1825 and left the next morning at 0545 (sunrise 0512) while two others (the pair) flew at 0546. The lone bird fed during the day on a pasture field about 1 mile from his roost tree; the pair fed in the same pasture but some little distance from the lone bird. At 1112 the lone crane flew back to the dam to drink and was followed at 1114 by the pair. When they arrived at the dam, the lone bird flew back to the same pasture. The pair remained at the dam, preening, drinking, and bathing until 1129, when they flew back to the field where they remained until 1715. Then they flew to another roost tree 100 m from the tree in which they had roosted the previous night. On 12–13 January 1962 this pair was nesting, the young hatching on 13–14 January. At this time the birds roosted in the marsh, one over the young and the other standing nearby. Later in January in Northern Rhodesia one bird was found roosting in an acacia tree at night. We frightened him from this tree as we walked

by in the dark. He flew off into the night, calling mournfully. Many Crowned Cranes in South Africa also roosted in trees, but the mate to the incubating crane in each case roosted in the marsh near the nest. At some of these nest sites there were no trees within 1 or 2 km, yet in others there were nearby trees.

At Nottingham Road, Natal, South Africa on 8 December 1961. I watched two Crowned Cranes leave their roost area at 0449 (sunrise 0459). They had been roosting in shallow water along the edge of a dam, and flew into a neighboring wheat field. Three Stanley Cranes flew at 0445; two more at 0459, and seven at 0500. Hadedahs were flying at 0500 as were Sacred Ibis and a flock of 81 Cattle Egrets. In Northern Rhodesia the pattern was about the same.

In the Mooi River-Drakensberg Mountain area of Natal, South Africa, I observed, 8 December 1961 to 9 January 1962, 12 lone Crowned Cranes, 19 groups of two, two groups of three; one with 19, and two with 28 cranes. The majority of the birds were on their breeding marshes and these flocks were nonbreeding individuals. The percentage of Crowned Cranes in pairs in South Africa and the Rhodesias was 59.01 and of birds in nonbreeding flocks, 40.98 per cent.

The Crowned Cranes in Kenya apparently nest at a different season since at Lake Naivasha on 2 December 1961 I observed a group of three.

COURTSHIP BEHAVIOR

Cranes apparently mate for life. They usually nest once each year and if successful they retain their family group for 9 or 10 months. The young raised the previous season are driven away and the pair prepares to nest again. Prior to nesting they exhibit a spectacular courtship behavior, the dance. Both male and female participate, but usually the male is the aggressor. Crowned Cranes begin their dance differently than do other cranes that I have observed. Without moving their body, they bob their heads up and down four to ten times. Sometimes this is all they do, but often they begin to bow. Then, spreading their wings, they jump 6 to 8 feet into the air with legs drooping motionless beneath them. Sometimes between hops they pick up objects from the ground and toss them into the air. Sometimes they call, sometimes not. The dancing crane often goes completely around his mate doing all this and sometimes both birds dance opposite each other. Sometimes one does the dancing, again the other.

Nonbreeding cranes also have a dance. The actions are very similar to those of courtship. A year-old Crowned Crane, which had been hand-reared, jumped all over the yard when it was released from its evening pen in Northern Rhodesia. We had a Sandhill Crane (*Grus canadensis*) that we

raised, which danced and jumped each morning or every few mornings, after it was 5 days old. However, cranes seem to prefer to do this when there is more than one. In nonbreeding flocks one must consider that they may be securing mates, and in these flocks the dance may be a courting display.

AGGRESSIVE AND DISTRACTION BEHAVIOR

When some enemy, man, cattle, or snake, approached a Crowned Crane nest, the birds showed distraction display. Sometimes the birds went through the dance procedure together; sometimes one or the other went through part of it. They used the head-bobbing display quite frequently. Sometimes they spread their wings, showing the large white patches, and ran around the intruder. Again they jumped up and down with their wings half outspread. When running around they often bent their legs and crouched down with head bent low. Sometimes they picked up objects from the ground and tossed them into the air.

Aggression was similar but more decisive. They seemed to know which enemy would retreat if they attacked it. For example, they drove a snake and two steers from nests, but when I came to the nest they remained nearby demonstrating. In aggressive attack they spread their wings and approached the enemy with arched neck and lowered head. They advanced together, side by side, the right wing of the one bird touched the left wing of the other. If the enemy did not retreat, when they were very near, they jumped at it and with wings flapping, feet kicking, and bills stabbing, soon routed it from the nest vicinity.

NESTING

Nest sites were in open marshes where a few centimeters of standing water and knee- to shoulder-high sedges and grasses produced isolation. The vegetation was higher immediately around the site so that when I was searching for nests, I usually worked through the regions of tallest grasses and sedges. All nests were susceptible to flooding. The average water depth around six nests of the South African Crowned Crane in Northern and Southern Rhodesia and South Africa was 12.1 (8-18) cm. The nests were mere piles of grasses and sedges pulled from the immediate vicinity. In the region of the six nests that I observed, all of the vegetation was completely trampled down for a distance of about 5 m in every direction. The birds had pulled nest material from this region and in so doing had trampled down the remainder. The six nests averaged in diameter 70.2 by 77.6 cm, varying from 50.8 by 52.3 up to 76 by 86 cm. The nests were neat piles with a well-cupped center on top for the eggs. The average height above the water was 12.2 (8-18) cm to the rim. Wyndham (1940) described one nest almost 2 m

TABLE 2
NESTS OF THE SOUTH AFRICAN CROWNED CRANE OBSERVED BY THE AUTHOR 1961-62

Nest number	Date found	Date eggs were laid	Date eggs hatched	Where found
1	11 December		21-22 December	South Africa, Natal, 11 miles WSW of Rosetta
2	31 December	Between 23-30 December	28 January*	South Africa, Natal, 20 miles WSW of Rosetta
3	6 January		Unknown	" " " " "
4	13 January	After 4 December	13-14 January	Southern Rhodesia, Salisbury, Rainham Dam
5	23 January		Unknown	Northern Rhodesia, near Monze, Lochinvar Ranch
6	23 January		23-24 January	" " "

All nests had three eggs except number 3, which had one egg.

* Hatching date obtained by William Barnes.

across at the base with a cupped portion 23 cm across, which was about the same at the top as the six nests I saw (see Table 2).

The pH of the water in the Crowned Crane marshes in Natal, South Africa, was 6.0 to 6.3; at Rainham Dam, Salisbury, Southern Rhodesia, it was 7.0 where the cranes nested while at the dam the pH was 8.0. At Lochinvar Ranch, near Monze, Northern Rhodesia, the pH was 7.5.

Nests of the other three Crowned Cranes have been described as very similar. The smaller northern birds may often nest in much deeper water.

THE EGGS

Crowned Crane eggs are pale bluish in color, unspotted, and unstreaked when newly laid. They are often glossy and in shape are ovate or pointed ovate. They soon become stained, and at hatching time are dirty brownish or greenish with an almost white background. Charles Wyndham (1940) wrote, "The ground colour of the shell is a pale greenish-blue of a shade practically identical with that of the normal heron type, but differing from the latter in being thinly incrustated over almost the entire surface with a dull-white chalky deposit similar to that found on the eggs of the various species of cormorants."

Twenty-four South African Crowned Crane eggs from South Africa measured 86.04 (78.3-93.4) by 56.21 (50.4-58.4) mm and 15 eggs from Northern and Southern Rhodesia were 86.41 (77.0-93.9) by 57.7 (56.9-59.0) mm. The average measurement of the 39 eggs was 86.19 by 56.78 mm. The average weight of 13 eggs was 149.66 g varying between 126.1 (at hatching) and 182.0 (when fresh).



FIG. 2. Crowned Crane nest near Broadmoor, Natal, South Africa, 16 December 1961.

Out of 17 recorded sets from the Rhodesias, 10 contained three eggs, 3 contained two, and 4 contained one, averaging 2.35 eggs per set. From all four provinces of South Africa, there were 11 sets with three eggs, 4 with two eggs, and 2 with one, averaging for 17 sets, 2.53 eggs. The 34-set average for the Rhodesias and South Africa was 2.44 eggs.

Wyndham (1940) found that the first egg was laid 4 days before the second and the third egg 3 days after the second. One nest that I found in South Africa had all three eggs laid during a week's period, but I did not know how many days came between the laying of each.

Chapin (1939) wrote of the eggs of *B. r. gibbericeps*, "pale blue . . . 79.6–86 × 56.5–58 mm. Two eggs usually compose a set, and they are said to become a dirty brownish as incubation advances." Jackson (1938) wrote, "eggs two to three in number, are dull white with a greenish tinge, but with a fair amount of gloss, and measure 85–88 × 56–60 mm."

Eggs of *B. p. ceciliae* are also a very light blue, almost white, and after incubation has progressed, became rusty stained. In two sets of eggs in the Sudan Natural History Museum, three eggs in one set (403) measured 73.5 × 53.2, 78.1 × 57.1, and 78.1 × 57 mm, and the two eggs in the second set (404) were 70.4 × 52 and 71.4 × 53 mm. The five eggs averaged 74.3 × 54.46 mm. These were taken by J. G. Meyers prior to 1950 in

Equatoria Province, Sudan. Mackworth-Praed and Grant (1952) gave the measurement average as 80×58 mm.

Bannerman (1931) wrote that with *B. p. pavonina* the egg is pale blue, two or three constituting a set. Later Bannerman (1951) reported that two sets of eggs, one of three and one of two, were found on 30 July and 22 September. The eggs were ovate or rounded ovate, white, stained with yellow and brown. Beneath the chalky top layer they appeared pale blue sparingly marked with small brown and chocolate spots. Some had no markings. The average measurement of the five eggs was 77.8×56.6 mm with extremes of 79.8×55.3 , 76.0×58.5 mm maximum and 76.4×55.0 mm minimum. The nests in which these eggs were found were haphazard accumulations of grasses. One measured 76 cm across, the other 76×102 cm.

NESTING SEASON

The nesting season in different parts of Africa apparently depends on the rainy season. At Dakar, Senegal, the rainy season is from July to October. Bannerman (1931) wrote that Welman found a nest with three eggs in a swamp at Gashua, northern Bornu, in August 1924. It was placed in 5 feet of water and mud—the swamp, the result of the wet-season flooding of the River Yo, was the breeding ground of a large number of these cranes. He saw several pairs at close quarters, flushing several individuals that might have been setting during the last week in August.

In Sudan, the rainy season comes between May and August at Malakal and vicinity. From existing records, the breeding season begins in June and extends into August. However, some birds may nest later, for I found a pair with two young about 6 weeks old on 4 February 1962, indicating that they had eggs about 25 November 1961. This was at Khor Adar, 80 miles north of Malakal. Mackworth-Praed and Grant (1952) gave the breeding season of *B. p. ceciliae* as September to November but this cannot be the average because all of the family groups I observed in February had fully grown flying young with them.

Chapin (1939) reported that Dr. Baquaert found a nest with two downy young, in a small marsh on the western slope of Mt. Mikeno, Congo on 22 March 1927. There is an egg set in the Museum of Comparative Zoology taken at Sindan Goma, Rutshura, Congo, 11 November 1938. Other *B. r. gibbericeps* nesting records given by Chapin (1939) included one from Dr. van Someren, who reported nests in Kenya Colony in June and July, built among reeds in a swamp. Paget-Wilkes found a nest near Kitale, Kenya Colony, 17 September.

Jackson (1933) wrote: "It breeds in both Kenya Colony and Uganda

between May and July. Two nests were 8 May 1903 at Naivasha and 2 June 1907 at Nairobi."

I observed a pair of East African Crowned Cranes at Lake Naivasha, Kenya, 2 December 1961. They had a fully grown young bird with them which could fly very well. This bird must have been hatched at least by June or July.

Concerning *B. r. regulorum* in Northern Rhodesia, Benson and White (1957) gave records from December to January. Benson (1960) wrote of the Rhodesias and Nyasaland, "The few data in the check list . . . point to this species being a rainy season breeder . . ." The percentage of nesting records given by him were: December, 27 per cent; January, 47 per cent; March, 8 per cent; and April, 12 per cent. Smithers, Irwin, and Paterson (1957) gave ten breeding records for Southern Rhodesia for January and one for February. Benson (1940, 1953) gave two breeding records for January, one for April, and one for May from Nyasaland.

Roberts, McLachlan, and Liversidge (1958) gave the nesting season of *B. r. regulorum* in South Africa as being between December and February. But there are some records as early as 1 November and as late as March. Some definite breeding records for *B. r. regulorum* are given below:

Northern Rhodesia.—Kaesmpa District, Kafue National Park: (1) 1 June 1959 (fully grown young able to fly with parents), Uys (Benson, 1960). (2) 20 July 1959 (young bird, two-thirds grown), Ansell (Benson, 1960). Luangwa Valley, Nsefu Game Reserve: (1) Late April 1958 (fully grown young bird unable to fly), Shenton (Benson, 1960). Monze, Lochinvar Ranch: (1) 23 January 1962 (three eggs), L. and C. M. Walkinshaw. (2) 23 January 1962 (two eggs, one young), L. and C. M. Walkinshaw. (3) 18 February 1962 (three eggs), W. Leslie Robinette.

Southern Rhodesia.—Gwelo District, Guinea Fowl: (1) 1 January 1951 (two eggs), Mr. Salmon. (2) 15 February 1953 (three eggs), Mr. Salmon. (3) 26 January 1955 (two eggs), Mr. Salmon (all three records from file cards of Southern Rhodesia). Matopos Research Station: (1, 2, 3) Three records of three eggs each, all during early January 1950, 1951, and 1952, D. C. H. Plowes (S. R. file cards). Nala: (1) 13 January 1954 (two eggs), I. Cannell (S. R. file cards). Salisbury, Rainham Dam: (1) 11 January 1951 (three eggs), H. M. Miles and R. M. Henderson. (2) December 1959 (parents observed with fully grown young). (3) 9 January 1960 (three eggs). (4) 8 January 1961 (one egg), C. J. Vernon and G. Hopkinson (above records from S. R. file cards). (5) 13 January 1962 (three hatching eggs), L. H. Walkinshaw.

Mozambique.—General: Fairly common on inland vleis but no nests found (Vincent, 1934).

South Africa.—Transvaal: Belfast: (1) 1 January 1908 (two eggs), H. C. Risch (Transvaal Museum, Pretoria). Bloemhof: (1) date ? (two eggs), D. Plowes (Transvaal Museum). (2) 20 March 1938 (one downy young), Miss E. B. Cusack (1943). (3) 13 April 1940 (two large young), Cusack (1943). (4) 10 January 1941 (one egg in nest, two on 13 January), 21 March (small downy young), Cusack (1943). Matlabas: (1) 7 December 1934 (three eggs), Transvaal Museum. Orange Free State: Bloemfontein: (1) June 1906 (two juvenal specimens), Transvaal Museum. Natal: Donn-



FIG. 3. South African Crowned Cranes at nest. Monze, Northern Rhodesia, 24 January 1962.

hauser: (1) 1 March 1904 (two eggs) (Sparrow, 1935). Howick, Shafton House: (1) 19 October 1931 (one egg), R. E. Symons (G. Symons collection). Rosetta, 11 miles west towards Giants Castle: (1) 11 December 1961 (three eggs), L. H. Walkinshaw. Rosetta, 20 miles west towards Giants Castle: (1) 31 December 1961 (three eggs), L. H. Walkinshaw. (2) 6 January 1962 (one egg), L. H. Walkinshaw. Rosetta, 8 miles west: (1) 24 February 1962 (three eggs), G. Symons, Wm. Barnes. Cape of Good Hope:



FIG. 4. Crowned Crane at nest No. 5, Monze, Northern Rhodesia, 24 January 1962 (note white cheek patch, red on top, and large wattles).

Transkei, Kentani: (1) 24 December 1946 (three eggs). (2) 26 January 1947 (three eggs). (3) 1 November 1947 (three eggs). The above eggs were collected by Pitt Fennell and are in the collections of Charles Jerome and Godfrey Symons (Estcourt, Natal). Franklin District, E. Griqualand: (1) 19 February 1931 (three eggs), Transvaal Museum. (2) 22 May 1931 (three eggs), Transvaal Museum.

ATTENTIVENESS OF THE ADULTS

Both adults incubate the eggs and help care for the young. On three of four different mornings the female had been incubating during the morning, the male was incubating on the fourth. On three mornings the first time the birds changed places at the nest came at 0531 (12 December), 0636 (18 December), and 0615 (31 December). The last changes on 2 days came at 1801 (18 December) and 1742 (31 December). All of these observations were made in Natal, South Africa.

On two all-day watches at the nest, the birds changed places seven times (18 December) and six times (31 December). The males incubated for three periods each day. The average on 18 December for the male was 99.6 minutes and on 31 December, 151.6 minutes. The female incubated for three times on 18 December, averaging 102 minutes, and for two periods, 31 December, averaging 116 minutes. Each bird spent more time away from the nest on their first inattentive period. For the male these first periods were 182 and 143 minutes and for the female, 185 and 203 minutes.



FIG. 5. Young South African Crowned Cranes. Rainham Dam, Salisbury, Southern Rhodesia, 14 January 1962.

During 1488 daylight minutes on 2 days, the males were at the nest for 755 minutes (50.7 per cent of the time); the female for 39.8 per cent of the time (592 minutes), and the eggs were unattended 141 minutes (9.4 per cent of the time).

Whereas most cranes when changing places at the nest often give a "Unison Call," the Crowned Cranes did not do so. They flew either directly to the nest or landed some little distance away and walked to the nest through the marsh. When the bird arrived at the nest, the other bird stood and left shortly, flying away to a nearby field (one was 0.5, another 1 mile away). The other bird then sat right down on the eggs. Occasionally the incubating bird rose and turned the eggs, looked all around and sat down again. After a long period of setting on an extremely hot day, the incubating crane sometimes rose and called a mournful *Ooouuw*, *Ooouuw* and stood looking all around as though expecting its mate to come and relieve it. On two occasions when the mate did not return, the male at one nest walked away once for 29 and again for 46 minutes. At a nest we found in Northern Rhodesia, during the early morning, neither parent was at or near the nest. However, on all other nest visits, one parent was there.

TABLE 3
WEIGHTS AND MEASUREMENTS OF CROWNED CRANES AT BIRTH

Number	Weight in grams	Wing	Tarsus	Middle toe	Bare tibia	Culmen	Where found
1	99.3	31.0	39.0	33.0		16.0	South Africa, Natal (nest 1)
2	97.4	28.8	40.3	34.2		19.4	Southern Rhodesia, Salisbury (nest 4)
3	98.3	29.2	41.3	35.2		19.0	" " "
4	97.5	29.8	43.0	30.6		19.1	" " "
5	104.9	30.6	38.8	35.8	20.2	18.8	Northern Rhodesia, Lochinvar Ranch (nest 6)
6	109.0	29.9	41.9	37.9	21.6	17.9	" " "
7	114.5	32.1	37.7	32.1	20.9	20.3	" " "
Average	102.9	30.2	40.3	34.1	20.9	18.6	

Measurements in millimeters.

THE YOUNG

Young South African Crowned Cranes usually hatch on the same or successive days, all hatching within a 24-hour period. Two to 4 days elapse between the laying of the eggs and they hatch between 29 and 31 days after the last egg is laid. A pair of Crowned Cranes (subsp.?) in the Providence, Rhode Island Zoo hatched the last egg 29 days after it was laid. In one South African nest I found the last egg was laid between 28 and 31 December 1961. William Barnes found that one egg hatched on 28 January 1962 at least 29 to 31 days later. A pair of Stanley Cranes hatched the last egg 30 days after the last egg was laid (I knew when the eggs were laid; John Vincent and William Barnes knew when they hatched). One pair of Sandhill Cranes in Michigan hatched one egg of two either 31 or 32 days after it was laid (Walkinshaw, 1950). During 1962, with two pairs in Jackson County, Michigan, incubation lasted either 28 or 29 days. One nest found 8 April contained the second egg 10 April and this egg hatched 9 May. At the second nest, with one egg 21 April, the second egg was laid either 22 or 23 April and both eggs had hatched the evening of 21 May. The youngest bird was still wet at that time.

At hatching time the young Crowned Crane is very weak but within only a few hours is able to leave the nest with its parents. The young at hatching range in weight between 97.4 and 109.0 g, gaining several grams during the first day. Seven newly hatched South African Crowned Cranes averaged 102.9 g (see Table 3). Their pink legs are much lighter colored than the dark gray ones of newly hatched Stanley Cranes.

At a nest at Salisbury, Southern Rhodesia, the parents brought the young back to the nest at night for at least a week. At one South African nest the

family was still found within 100 m of the nest 2 weeks after the young hatched.

From the day of hatching, the entire Crowned Crane family remains intact until long after the young are able to fly. Indications are that the young can fly at about 3 months of age. Most of the time is spent in or along the edge of the marsh in which the young hatch. They feed in much more moist areas than either Stanley or Wattled Cranes but at times they too work onto neighboring fields.

When the family breaks up in 7 to 9 months, the nonbreeding young birds tend to join together in flocks. These flocks spend much of their time feeding in fields. One of the foods appeared to be seeds of grasses, sedges, and grains. When downy, the young were fed considerably on crabs, for I found remains of them on nearly all nests where there were small young.

FEEDING AND FLIGHT

After feeding during early morning hours the Crowned Cranes in Sudan, Kenya, Northern and Southern Rhodesia, and South Africa all seemed to be eating grass and sedge seeds, often picking them directly from the plant. After this type of feeding, if they were not on a wet area, they returned during mid-morning to drink.

Cranes were timed in flight in Sudan, Kenya, and South Africa, and all flew about 120 beats per minute. Speed was about the same as for Sandhill Cranes, 28 to 35 mph.

THE VOICE

The normal call of *Balearica regulorum* sounds like *Ya-ouu-goo-luug*. It is very mournful and penetrating. They also give a single-syllabled *Oouuw*, and at times a double-syllabled similiar call which has probably given them the name of "Ma-hem." Adults call the young to them with a low *Purrrr* quite similar to a call used by *Grus canadensis* (Walkinshaw, 1949), and *Grus grus* (Mountfort, 1957) as well as *Tetraptyx paradisea*. I have called the young of *Grus canadeusis*, *Balearica regulorum*, and *Tetraptyx paradisea* out of the marsh vegetation where they were hiding by imitating this call.

The call of the Sudan Crowned Crane is much more goose-like, a sharper, *Ka-wouk*, *Ka-wouk*, *Ka-wouk*, *Ka-wouk*. The call of the West African Crowned Crane is very similar to that of the Sudan bird, a loud trumpeting, *Oyak-oyak* or *Quack-quack* (Bannerman, 1931).

The downy young of *Balearica regulorum regulorum* give a shrill peeping-like call.

SUMMARY

Four Crowned Cranes (*Balearica*) have been described from Africa. They have a bill shorter than the head; nostril oval; a tuft of straw-like feathers on the nape, and no

tracheal convolutions in the sternum. Some authors have separated *Balearica* into two species and each species into one additional subspecies.

B. pavonina pavonina is found in West Africa; *B. p. ceciliae* in Sudan, northern Uganda, and southwestern Ethiopia. These cranes are smaller and darker than the others and have the bare cheek patch mostly red (at the bottom) with a smaller upper portion white. *Pavonina* has about one-half white, *ceciliae* about one-third. The West African crane has a horn-colored bill tip, the Sudan crane a black bill (this is not always the case). *B. pavonina* has a very small red wattle.

B. regulorum regulorum is found in southern Africa, from the Cunene River, Congo, and Tanganyika south to Ngamiland and Cape Province. *B. r. gibbericeps* is found in East Africa from eastern Congo, through Uganda to Kenya and Tanganyika. *Balearica regulorum* is a larger crane with a large red wattle and a cheek patch white with a small upper portion red. They are lighter gray in color. Typical *regulorum* has a rounded cheek patch while *gibbericeps* has a slight protrusion of the cheek patch into the black velvety feathers of the top of the head.

Crowned Cranes roost at night either in shallow water of a pool or marsh or in adjacent trees. Nonbreeding Crowned Cranes most often roost in trees, breeding birds in shallow water very near to nest sites (except the setting bird). In Sudan, when the young birds are grown, family groups join into large flocks, separating again into pairs when the breeding season approaches. The breeding season is most often during the rainy season. The northern three forms nest from June to August usually, the South African bird from November to late February.

Crowned Cranes have a dance similar to that of other cranes, but they begin it differently, by bobbing the head up and down about eight to ten times before they begin bowing or dancing. They use this at times as a distraction display. In one aggressive display both birds of a pair walk side by side with outspread wings, advancing toward the enemy with their heads in a threatening position.

Nests of the South African Crowned Crane are large piles of dead sedges, grasses, and reeds, piled into a rather neat nest with a well-cupped center for the eggs. Six nests averaged 70.2 by 77.6 cm across and 12.2 cm above surrounding water which was 12.1 (8-18) cm deep.

Eggs are pale blue when laid, unspotted and ovate to pointed ovate in shape. They become dirty white, with streaks of brownish and greenish. Five Sudan eggs averaged 74.3 by 54.46 mm in measurements. From East Africa eggs have been described as measuring 79.6-88 by 56-60 mm. Typical *regulorum* eggs from South Africa and the Rhodesias averaged (39) 86.19 by 56.78 mm. Thirteen South African eggs averaged in weight 149.66 g, varying between 126.1 (at hatching) and 182.0 (when fresh).

Incubation required between 29 and 31 days and both parents incubate. During three of four nights observed, the female incubated (the male is a larger bird) while during two complete days' observations, they changed places seven and six times, respectively. The male incubated for three periods each day, averaging for the six periods 125.6 (56-203) minutes; the female for three periods 1 day, two on another, for an average of 107.8 (14-182) minutes. The male incubated for 50.6 per cent of the daytime and the female 39.8 per cent.

The eggs in the same nest hatch during a 24-hour period, and the young, in a few hours, become strong enough to leave the nest. However, they return to the nest site for at least 2 weeks to spend the night on the nest. They feed in the marsh near the nest during this period.

The newly hatched young is covered with buffy down with a darker middorsal vertical

stripe. This has two dark horizontal extensions, one over the shoulders onto the wings, the other posteriorly to the mid-back region extending onto the flanks. The face is covered with shorter pale ivory down. The legs are flesh color with the soles of the feet pale yellow. The bill is slaty gray with the base of the lower mandible horn color. The egg tooth is pale ivory. The eye is brown.

The call of *Balearica pavonina* is goose-like, *Ka-wonk*, *Ka-wonk*, *Ka-wonk*, *Ka-wonk*, while those of East and South Africa are much more mournful, *Ya-ouu-goo-lung*. Sometimes these cranes also give a single *Oouuw* or a similar double-syllabled one. When calling the young to them the adults give a typical crane *Purrr* call to which the young respond immediately. The young give a shrill peeping.

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819 NORTH AVENUE, BATTLE CREEK, MICHIGAN, 18 MARCH 1963 (ORIGINALLY
SUBMITTED 12 NOVEMBER 1962)

GENERAL NOTES

A hybrid Scaled × Douglas Quail.—A cage-reared male hybrid between the Scaled Quail (*Callipepla squamata pallida*) and the Douglas Quail (*Lophortyx douglasii bensoni*) provides a previously unrecorded example of hybridism in the American Phasianidae. This brings to five the number of crosses recorded between the four species in the genera *Lophortyx* and *Callipepla*. The only possible combination not yet known (Gray, 1958. Bird Hybrids) is that of a Douglas × Gambel Quail (*Lophortyx gambelii*).

This bird was the result of the mating of a male Scaled Quail with a female Douglas Quail. The parents paired and remained paired despite the presence of birds of their own species in the same cage. Several similar hybrids have been raised in the past; all have apparently been sterile. The bird described here was approximately 1 year old at its death. It is a mounted specimen in Walker's possession (see Fig. 1).

The description which follows is based on direct comparison of the hybrid specimen with males of both parental species, unless otherwise noted. Females of the parental species and both sexes of the Gambel and California Quail (*L. californicus*) were at hand as the description was prepared.

The feathers of the forehead and crown have definite shaft stripes, as in *douglasii*, but the stripes are lighter and redder. The crest is longer than that of *squamata*, about as in *douglasii* but much darker, shading from olive basally to buff at the tip. The crest is fuller than normal for *douglasii*, approaching the condition found in *squamata*. The ear coverts are dark brown, plain as in *squamata* rather than streaked as in *douglasii*. The feathers of the neck are gray with a narrow shaft stripe and terminal edge of reddish-brown. In *douglasii* the shaft stripe expands terminally into a triangle, whereas it is barely present in *squamata*.

The basic color of the feathers of the upper back of the hybrid is close to that of *squamata*, considerably paler than in *douglasii*, but the terminal band is extremely narrow and faint. The central back, rump, and upper tail coverts are similar in both parents and in the hybrid. The light vermiculations at the tips of the tail coverts are not quite as bold as in *douglasii*.

The throat feathers of *C. squamata* are buffy, with faint reddish-brown shaft stripes; in *L. douglasii* the bold black shaft stripes expand to the width of the white feather subterminally. In the hybrid there are moderately wide, dark-brown shaft stripes on light gray feathers. The effect is quite different from either parent. The gray breast feathers of the hybrid are marked with narrow reddish-brown shaft stripes and terminal bands, similar to but not as bold as those of *squamata*; there are no terminal bands and few shaft stripes in *douglasii*.

The abdomen of the hybrid closely resembles that of a female California Quail, with dark shaft stripes, terminal bands, and central chevron marks on the feathers. This is not far from the condition of *squamata*, but is quite different from *douglasii*. The large spots characteristic of the vanes of the ventral feathers of *douglasii* show to some extent on the hybrid, toward the flanks; in the central abdominal region the spots are so expanded as to cover most of the vane. The shape of the dark markings on the under tail coverts in the hybrid is the same as in *douglasii*, and the color is only slightly lighter.

Streaked flank feathers are characteristic of the Scaled, California, and Gambel Quail. The appearance of the shaft stripes of these three species is quite different from that of the spotted vanes of the Douglas Quail. In some of the latter, however, elongation of the spots into streaks gives a similar effect but with a different mechanism. The

streaked flanks of the hybrid result from pale shaft stripes as found in *squamata*, not from elongated vane spots as in *douglasii*.

The wing feathers are plain and solid in color, as in *squamata*, lacking the vane markings and vermiculations found in *douglasii* but with a dark reddish-brown cast reminiscent of that species. The primaries are darker than in *squamata*, about as in *douglasii*. The inner secondaries are white-edged on the inner vane, as in both parents,



FIG. 1. Male hybrid Scaled \times Douglas Quail. Photo by Ron Garrison, San Diego Zoo.

but lack the edging of the outer vane found in *douglasii*: the color of these feathers is intermediate, but there are vermiculations as in *douglasii*.

Ridgway and Friedmann (1946. *U. S. Nat. Mus. Bull.* 50, Pt. 10) give average wing lengths of 118.8 and 111.3 mm for male Scaled and Douglas Quail, respectively. The frayed wing of the hybrid measures 116.8 mm. It is not possible to take other measurements accurately from the mounted specimen.

Members of the genus *Lophortyx* have 12 rectrices, whereas *Callipepla* has 14 (Ridgway and Friedmann, op. cit., 264, 275). The hybrid has 14 rectrices.

The overall aspect of this hybrid Scaled \times Douglas Quail is not particularly like either parental form. The length of the crest gives the bird a *Lophortyx*-like appearance. From a dorsal view, excluding the head and neck, the hybrid looks rather like a female Scaled or Gambel Quail. Ventrally, except for the breast, the resemblance is to a female California Quail.

Although young quail are generally not proficient in calling, efforts to that end by this bird resulted in the call of the Douglas Quail. There was no sign of the typical Scaled Quail action of throwing back the head when calling.

We wish to thank Dr. Ralph J. Raitt for constructive comments on this paper.—RICHARD C. BANKS, *Natural History Museum, San Diego, California*, AND LEWIS WAYNE WALKER, *Arizona-Sonora Desert Museum, Tucson, Arizona*, 6 April 1964.

Aggressive behavior of hen pheasant while protecting chicks.—Young Ring-necked Pheasants were captured on 5, 6, and 7 July 1963, in Lucas County, Ohio. On every occasion of capture the chicks cheeped loudly and the hen would circle me at a distance of 40 to 100 feet. The cheeping of the chicks stimulated a clucking from the hen although she remained concealed.

On 13 July 1963, I had occasion to see an adult hen pheasant with several chicks. When alarmed, the adult bird ran under some nearby bushes and gave a loud squawking call. The young birds at first cheeped loudly and scattered, but upon hearing the hen give this signal they immediately crouched and remained quiet for about a minute. The hen ceased squawking and the chicks soon started to move about as if searching for her, cheeping loudly. Two of the chicks were captured and promptly began struggling and cheeping in a louder, more drawn-out manner. The hen pheasant then flew directly at me and braked herself to land about 4 feet away, squawking throughout the performance. She then circled me, making short rushes and retreats. Her feathers were ruffled, especially along the capital and spinal tracts, and she continued to make clucking and squawking sounds.

After the pheasant had continued her demonstration of charging and retreating for perhaps 3 minutes, I made a quick movement as if to capture her. She flew approximately 40 feet into a thicket but continued squawking.

The chicks were released and observation from nearby revealed that within 5 minutes the hen returned to the spot where she had left her chicks and all of them apparently were soon together with her.

The aggressive behavior of this hen pheasant might well be very effective in obtaining at least temporary release of a chick captured by a predator. The initial element of surprise at seeing a large ball of feathers hurtling straight toward the head coupled with the loud squawking would perhaps cause the retreat of a less determined predator. Thus, the mock attack might be adaptive in providing survival of more chicks.—LARRY C. HOLCOMB, *Department of Biology, The University of Toledo, Toledo, Ohio*, 21 March 1964.

Notes on color aberrancies in the Rio Grande wild Turkey.—The Texas Parks and Wildlife Department conducted trapping and banding programs during February and March 1960-63, in order to mark wild Turkeys of the Rio Grande subspecies (*Meleagris gallopavo intermedia* Sennett) while they were concentrated in traditional winter roosting areas.

Trapping was done in three major roosting areas in southeastern Sutton County, Texas, called the Ross roost, the Wade roost, and the Stewart roost, respectively. Each of these roosts represented a separate wintering concentration of Turkeys.

The winter population of the Ross roost was estimated at between 500-700 Turkeys during the winter of 1960-61, in which season we carried out the only winter trapping that was done at this roost. Two white Turkey hens were seen repeatedly around this roost during February and March 1961. These two hens were solid white with tarsi and eyes of normal coloration, and were members of two separate feeding flocks. In the larger of these flocks four light smoky gray hens with normal marking patterns were often seen. Observations made around this roost in 1961-62 revealed the presence of two white hens. One white hen was seen during the winter of 1962-63.

The winter population of the Wade roost was estimated at 600-800 Turkeys during the winter of 1960-61; 500-700 during 1961-62; and 300-400 during 1962-63. Three white hens, two in one feeding flock and one in another, were seen often during February and March of 1960 and 1961. In March 1961, a white hen was trapped with a group of approximately 30 hens. Three of the hens trapped were young of the previous hatch and were smoky gray in color with normal coloration patterns. These birds were marked with colored leg markers (Thomas, J. W., and R. G. Marburger, *J. Wildl. Mgmt.*, in press) and released. Two white hens, including the marked one, were seen around the Wade roost during the winter of 1962-63. At least one of the marked smoky gray Turkeys was also seen.

The winter populations of the Stewart roost were estimated at 600-800 during the winter of 1960-61; 500-700 in 1961-62; and 200-300 in 1962-63. One white hen was observed around the roost in March 1961. A white hen was trapped during March 1962 and retrapped in March 1963. At least two smoky gray hens with normal coloration patterns were seen in March 1961.

These white Turkeys and smoky gray Turkeys with normal coloration patterns were believed to be natural offspring of the wild Turkeys as there were no flocks of white domestic Turkeys in this general area. The weight and body conformation of trapped white and smoky gray hens were comparable to normally colored wild Turkeys. Field observations of other white or gray hens indicated that size and body conformation were indistinguishable from normally colored wild Turkeys. It was not known if the smoky gray Turkeys were offspring of the white hens, but it was interesting to note that the majority of the smoky gray hens observed were seen in feeding flocks containing white hens.

Interviews with the owners of the ranch property where the roosts were located, Mr. Bill Wade of Sonora and Mr. Gordon Stewart of Junction, indicated that they had seen occasional wild white Turkey hens in the wintering flocks as long as they had been familiar with the area, which in the case of Mr. Stewart was from the 1920's.

Neither Mr. Wade or Mr. Stewart could ever remember having seen a white male. In the course of work we never saw a white or smoky gray male Turkey.

It was our opinion that the white Turkeys were noticeably wilder and more alert than their normally colored flock mates. This noticeable difference in wildness might be

accounted for by the increased danger of being without protective coloration. Those white birds that survive might of necessity have been more wild and alert.

Albinism in both sexes of the eastern wild Turkey (*Meleagris gallopavo sylvestris*) has been previously noted (Bailey, R. W., 1955. *J. Wildl. Mgmt.*, 19:408). "Smoke gray" aberrancies in *M. g. osceola*, similar to those described here, have been noted (Williams, L. E., Jr., 1964. *J. Wildl. Mgmt.*, 28:148-152).

This note is a contribution of the Texas Parks and Wildlife Department, Pittman-Robertson Project W-62-R.—JACK WARD THOMAS, Llano, Texas; CALVIN VAN HOOZER, Sonora, Texas; AND RODNEY G. MARBURGER, Kerrville, Texas, 28 January 1964.

Roosting habits of Red-bellied Woodpeckers.—During 1962, I observed the roosting habits of 15 Red-bellied Woodpeckers (*Centurus carolinus*) in the vicinity of Carbondale, Illinois and these are the results.

1. Although adult birds roosted singly in cavities, juveniles for at least the first few nights after fledging roosted in the open. As in other members of the genus *Centurus* on which information is available (Skutch, 1943. *Sci. Mon.*, 56:358-364), newly fledged birds must learn to seek roosting cavities by themselves.

2. Individual birds generally spent several minutes looking out of their roost cavities before leaving in the morning and frequently did the same in the evening before dropping from sight.

3. Generally upon leaving an excavation, and for several minutes before going to roost in the evening, individual birds uttered the location call (the *cha* note; Kilham, 1961. *Wilson Bull.*, 73:237-254).

4. Both sexes changed their roost cavities frequently, but it was not uncommon for a given bird to return at a later date and roost in a previously abandoned excavation.

5. With one exception, males roosted in cavities being excavated for nesting purposes; and in all cases roosted in such cavities throughout the incubation and most of the nestling periods. A given male abandoned the nest cavity for roosting purposes one or two nights prior to fledging of the young.

6. Although a surplus of excavations was dug during the breeding season, both sexes excavated cavities outside this period. These latter cavities were shallower than the excavations used for nesting purposes.

7. As would be expected, the times of leaving the roost hole and going to roost were coordinated with sunrise and sunset. The maximum, minimum, and mean roosting times, using as reference points civil sunrise and sunset times (Hansen, 1962. "The World Almanac." New York World Telegram and The Sun, N. Y., pp. 456-470), are given in Table 1. Only three periods of the year were chosen for comparison; winter (22 December to 21 March), spring (22 March to 21 June), and fall (24 September to 21 December). The roosting behavior of this woodpecker was not observed during the summer months. These periods were selected because they corresponded to changes in sun time; if Red-bellied Woodpeckers responded to factors other than the sun, these responses would be reflected in the changes of roosting time in relation to sunrise and sunset. Although females tended to arise earlier than males, there were no statistically significant differences between means of the times the males and females left their roost holes on winter, spring, and fall mornings. However, an analysis of variance

TABLE 1
RELATIONSHIPS BETWEEN SUNRISE, SUNSET, AND ROOSTING TIME OF RED-BELLIED
WOODPECKERS

a. Leaving Roost AM									
	Males					Females			
	No. of observations	Extremes	Mean	sd		No. of observations	Extremes	Mean	sd
Winter	19	+30 -23	+1.9 ± 3.1	12.9		10	+20 -11	+2.7 ± 4.3	12.9
Spring	22	+39 -11	+5.0 ± 2.7	12.4		16	+19 -15	-0.1 ± 2.6	10.1
Fall	27	+23 -22	-5.7 ± 2.0	10.0		22	+39 -24	-7.0 ± 3.1	14.3

b. Going to Roost PM									
	Males				Females				
	No. of observations	Extremes	Mean	sd	No. of observations	Extremes	Mean	sd	
Winter	28	-115 -21	-65.3 ± 4.4	22.8	12	-91 -29	-54.0 ± 2.5	8.1	
Spring	29	- 52 + 7	-19.4 ± 3.6	19.2	11	-40 +12	-14.8 ± 3.6	11.5	
Fall	15	- 66 +14	-28.8 ± 6.5	23.7	6	-29 + 9	- 6.2 ± 5.1	12.4	

c. Comparison of Means of PM Roosting Times						
	Winter		Spring		Fall	
	M	F	M	F	M	F
M; winter		0	X	X	X	X
F; winter			X	X	0	X
M; spring				0	0	0
F; spring					0	0
M; fall						0

M = male; F = female.
 sd = Standard deviation.
 + = No. of min after sunrise or sunset.
 - = No. of min before sunrise or sunset.
 0 = No statistical difference between means of the birds in periods compared.
 X = Statistically significant difference; $P < 0.01$.

demonstrated a number of significant differences in the means of times of going to roost in the evening (Table 1). These differences in roosting times of particularly the winter versus the spring periods were very likely due to the increased demands of nesting activity during the latter period. As Red-bellied Woodpeckers spend a disproportionate amount of time during the fall months storing mast and other vegetable matter (Kilham, 1963. *Wilson Bull.*, 75:227-234; personal observations), perhaps this habit was responsible for their going to roost later in the day during this period of the year. This, then, would account for the numerous statistically significant differences between the means of the fall and the winter periods.—DAVID W. STICKEL, *Zoology Department, Holyoke Junior College, Holyoke, Massachusetts, 27 January 1964.*

The nest of *Granatellus venustus* Du Bus.—According to my information and to A. R. Phillips (pers. comm.), the nest of the Red-breasted Chat (*Granatellus venustus* Du Bus) has not been described. This is not surprising in view of the apparent rarity of the nominate race on the mainland of Mexico. However, in the course of fieldwork in 1962 on María Magdalena (of the Tres Mariás group, Nayarit), two nests of the insular subspecies, *francescae*, were found. The first was found on 29 June and was at that time being built by a female. The second was found on 1 August; it was similar to the first, but complete and contained two white eggs (unmeasured), which were being incubated by a female. The tree (*Caenodendron mexicanum* Standl.) in which the nest was situated stood 20 m from an arroyo at a point 2 to 3 km from the beach, on the southeast side of the island. The nest was placed in the fork of a twig at the perimeter of the foliage 1 m up in this 3-m tree. Foliage extended directly above the nest but not below it. The thin-walled, cup-shaped nest was made of fine herb stems, leaf petioles, vines, and material like "Spanish moss," with the finer elements on the inner surface. Most of the elements were less than 1 mm in diameter.

The rim of the nest was attached to the twigs by these same components as well as by spider webs. The maximum outer diameter of the nest, at the rim, was 7 cm and the inner diameter 5 cm; its maximum depth was also 5 cm.—P. R. GRANT, *Zoology Department, University of British Columbia, Vancouver 3, B. C., 15 May 1964.*

Wild Turkey behavior affected by the presence of Golden Eagles.—

The Texas Parks and Wildlife Department conducted a trapping and banding program during February and March 1960–63, in order to mark wild Turkeys of the Rio Grande subspecies (*Meleagris gallopavo intermedia* Sennett) while they were concentrated in traditional winter roosting areas in Sutton County, Texas.

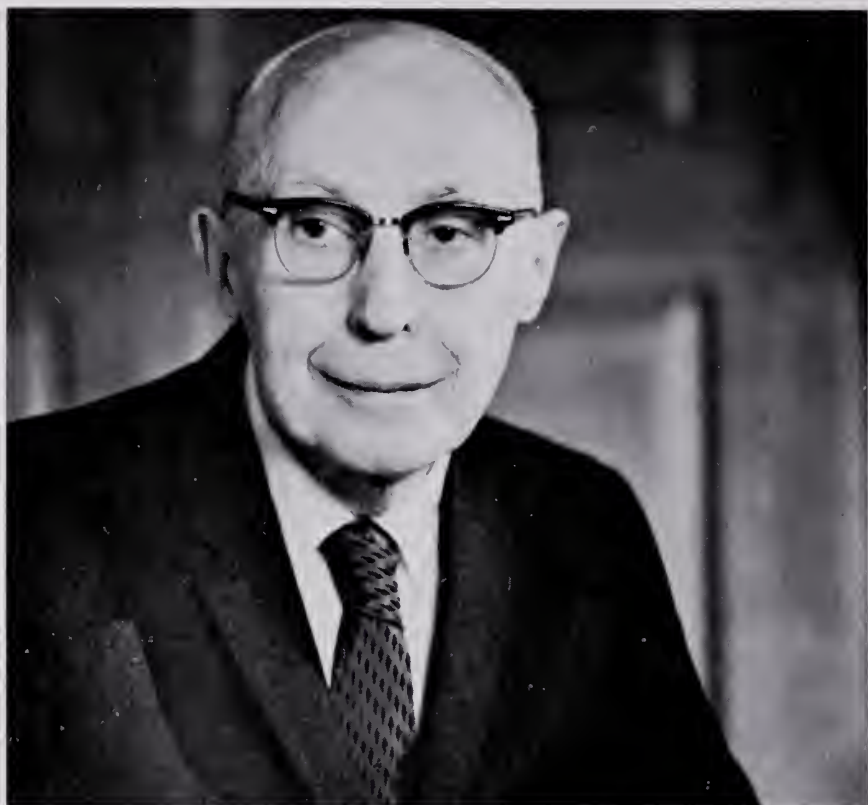
During the winters of 1960, 1961, and 1962, we saw no sign of Golden Eagles (*Aquila chrysaetos*) around the wintering Turkey concentrations. In March 1963 we saw Golden Eagles almost daily in the vicinity of the winter roosts where we were trapping. The effects of the eagles on the behavior of the Turkeys was best described in Thomas' field notes as follows: "March 20, 1963. We have noticed that the Turkeys are extremely difficult to trap this year and seem to be more wild than we have seen them over a period of the last 4 years. Turkeys fed in close proximity to the drop-nets and then for no apparent reason flushed and flew for cover. Observations made in previous years indicated that the turkeys must be severely alarmed to take to the wing. These repeated sudden retreats to heavy brush cover were associated with the overflight of soaring birds such as hawks and Turkey Vultures. Still we were puzzled as we had never seen this type of behavior before. We questioned Mr. Bill Wade and Mr. Gordon Stewart, on whose property we were trapping, about this behavior. They attributed it to the fact that Golden Eagles had been harassing the Turkeys for the past 5–6 weeks. Mr. Wade reported that he had seen a pair of eagles kill two Turkey hens during the past week. Mr. Wade, who we considered a reliable observer, was accompanied on both of these occasions by two ranch laborers who verified the report. Both of these kills involved two Eagles working as a team. The Turkeys had taken refuge in dense motts of liveoak brush after being flushed by the Eagles and refused to move as the Eagles swept back and forth over the motts. One of the pair then landed in an open area adjacent to the mott and walked into the mott. This action caused the turkeys to walk or run or both from their hiding place. The second Eagle, still in the air, would make the kill. In one of the two instances, the Turkey hen was recovered by the two ranch laborers.

"March 21, 1963. 10 A.M., while watching the Turkeys feeding on a baited area close to the cannon net we noticed a Golden Eagle circling the area at an altitude of about 300 feet. When the Turkeys saw the Eagle, they all began to give alarm signals and flushed from the open area where they were feeding and hid in the surrounding liveoak motts. There were approximately 40 hens and 9 gobblers feeding in the area at the time. The Turkeys remained under cover for approximately 30 minutes. The Eagle made no attempt to catch any of the Turkeys, possibly due to our presence which could have easily been seen from the air, and continued on out of sight. 2 P.M., more Turkeys had entered the open baited area when a Golden Eagle flew over the area at an altitude of approximately 35 feet. The Turkeys simultaneously gave alarm signals and flushed for cover. During both of the observations concerning Eagles made this date, the alarm signals were given almost simultaneously by all of the Turkeys and these signals were continued for several minutes with greater than usual volume. Even though the Eagle made no attempt to catch any of the Turkeys it was very apparent that the Turkeys were upset by the presence of the Eagle." These field notes were typical of the daily difficulties encountered during the 1963 trapping operations. In fact, trapping was abandoned 2 weeks ahead of the scheduled closing date because of low trapping success. We were not able to make an estimate of the predation loss of the Turkeys to Golden Eagles. However, the mere presence of Golden Eagles in the vicinity of the wintering Turkey concentrations was enough to cause noticeable increases in the Turkey's wildness so that the difficulties involved in trapping were greatly increased.

Only two other references to Golden Eagle harassment of wild Turkeys of the Rio Grande subspecies were found in a canvass of literature. Golden Eagles were observed "harassing" wild Turkeys in winter roosting areas in Tom Green County, Texas during 1949 and 1950 (Walker, E. A., 1951. Texas Game, Fish, and Oyster Comm., F. A. Report Series No. 6, 45 pp.).

At least 3 of 548 Rio Grande Turkeys transplanted from Texas to Nebraska were killed by Golden Eagles during the winter of 1961-62 (Suetsugu, H. Y., and K. E. Menzel, 1963. *Trans. N. A. Wildl. Conf.*, 28:297-307).

This note is a contribution of the Texas Parks and Wildlife Department, Pittman-Robertson Project W-62-R.—JACK WARD THOMAS, Box 1148, Llano, Texas; CALVIN VAN HOOZER, Box 132, Sonora, Texas; AND RODNEY G. MARBURGER, 111 Kellogg Bldg., Kerrville, Texas, 28 January 1964.



REUBEN MYRON STRONG

1872-1961

A Founder of the Wilson Ornithological Society

The death of Reuben Myron Strong on 11 August 1964 in his summer home at Petosky, Michigan, ended a career whose pattern of usefulness to science and conservation had emerged clearly half a century earlier. Born on 8 October 1872, in North Greenfield (now part of West Allis), Wisconsin, of English and Irish stock, his first job was that of a country school teacher near Wauwatosa at a salary of \$40 a month. He used to add humorously, "I was also the janitor!"

In his early career he taught many subjects. Following his graduation from Oberlin College in 1897, he spent the next year at Lake Forest Academy as instructor in chemistry, physics, and zoology—and assistant football coach. Following his graduation from Harvard with the Ph.D. in 1901 he was instructor in botany and physiography in the University of Chicago Academy and coached the football and track teams. His prowess as an athlete was not generally appreciated among his acquaintances. He once observed that he may have had a little to do with Notre Dame's great success in football because he coached the man who coached Knute Rockne! But even at the advanced age of 80 he once astonished the writer with the statement that he had to get home early that evening to go ice skating with Mrs. Strong on the Midway!

He became instructor in biology at Haverford College in 1902 but returned to the

University of Chicago on a Carnegie Research assistantship the following year. He stayed on for 10 years as instructor in the Zoology Department. During this period he was the protégé of Prof. Carl O. Whitman whose interest in the genetics of pigmentation in feathers influenced some of his own research. He was fond of recalling the days with Whitman, and Whitman's death may have influenced him in accepting a professorship of anatomy at the University of Mississippi in 1914. Two years later he occupied a similar position at Vanderbilt University. He became Chairman of the Department of Anatomy in the Loyola University School of Medicine in September 1918. But he actually gathered the staff and literally launched the entire medical school.

Dr. Strong's retirement from Loyola in 1946 probably disturbed his pattern of activity but little. One could find him almost daily in his office on the fourth floor of the Chicago Natural History Museum, where he was engaged in a study of the comparative anatomy of the albatrosses. From this office, too, he administered the affairs of the Illinois Audubon Society and the Chicago Conservation Council, which consists of a membership of delegates from about 60 local and national societies.

His publications numbered about 125, ranging from development of pigment, animal coloration, animal behavior, ossification of the skeleton to gross anatomy and neurology. But he was always engaging in something useful—often a tedious, long-range project of a sort most scientists avoid. His four-volume "Bibliography of Birds" is reasonably complete to 1939 and tremendously valuable to ornithologists. His life of 92 years spanned a most important period in the history of science and of conservation. He was taught neurology by Prof. G. H. Parker, had worked in Edinger's neurological institute in Frankfurt, Germany. He knew Hans Gadow. To a younger anatomist, Gadow was just a name; it was good to know something about him, personally, and Dr. Strong became a link with the past. He was broad enough to grasp the changing trends in science to which he was witness. In conservation affairs he retained his clarity of mind to the end. Be the opposition politician or steel company, he knew the adversary realistically.

His interest in natural history was with him from youth. At eighteen he had already collected most of the flowering plants near his home. He was a member of the Board of Directors of the Illinois Chapter of the Wild Flower Preservation Society since 1923. He was president of the Illinois Audubon Society from 1941 to 1951 and honorary president since. He was a member of the Board of Directors of the Illinois Dunesland Preservation Society and a member of the Save the (Indiana) Dunes Council. Dr. Strong founded the Chicago Ornithological Society in 1912 and was one of the founders of the Wilson Ornithological Society (see *Wilson Bull.*, 51:3-10). He was honorary member of the Nature Conservancy and Friends of Our Native Landscape. He was on the executive council of the American Association of Anatomists from 1916 to 1919, and was a member of the board of governors of the Institute of Medicine, 1935-40.

On 20 June 1907, he married Mary Ethel Freeman, who died several years ago. They are survived by a daughter, Miss Madelaine Freeman Strong, of 88 Morningside Drive, New York.

All of this is the mere recital of facts. Dr. Reuben M. Strong was a bright and cheerful man with a sense of humor and a kindly interest in younger scientists. What strikes one in retrospect is the large amount of work he accomplished by steady effort and the usefulness of his life. He started many things which will continue like the ripples going out on a quiet pond.

ORNITHOLOGICAL NEWS

The latest membership list, published in this issue, offers some interesting information about the Society. The median length of membership in the Society is about 11 years (approximately 50% of the membership has joined since 1953). Six members have belonged for 50 or more years; 24 have been members for 41 to 49 years; and 80 have belonged for 31 to 40 years. About a third of the total membership has belonged to the Society for 15 to 30 years.

The Society now has members in 49 states (Nevada is missing), the District of Columbia, 3 U.S. territories, 8 Canadian provinces, and 12 foreign countries. New York can claim the most members with 138, followed by Michigan and Ohio with 122 and 103 members, respectively. A complete breakdown of the geographical distribution of the membership is given at the end of the membership list.

Persons who attended the Annual Meeting at Kalamazoo in May will be interested to know that the fine Kalamazoo Nature Center which we saw in the construction stage was dedicated on 24 October. Congratulations are due to H. Lewis Batts and his associates for the successful completion of this project.

The Acting Secretary of the International Commission on Zoological Nomenclature informs us of the proposed use of the plenary powers of the Commission in five cases. The only case in class Aves is the proposed suppression of the name *Certhia chrysotis* Latham, 1801 (Z.N. (S.) 1653). Persons interested in commenting on this case should write the Commission before 7 February 1965. All communications should be addressed to: The Secretary, International Commission on Zoological Nomenclature, c/o British Museum (Natural History), Cromwell Road, London, S.W. 7, England.

As the plans progress it becomes apparent that the 1965 Annual Meeting in the Black Hills of South Dakota will be one of the more memorable meetings of the Society. Plan now to be there.

It is a pleasure to acknowledge the assistance and services of the members of the Editorial Board: Andrew J. Berger, Tom J. Cade, William C. Dilger, William W. H. Gunn, William A. Lunk, Robert A. Norris, Kenneth C. Parkes, Raymond A. Paynter, Jr., and Olin S. Pettingill, Jr. Other persons who have provided valuable assistance in the preparation of this volume are Pershing B. Hofslund, C. Chandler Ross, Phillips B. Street, and Tanya Hall.

A sum of \$526 is available in the *Josselyn Van Tyne Memorial Fund* for research grants in 1965. Any student of birds is invited to apply. Young men and women just starting their careers or others not eligible for government grants are particularly encouraged to apply.

Applicants should prepare a brief but comprehensive description of their research project specifying the objectives and proposed plan of procedure. Particulars of the type and amount of financial assistance needed must be indicated. A brief statement of the applicants' ornithological background should be appended. Letters of recommendation from one or more recognized ornithologists would be helpful.

Applications should be submitted not later than 1 April 1965 to the Chairman of the A.O.U. Research Committee, John T. Emlen, Jr., Department of Zoology, University of Wisconsin, Madison, Wisconsin.

A NORTH AMERICAN NEST-RECORD CARD PROGRAM

Beginning in January, 1965, the Laboratory of Ornithology at Cornell University will operate a nest-record card program on a continent-wide basis and would like the assistance of everyone.

Through the cooperation of Dr. David B. Peakall and the Onondaga Audubon Society, the Laboratory has carried on a nest-record card program on a local basis for two years. The aim of the program, which is similar to one used in Britain (see Mayer-Gross, 1962, *Bird Study*, 9:252-258), is to collect specific data on bird reproduction in a form convenient for statistical analysis. The results of this two-year trial have been so gratifying that we are encouraged to make the program continent-wide.

For this to be a success we will need the cooperation of all bird observers in all parts of the continent, particularly the United States and Canada. We will also need—because we are certain that regional centers can handle the distribution of data cards and their return to the Laboratory better than individuals—the cooperation of all bird clubs and other societies whose members make field observations of birds.

The Laboratory will provide bird clubs or individuals with cards. The observers will record the contents of each nest found on a separate card and make dated notations on the same card for each subsequent visit to the nest. Each card will then contain all the data from a single nesting. While one observation of a nest will be valuable, additional observations over a period of days or weeks will increase the worth of the record. Our goal is to have hundreds, possibly thousands, of cards containing data on each species from all parts of its range.

We are well aware that there are other local nest-record card programs in this country and in Canada (see Peakall, 1964, *Audubon Field Notes*, 18:35-38) and, naturally, we do not intend to infringe on them in any way. We only hope that they will cooperate with us and help broaden the scope of the whole endeavor. The net result should be the accumulation of far more data on every species than heretofore and the centralization of these data for comprehensive and intensive study, much as is true of the bird-banding program of the U.S. Fish and Wildlife Service. All of the information from our program will, of course, be available to anyone who is interested.

Clearly this is a program in which every person seriously interested in birds can participate, be he a seasoned nest finder or one who merely watches a nest from a window. Local organizations, or individuals not members of local groups, may address all inquiries and communications to the North American Nest-Record Card Program, Laboratory of Ornithology, Cornell University, Ithaca, New York 14850.—*Olin Sewall Pettingill, Jr., Director.*

ORNITHOLOGICAL LITERATURE

THE ROLE OF OLFACTION IN FOOD LOCATION BY THE TURKEY VULTURE (*Cathartes aura*). By Kenneth E. Stager. Los Angeles County Museum Contributions in Science, Number 81, Los Angeles, 30 June 1964: 6 × 9¼ in., 63 pp., 19 figs.

Because of their keen senses of sight and hearing, and the lack of any overt behavior in response to odors (except in the Kiwi, Turkey Vulture, and a few procellariiforms), birds have an olfactory sense that is usually dismissed as being poorly developed. The nasal cavities, however, serve the same functions as in mammals in conducting, cleansing, and warming the inspired air. It is the other function of the nasal cavities—smell—that has aroused the interest of ornithologists since 1826, when John James Audubon reported on his experiments to test the sense of smell in the Turkey Vulture, *Cathartes aura*.

Most ornithologists have, at one time or another, discussed and debated the question of olfaction in vultures. We need not do so any longer, at least in connection with the North American Cathartidae. Dr. Stager reviews the controversy that began with Audubon's experiments and discusses the olfaction experiments of other workers. From these earlier experiments a number of hypotheses were presented to explain the ability of the Turkey Vulture to find its food. The Turkey Vulture was believed to respond to the sight and sound of hordes of flies, to the movements of carrion-eating mice and ground squirrels, or to the movements of domestic dogs in forested areas. One experimenter assumed the presence of a food-finding sense. And another, although admitting the presence of a well-developed olfactory tract, believed that it served to detect air currents, not food.

Stager briefly mentions cathartid taxonomy and reviews the paleontological record. Much of the controversy over the role of olfaction in food finding resulted from applying the observations of one vulture to all vultures, and from assuming a basic similarity and close relationship between Old and New World vultures.

Stager's personal observations and simple experiments that led to this study are convincing evidence favoring the existence of an olfactory sense in *Cathartes*. In arriving at his conclusion that *Cathartes* utilizes olfaction in locating its food, Stager conducted field experiments with noncaptive Turkey Vultures, studied the comparative behavior of the Cathartidae, and undertook comparative morphological studies of the olfactory tracts of cathartine vultures. The purpose of the author's research was "to obtain evidence to support the premise that the Turkey Vulture has a well-developed sense of smell and employs this sense to a high degree as an integral part of its food-locomotor mechanism."

The author conducted most of the observations and experiments in California. But he also gathered data in Mexico, Brazil, Bolivia, India, and Burma. In the field experiments (except the decoy-carcass tests) all visual clues relating to the bait were removed so that an olfactory stimulus was the only clue to which the Turkey Vulture could respond. If the odors, emanating from the test site on wind currents of known direction, attracted the Turkey Vultures, Stager concluded that the birds reacted to the olfactory stimulus. One series of experiments included a forced-air unit in which odors from bait placed in a chamber were forced by a powerful fan through a vertical 7-foot stack. In another series of tests carcasses were placed in portable bait chambers that were hidden in vegetation. A third series included the response of *Cathartes* to an odorous and highly volatile substance, ethyl mercaptan. In a fourth series of tests a mounted decoy deer and a fresh deer carcass were placed in an open field. All experiments were set up at night to prevent detection by vultures. During the tests the birds

were carefully observed with binoculars and spotting scope from selected sites as much as 275 yards from the bait. No controls in the usual sense were set up. The author considered that the experiments were controlled "in the sense that all visual stimuli concerned with bait material were eliminated." The odors originating from all experiments attracted Turkey Vultures.

The tests using the mounted decoy and the fresh deer carcass indicated that the sight of an animal form is not sufficient to bring the vulture down to it. A mule deer that was professionally mounted and realistically positioned to mimic a dead animal did not attract the Turkey Vultures that passed over the area on five successive days, although the decoy was placed in an open field. However, a fresh carcass brought a positive response after it was substituted for the mounted specimen. Both the decoy and freshly killed deer were placed in the same spot and in identical positions. Rather than circling directly above the dead animal, the vultures circled about 100 yards downwind, in a position to receive the wind-carried odors of the decomposing animal.

Dispelling the notion that flies are the signal that attracts *Cathartes*, Stager shows that the Turkey Vulture responds to an olfactory stimulus emanating from a site free of necrophagous insects. For 5 days flies were attracted to a sweetened concoction, but Turkey Vultures were not, although they flew over the area periodically on foraging flights.

Following the discussion and analysis of the various experiments, Stager discusses the comparative behavior of the Cathartidae in relation to food habits. That the Turkey Vulture finds its food in a different manner from the other cathartine vultures is reflected in its flight habits. In flight, *Cathartes* flaps more than the condors, less than the Black Vulture, *Coragyps*. Its flight is wobbly. It can soar in calm and light winds better than other vultures. It will feed upon smaller animals than other vultures will, but will not take live prey. Nor will it respond to the sight of a carcass alone, but must receive an olfactory stimulus before alighting. But the most important characteristic of its flight in relation to this study is that the Turkey Vulture usually forages close to the ground. *Coragyps*, on the other hand, is aggressive, soars at a higher altitude, is known to kill live animals, and will drop from a considerable height to investigate. The Andean Condor, *Vultur*, and the California Condor, *Gymnogyps*, are the best of the soaring vultures. *Vultur* frequently soars along cliffs. I have seen this type of soaring a number of times in the Argentine Andes. But once I saw a flock of 33 Andean Condors soaring several thousand feet above the top of the 7,500-foot ridge from which I was watching them. Few observations are available for the King Vulture, *Sarcoramphus papa*. Stager suggests that the King Vulture may also use olfaction in finding its food. It is always seen in or over forest; it frequently skims low over the forest canopy; and its olfactory chambers, conchae, and olfactory epithelium are highly developed. In British Honduras I saw King Vultures on several occasions soaring just over the trees. But more often I saw them circling singly or in pairs high in the sky, so high that without field glasses they appeared only as unidentifiable specks.

Stager's morphological studies included an examination of the gross and microscopic anatomy of the olfactory chamber, and the comparative size of the olfactory bulbs. The results show that (1) the absolute size of the external nares is greater in *Cathartes* than in the other Carthartidae, although the Turkey Vulture is smaller than all others except *Coragyps*; (2) the anterior respiratory conchae in each genus of Carthartidae is different, markedly so in *Cathartes* and *Sarcoramphus* where it assumes a nearly vertical position instead of a horizontal one; (3) the olfactory chamber is more highly developed in *Cathartes* than in the other vultures examined (no example of *Vultur*);

(4) the olfactory chamber and its concha or tubercle are lined with a thicker layer of columnar epithelium that contains more gland cells than is found in *Coragyps* and in the Old World vulture, *Sarcogyps* (*Sarcoramphus* showed a high degree of development of the nasal epithelium similar to that in *Cathartes*; *Vultur* and *Gymnogyps* were not examined); (5) the olfactory bulb is larger in the Turkey Vulture than in any other cathartine vulture or several Old World vultures examined.

One question that occurred to me, as I perused this paper, concerned the distance at which the Turkey Vulture detects the odor of a decomposing animal. Olfaction undoubtedly operates at short range. There is nothing in the report to indicate otherwise. Obviously, many variables enter into this problem, such as the size of the animal, how long it has been dead, and the strength of the air currents. Stager does not mention the distance between the test site and the point at which the Turkey Vultures turned into the odorous air current and glided toward the bait. His only references to distance were when he walked "several hundred yards" and 200 yards downwind, and easily detected the odor of the bait or ethyl mercaptan.

The publication contains few typographical errors. But two of these may confuse the reader. Thus the captions for Figures 16, 17, 18, and 19 should be on the right-hand margin instead of the bottom of the page. On page 20, precaution Number 2 should read: "All baits were placed in the blower at night to rule out any possibility of detection by turkey vultures. Baits were placed in the blower at 4:00 a.m. to prevent molestation by carnivores." The date of the Koford reference on page 38 should read 1953.

This publication represents an important contribution to ornithological knowledge. For well over 100 years the question of olfaction in vultures with regard to food finding has remained an open one. Although much has been written on the subject of olfaction in vultures, no previous study was as thorough. Earlier studies were performed for the most part only with captive birds, or were one-shot field tests. Probably the most convincing field tests prior to this report were those conducted by Chapman (1938, "Life in an Air Castle"). Not only has Stager conducted a convincing series of field experiments, but has supplemented these with morphological studies that provide new knowledge on the olfactory sense of vultures. The development of the rubber latex technique provides a useful tool for the study of external form and size of major divisions of the brain in the absence of the brain itself. This study seems to show rather conclusively that *Cathartes aura* has a well-developed sense of olfaction used in locating food at short range. The other cathartine vultures, with the possible exception of the King Vulture, lack the degree of olfactory development and the flight behavior that enable the Turkey Vulture to locate its food by smell.—DOUGLAS A. LANCASTER.

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Bagg, Aaron Moore, Farm St., Dover, Mass.	1948
Batts, H(enry) Lewis, Jr., 2315 Angling Rd., Kalamazoo, Mich.	1946
Carnes, Mrs. Herbert E., 31 Dogwood Lane, Tenafly, N. J.	1944
Desmond, Thomas C(harles), Box 670, Newburgh, N. Y.	1942
Goelet, Robert G., 425 Park Ave., New York 22, N. Y.	1953
Mills, Herbert H., Arrowhead Farms, R.F.D. 3, Bridgeton, N. J.	1951
Peterson, Roger Tory, Neck Rd., Old Lyme, Conn.	1942
Stettenheim, Peter, U.S.D.A. Avian Anatomy Project, Dept. of Poultry Science, Mich. State Univ., East Lansing, Mich.	1951
Stokes, Allen W., Dept. of Wildlife Management, U.S.A.C., Logan, Utah	1950
Stoner, Mrs. Lillian C., 399 State St., Albany 10, N. Y.	1945
Strong, Reuben M.	Founder, Deceased
Tucker, Mrs. Carll, Penwood, Mt. Kisco, N. Y.	1928
Van Tyne, Josselyn	Deceased

†Life Member *Sustaining Member Others—Active Members

Abbott, Jackson Miles, 1100 Doter Drive, Waynewood, Alexandria, Va.	1948
Abbott, Waldo G., Museum of Natural History, Santa Barbara, Calif.	1963
Abraitys, Vincent, Sergeantsville, N. J.	1956
Adams, C(lyde) Bruce, 40 Summit Rd., Riverside, Conn.	1959
*Adams, Heman P(urdy), 7 Highland Ave., Maplewood, N. J.	1959
Adams, William Hensley, Jr., Route 2, Riceville, Tenn.	1951
*Adelson, Richard Henry, Remsen's Lane, R.D. 1, Oyster Bay, L. I., N. Y.	1938
Adkisson, Curtis S(amucl), Route 3, Morrilton, Ark.	1963
Agey, H. Norton, 908 Ave. H, N.E., Winter Haven, Fla.	1960
Ahlquist, Jon Edward, 2014 West 16 St., Ashtabula, Ohio	1959
Aiken, Carl Howard III, 3767 Georgetown, Houston 5, Texas	1959
*Aldrich, John Warren, 7725 Lakeview Drive, Falls Church, Va.	1930
*Alexander, Donald C(hild), 16 Pleasant St., Nahant, Mass.	1937
*Alexander, Gordon, Dept. of Biology, Univ. of Colorado, Boulder, Colo.	1936
Alexander, Horace G(undry), 26 Bon Acord Rd., Swanage, Dorset, England	1962
Allen, Arthur W(esley), 561 Eastern Blvd., Watertown, N. Y. 13601	1959
Allen, Ted T(ipton), Dept. of Biology, Jacksonville Univ., Jacksonville, Fla.	1958
†Allin, A(lbert) E(llis), Provincial Laboratory, Fort William, Ont., Canada	1943
Allyn, (Paul) Richard, 709 Myers Bldg., Springfield, Ill.	1944
Almon, Lois, 2946 Cambridge Ave., Milwaukee 11, Wisc.	1958
Alperin, Irwin M., 187 Cedar Lane, Babylon, N. Y. 11702	1939
†Altemus, Edward Lee, Lafayette Ave., Fort Washington, Pa.	1954
Altsheler, Mrs. Yancey R(ober)ts, 2412 Dundee Rd., Louisville 5, Ky.	1954
Amadon, Dean, American Mus. of Natural History, Central Park West at 79th St., New York 24, N. Y.	1935
Ames, Peter L., 393 Mansfield St., Apt. One, New Haven, Conn.	1963
Ammon, Walter L., 2607 Kessler, Midland, Texas	1958
Anaka, William, Spirit Lake, Saskatchewan, Canada	1957
Anderson, Anders H(arold), 3221 East Kleindale Rd., Tucson, Ariz.	1937
Anderson, Eugene N(ewton), Jr., Dept. of Anthropology, Kroeber Hall, Univ. of California, Berkeley 4, Calif.	1964
Anderson, Frank G., Dept. of Sociology, Univ. of Maryland, College Park, Md.	1951
Anderson, Henry A., 3700 16th Ave., Kenosha, Wisc.	1961
Anderson, John M., R.R. 4, Winous Point Club, Box 359, Port Clinton, Ohio	1938
Anderson, Mrs. Paul T., Wolf Trap Hill, R.F.D. 2, Winter St., Middleborough, Mass.	1961
Anderson, Richard A(rlen), 1147 Greenshaw Drive, St. Louis 37, Mo.	1963
Anderson, R. K., Dept. Wildlife Management, 226 Russel Laboratories, Linden Drive, Madison, Wisc. 53706	1962

* Correct to 31 August 1964.

Anderson, Ted R(oger), 7803 Summit, Kansas City, Mo.	1964
Angstadt, Robert B., 1018 Danby Rd., Ithaca, N. Y.	1962
†Annan, Ormsby, 744 Hinman Ave., Evanston, Ill.	1956
Anthes, Clarence A(lvin), 707 North Moreland Blvd., Waukesha, Wisc.	1939
*Arbib, Robert S(imeon), Jr., 226 Guion Drive, Mamaroneck, N. Y.	1947
Armington, Sven, Blanchegatan 18, Stockholm No., Sweden	1948
Armstrong, Virginia, Old Concord Rd., Lincoln, Mass. 01773	1939
Arner, Dale H., Mississippi State Univ., Dept. of Zoology, State College, Miss.	1964
†Arnold, Elting, 4914 Dorset Ave., Chevy Chase 15, Md.	1941
Arnold, Keith A(lan), 826 Steward Ave., Jackson, Mich.	1960
Arny, Samuel A., 7432 Hamlet St., Springfield, Va.	1947
Atkeson, Thomas Zephaniah, P. O. Box 1643, Decatur, Ala.	1953
Austin, Mrs. Harold C., 1116 Mandana Rd., Oakland 10, Calif.	1950
Austin, Oliver L(uther), Jr., Florida State Museum, Gainesville, Fla.	1930
*Avent, Carrie Pillow, Minter City, Miss.	1959
Axtell, Harold H., Buffalo Museum of Science, Humboldt Park, Buffalo 11, N. Y.	1950
Babcock, Charles D., 127 Jefferson St., Cattaraugus, N. Y.	1959
Baepfer, Donald H(enry), Dept. of Biology, Central Washington State College, Ellensburg, Wash.	1955
Bailey, Alfred Marshall, Denver Museum of Natural History, City Park, Denver, Colo. 80206	1928
Bailey, Mrs. Harold H(arris), Rockbridge Alum Springs Biological Laboratory, Route 2, Goshen, Va.	1963
Bailey, Karl D., 5275 Adams Rd., Bloomfield Hills, Mich.	1963
Bailey, W. Wallace, Director, Wellfleet Bay Wildlife Sanctuary, Box 171, South Wellfleet, Mass.	1959
Baillie, James Little, Royal Ont. Mus., 100 Queen's Park, Toronto, Ont., Canada	1939
*Baird, James, South Great Rd., South Lincoln, Mass.	1954
†Baker, Bernard W., R.D. 1, Judson Rd., Spring Lake, Mich.	1938
*Baker, John H(opkinson), 169 East 78 St., New York 21, N. Y.	1930
Baker, Paul S(eaman), 21 Woodlot Lane, Huntington, L. I., N. Y.	1946
Baker, Rollin Harold, The Museum, Michigan State Univ., East Lansing, Mich.	1938
*Baker, William C(alvin), 559 Euclid St., Salem, Ohio	1931
Baldwin, Mrs. Amy G., 6335 Kimbark Ave., Basement Apt., Chicago, Ill. 60637	1943
Baldwin, Paul H., Dept. of Zoology, Colorado State Univ., Fort Collins, Colo.	1956
Baldwin, William Grove, 601 Douglas, Box 1627, Wenatchee, Wash.	1959
*Ball, Kathleen E., 11719 133rd St., Edmonton, Alberta, Canada	1946
Ball, W(illiam) Howard, 4322 Sheridan St., University Park, Hyattsville, Md. 20782	1961
*Ballentine, George L., 268 Oakwood Rd., Charlestone 4, W. Va.	1963
Balsom, Mrs. Amos Parker, 2209 East Stratford Court, Milwaukee 11, Wisc.	1949
Banks, Clinton S(eeger), 202 Wilma Ave., Steubenville, Ohio	1945
Banks, Richard C(harles), Natural History Museum, P. O. Box 1390, San Diego 12, Calif.	1959
Banta, Edna, R.R. 1, Nashville, Ind.	1945
Barbour, Llewellyn P(helps), 4780 Wood St., Willoughby, Ohio	1948
*Barker, Paul R(aymond), 18 Ridgeway, Ann Arbor, Mich.	1962
Barlow, Jon Charles, Museum of Natural History, Univ. of Kansas, Lawrence, Kan.	1959
Barrus, Mrs. Virginia F(rench), 31649 Shaker Blvd., Cleveland, Ohio 44124	1964
†Bartel, Karl E(mil) Edgar, 2528 West Collins St., Blue Island, Ill.	1934
Bartleson, Fred D(urant), Jr., 6485 Operations Squadron, Box 24, APO 0323, San Francisco, Calif.	1952
*Bartlett, Guy, 1053 Parkwood Blvd., Schenectady 8, N. Y.	1938
†Bartlett, L(awrence) M(atthews), 750 South Dilkerson St., Arlington, Va. 22204	1957
Bartlett, Wesley H., 122 South Ridgley Ave., Algona, Iowa	1936
Barton, Roger, 22 Arlington Ave., Caldwell, N. J.	1960
Bastin, Eric W(alter), Shalamar, Apt. 305, 40 Robinson St., Hamilton, Ont., Canada	1951
Batchelder, Edgar M(arden), 56 Orchard St., Marblehead, Mass.	1941
†Baum, William W., 1257 Cranford Ave., Lakewood 7, Ohio	1963

Baylor, L(eslie) M(ilton), Dept. of Languages, S. D. School of Mines, Rapid City, S. D.	1954
Bayly, James C(artwright), 19 Grenville Court, Brockville, Ont., Canada	1961
Beardsley, M(argaret) Hortense, 330 North Chestnut St., Ravenna, Ohio	1941
Bebb, Forrest, 1300 Boston Ave., Muskogee, Okla.	1955
Beck, Robert E(dwin), Jr., Route 6, Hagerstown, Md.	1964
†Beckett, T. A. III, Johns Island, South Carolina	1963
*Beddall, Mrs. Barbara G(ould), 2502 Bronson Rd., Fairfield, Conn.	1958
Beecher, William J(ohn), Chicago Academy of Sciences, 2001 North Clark St., Chicago 14, Ill.	1948
Beer, James R(obert), Dept. of Ent., Fishery & Wildlife, Univ. of Minn., St. Paul 1, Minn.	1957
†Behle, William H(arroun), Dept. of Biology, Univ. of Utah, Salt Lake City, Utah	1935
Behrens, Harry Carl, Box 1055, Rapid City, S. D.	1950
†Belcher, Paul Eugene, 230 Mineola Ave., Akron 13, Ohio	1938
Belknap, John B(alcom), 92 Clinton St., Gouverneur, N. Y.	1959
*Bell, Henry III, U.S. Geol. Sur. Agri. Res. Center, Beltsville, Md.	1946
Bell, Miriam, 2257 Upton Ave., Apt. 11, Toledo, Ohio 43606	1958
Bell, Ralph K(ennedy), R.D. 1, Box 142, Clarksville, Pa.	1963
Bellrose, Frank G., Jr., Illinois Natural History Survey, Havana, Ill.	1963
Bender, Charles R(ichard), 364 Alex Hamilton, San Antonio 28, Texas	1960
Bennett, Esther V(orena), S. I. U. Museum, Carbondale, Ill.	1954
Bennett, Holly Reed, 2457 Orchard St., Chicago 14, Ill.	1949
Benson, Seth Bertram, 645 Coventry Rd., Berkeley 7, Calif.	1930
Bent, Mrs. M. V., 275 Monroe Ave., Rochester, N. Y.	1955
Benton, Allen H(aydon), Dept. of Biology, State College, Fredonia, N. Y.	1953
†Berger, Andrew J(ohn), Dept. of Zoology, University of Hawaii, Honolulu, Hawaii 96822	1940
Berger, Daniel D(avid), 510 East MacArthur Rd., Milwaukee 17, Wisc.	1953
†Bergstrom, E(dward) Alexander, 37 Old Brook Rd., West Hartford 7, Conn.	1943
*Berkowitz, Albert Clarence, P. O. Box 1341, Des Moines 5, Iowa	1946
Berrett, Delwyn Green, Box 9, Menan, Idaho	1959
Betts, Amelia J(eannette), Baldwin City, Kansas 66006	1953
Biaggi, Virgilio, Jr., College of Agriculture, Mayaguez, Puerto Rico	1945
†Bibbee, P. C., Dept. of Biology, Davis & Elkins College, Elkins, W. Va.	1958
†Biddle, E. Turner, Leiters Ford, Ind.	1960
Bigger, Walter K., Star Route, Trout Run, Pa.	1963
Billeb, Stephan L., 953 Judah St., San Francisco 22, Calif.	1962
Binford, L(aurie) C(harles), Museum of Natural History, Louisiana State Univ., Baton Rouge 3, La.	1954
Birch, Robert Lee, Dept. of Biology, West Virginia Univ., Morgantown, W. Va.	1950
Birkenholz, Dale E(ugene), Dept. of Biological Science, Illinois State Normal Univ., Normal, Ill.	1957
Bishop, Earl, 633 South Orchard St., Madison 5, Wisc. 53715	1962
Black, Charles T(theodore), Route 1, Box 480, East Lansing, Mich.	1935
Black, Gladys B., 608 DeWitt, Pleasantville, Iowa 50225	1963
Black, W. F., Dept. of Biology, Sir George Williams Univ., Montreal 25, P.Q., Canada	1962
Blades, Herbert, 1708 West Gilpin Drive, Willow Run, Wilmington 5, Del.	1962
Blake, Charles H(enry), P. O. Box 613, Hillsboro, N. C.	1950
Blake, Emmet R., Chicago Natural History Museum, Roosevelt Rd. & Lake Shore Drive, Chicago 5, Ill.	1939
Blake, Mrs. Grace R., 1933 Westwood Drive, Topeka, Kan.	1950
Blakeslee, Howard E., 1722 East 45th St., Ashtabula, Ohio	1959
Blanchard, Harold H(opper), 32 Calumet Rd., Winchester, Mass.	1946
Blaney, John L., 7375 Cmbt. Spt. Sp., APO 22, New York, N. Y.	1958
†Bleitz, Donald Lewis, 5334 Hollywood Blvd., Los Angeles, Calif. 90027	1948
Blount, Elisabeth R(ose), 741 Ruiz St., San Antonio 7, Texas	1961
Bock, Walter (Joseph), Dept. of Zoology, Univ. of Illinois, Urbana, Ill.	1953
Bodsworth, Fred, 294 Beech Ave., Toronto 13, Ont., Canada	1956
Bolen, Eric G(eorge), Box 1396, Welder Wildlife Foundation, Sinton, Texas	1964

†Bond, James, 1900 Race St., Philadelphia 3, Pa.	1945
Bond, Richard M(arshall), Kingshill, St. Croix, U.S. Virgin Islands	1936
Bond, Richard R(andolph), Dean of Faculty, Elmira College, Elmira, N. Y.	1955
Bondi, Joseph, 349 North Fulton Ave., Mt. Vernon, N. Y.	1960
Boone, George C., Biology Dept. Susquehanna Univ., Selinsgrove, Pa.	1961
†Booth, Mrs. Robert V. D., 1085 Bank St., Painesville, Ohio	1949
Bopp, J(an) M(artin), 113 North 15th St., Niles, Mich. 49120	1964
Bordley, James III, 13 Main St., Cooperstown, N. Y.	1957
Bordner, Dorothy L., 926 West Beaver Ave., State College, Pa.	1959
Borell, Adrey Edwin, Soil Conservation Service, 3140 Wadsworth Blvd., Denver 15, Colo.	1936
†Borror, Donald J(oyce), Dept. of Zoology & Entomology, Ohio State Univ., Columbus, Ohio 43210	1927
Boulton, Rudyerd, Box 8305 Causeway, Salisbury, South Rhodesia	1957
Bourdo, Eric Albert, Jr., Ford Forestry Center, L'Anse, Mich.	1951
Bower, Mrs. F. L., R.F.D. 1, Lee's Hill Rd., Box 496, Basking Ridge, N. J. 07920	1954
Bowman, Robert I., Dept. of Biology, San Francisco State College, 1600 Holloway Ave., San Francisco 27, Calif.	1962
Boyd, Elizabeth M(argaret), Mount Holyoke College, South Hadley, Mass.	1941
Boyd, Ivan L., Dept. of Biology, Baker Univ., Baldwin, Kan.	1951
*Brackbill, Hervey G(roff), 2620 Poplar Drive, Baltimore 7, Md.	1942
*Bradburn, Donald Muir, 440 Bellaire Drive, New Orleans 24, La.	1950
Brady, Alan, Box 103, Wycombe, Pa.	1959
*Branch, Mrs. Margaret G(amble), 1324 Wells St., Ann Arbor, Mich.	1952
Brandes, K(enneth) W(illiam), 51 Stevens St., Wellsville, N. Y.	1959
Branum, Florence (Pauline), 727 Rutter Ave., Lancaster, Ohio 43130	1946
Brauner, Joseph, Apt. 19, 18645 Collins St., Tarzana, Calif.	1942
*Braunschweig, Mrs. Lee W(elsh), Box 514, Winchester, Va. 22601	1953
†Brecher, Leonard C(harles), 1900 Spring Drive, Louisville, Ky.	1939
†Breckenridge, Walter J(ohn), Museum of Nat. History, Univ. of Minn., Minne- apolis, Minn.	1929
Breitweiser, Mrs. Alberta P(auline), 1002 Chestnut St., Anderson, Ind.	1964
Brewer, Richard Dean, Dept. of Biology, Western Michigan Univ., Kalamazoo, Mich.	1949
Brierley, Frances, 26 Crandall St., Adams, Mass.	1963
Brigham, Edward M(orris), Jr., Kingman Memorial Museum, Battle Creek, Mich.	1931
Brigham, Edward M(orris) III, Box 125, Atlas, Mich. 48411	1960
Broadbooks, Harold E(ugene), Southern Illinois Univ., Alton Residence Center, Alton, Ill.	1948
Brodkorb, Pierce, Dept. of Biology, Univ. of Florida, Gainesville, Fla.	1951
*Brooke, Mrs. Margaret, 126 51st St., Des Moines 12, Iowa	1958
†Brooks, Maurice, Div. of Forestry, West Virginia Univ., Morgantown, W. Va.	1927
Broun, Maurice, Route 2, Kempton, Pa.	1935
Brown, Jerram L., Dept. of Biology, Univ. of Rochester, River Campus Sta., Rochester 20, N. Y.	1950
Brown, John Warner, Oatka Farm, Scottsville, N. Y.	1959
†Brown, Laurence A(lynn), Jr., 434 Marlborough St., Boston 15, Mass.	1958
Brown, N(orman) Rae, Faculty of Forestry, Univ. of New Brunswick, Frederic- ton, N. B., Canada	1945
Brown, Woodward H(art), 4815 Ingersoll Ave., Des Moines 12, Iowa	1949
Bruce, James A(ddison), 565 Spring St., Wooster, Ohio	1952
Brueggemann, Anna L(ouise), 2316 Berwick Blvd., Columbus 9, Ohio	1943
†Bruns, James Henry, 800 Lowerline St., New Orleans 18, La.	1941
Bryan, Burton Donald, Box 2, Adamsville, R. I.	1949
Bryan, Mrs. Clio Robbins, Hare's Hill Rd., Box 274, Kimberton, Pa.	1963
Bryant, Mrs. Paula S., 559 Homer Ave., Palo Alto, Calif.	1957
*Bryens, Oscar McKinley, Route 1, White Pigeon, Mich.	1924
*Buchheister, Carl W., 1130 Fifth Ave., New York 28, N. Y.	1943
Buck, Mrs. J(ohn) P(aul), R.R. 1, Box 332, Hamlet, Ind. 46532	1960
†Bucknell, Donald N(eedham), 134 Wonham, Ingersoll, Ont., Canada	1953
Bull, John L., 1148 Virginia St., Far Rockaway, N. Y.	1952

Bunnell, John R., 3867 Edgewood Ave., Fort Myers, Fla.	1953
Burger, Joanna, 1221 Ferry Rd., Schenectady, N. Y.	1962
Burk, Myrle M., R.R. 2, Waterloo, Iowa	1960
Burnham, Gladys L(ou), Howard County Junior College, Big Spring, Texas	1954
Burns, R. K., Bridgewater College, Bridgewater, Va.	1963
Burns, Robert David, Dept. of Biology, Kenyon College, Gambier, Ohio	1948
Burr, Irving W(ingate), 1141 Glenway, West Lafayette, Ind.	1945
*Burrell, Helen E., 1523 Orchard Drive, Kalamazoo, Mich.	1962
Burt, William Henry, Museum of Zoology, Univ. of Mich., Ann Arbor, Mich.	1928
Burt, Benjamin P., 109 Haffenden Rd., Syracuse, N. Y. 13210	1956
Burt, Harold E., 2163 North Starr Ave., Columbus, Ohio 43221	1953
Bushman, John, Desert Test Center, Fort Douglas, Salt Lake City, Utah 84113	1951
Buskirk, Robert, 9500 East 86th St., Indianapolis 26, Ind.	1962
Buskirk, William, 9500 East 86th St., Indianapolis 26, Ind.	1962
*Butsch, Robert Stearns, Exhibit Museum, Univ. of Michigan, Ann Arbor, Mich.	1947
Cadbury, Joseph M., 108 W. Phil-Ellena St., Philadelphia 19, Pa.	1963
Cade, Tom, Dept. of Zoology, Syracuse Univ., Syracuse 10, N. Y.	1950
Cahalane, Victor H(arrison), Derbyshire Rd., Clarksville, N. Y.	1933
Calef, Robert, Delta College, University Center, Mich.	1954
Callison, Charles H., National Audubon Society, 1130 Fifth Ave., New York 28, N. Y.	1960
*Calvert, Earl Wellington, R.R. 2, County Home, Lindsay, Ont., Canada	1937
Calvin, Robert L(eal), R.D. 3, Pulaski Rd., New Castle, Pa.	1951
Camp, Mrs. Dorothy I(rene), R.D. 1, Stuart Lake, Marshall, Mich.	1957
Campbell, Louis W(alter), 4531 Walker Ave., Toledo 12, Ohio	1926
Campbell, Mildred F(lorencia), 29 North Hawthorne Lane, Indianapolis, Ind. 46219	1938
Carl, Harry G., 2304 Davie St., Davenport, Iowa	1949
Carpenter, Charles C., Dept. of Zoology, Univ. of Oklahoma, Norman, Okla.	1951
Carpenter, Floyd S., 2402 Longest Ave., Louisville 4, Ky.	1934
Carlson, Carl, 5706 Lone Oak Drive, Bethesda, Md.	1962
*Carrick, W(illiam) H(enese), Niska Waterfowl Research Sta., R.R. 6, Guelph, Ont., Canada	1960
Carroll, Robert P., Dept. of Biology, Virginia Military Institute, Lexington, Va.	1942
†Carrothers, Vera, 14704 Alder Ave., East Cleveland 12, Ohio	1938
Carson, L(ew) B(allard), 1306 Lincoln St., Topeka, Kan. 66604	1948
*Carter, Charles E(dward), 1339 30th St., Orlando, Fla.	1958
Carter, Dennis L(ee), Box 267, Springdale, Utah 84767	1947
*Carter, Mrs. E. W., Route 2, Perrysburg, Ohio	1946
†Carter, William A., Route 4, Ada, Okla. 74820	1961
Cassel, J(oseph) Frank(lin), Dept. of Zoology, North Dakota State Univ., Fargo, N. D.	1940
Caswell, Herbert H(all), 952 Sheridan St., Ypsilanti, Mich. 48197	1959
Cater, Milan B(ryson), P. O. Box 146, Madison Heights, Va.	1944
†Chalif, Edward Louis, 37 Barnsdale Rd., Short Hills, N. J.	1947
Chamberlain, B(arnwell) Rhett, Wadmalaw Island, S. C.	1957
Chamberlaine, Lee B., Star Route, Box 19A, Ochopec, Fla.	1957
Chambers, Glenn D., 1703 Highridge Drive, Columbia, Mo.	1959
*Chambers, W(illie) Lee, 830 Robinson Rd., Route 1, Box 410, Topanga, Calif.	1909
Chandler, Richard D., 101 Oak St., Wellesley 81, Mass.	1963
Chapelle, Francis O(berlin), 2120 North Troy St., Arlington 1, Va.	1954
Chapman, Blanche Hammond, 1325 South 19th St., Birmingham, Ala.	1953
Chapman, Herman Floraine, 712 South Dakota Ave., Sioux Falls, S. D.	1947
Chapman, Lawrence B., R.F.D. Box 87, Hubbardston, Mass.	1940
Chase, Charles Greenough, Mere Place R.D., Brunswick, Me.	1959
Chase, Theodore, Jr., 1915½ Addison St., Apt. 103, Berkeley, Calif. 94704	1960
Choate, Ernest A., 411 Rodman Ave., Jenkintown, Pa.	1954
Christie, David S., East Riverside Post Office, Kings County, N. B., Canada	1962
Church, Mrs. Herbert M., Jr., Janelia Farms, Ashburn, Va.	1963
Chutter, Mildred C., Box 229, Athens, Ohio	1936
Clark, George A(lfred), Jr., 6509 24th Ave. N.E., Seattle, Wash. 98115	1955

Clark, George C(lifford), P. O. Box 167, College, Alaska	1961
Clark, Robert A., Lewis St., Petersham, Mass. 03166	1964
†Clarkson, Mrs. Edwin O., Winghamen, 248 Ridgewood Ave., Charlotte 7, N. C.	1940
Clement, Roland C(harles), Weed Ave., R.F.D., Norwalk, Conn.	1941
†Clements, H(iram) Everest, 35 Argyle St., Rochester 7, N. Y.	1949
*Clise, Mrs. Charles Frances, 1030 39th Ave. East, Seattle 2, Wash.	1957
†Clow, Marion, Box 163, Lake Forest, Ill.	1929
Clyde, E(dward) C(alvin), Jr., Box 495, Effingham, S. C.	1963
Cochran, William W., 1460 West Forest St., Decatur, Ill.	1964
†Coffey, Ben Barry, Jr., 672 North Belvedere, Memphis 7, Tenn.	1927
Coffey, John W(allace), 508 Spruce St., Bristol, Tenn.	1964
Coffey, Lula C(oooper), 672 North Belvedere, Memphis 7, Tenn.	1952
Coggeshall, Robert D., Chair Factory Rd., Elma, N. Y.	1956
Cogswell, Howard L(yman), Dept. of Biological Science, California State College at Hayward, Hayward, Calif. 94542	1944
*Cohn, Mrs. Jean W., Museum of Zoology, Univ. of Michigan, Ann Arbor, Mich.	1954
Colby, William H., 28 Shawnee Trail, Sparta, N. J.	1963
†Cole, Mrs. Richard D., 625 Valley Lane, Towson 4, Md.	1955
Cole, William W(alter), Jr., 601 South Vermont Ave., Los Angeles, Calif. 90005	1964
*Collier, Gerald, Dept. of Zoology, San Diego State College, San Diego 15, Calif.	1956
Collins, Charles T(hompson), Dept. of Biology, Univ. of Florida, Gainesville, Fla.	1959
Compton, Mrs. L. E., 2745 South Genessee Rd., Waukesha, Wisc.	1957
Compton, Lawrence Verlyn, Biology Division, Soil Conservation Service, Washington 25, D. C.	1923
†Conboy, Mrs. John William, 417 Studebaker St., Mishawaka, Ind.	1954
Conn, Robert Carland, 755 Ross Lane, Bound Brook, N. J.	1945
Conrad, Charles L(ouis), 137 North 11th St., Wheeling, W. Va.	1937
Conway, Albert E., 713 Wooddale Rd., Wilmington, Del. 19809	1962
Conway, C(harles) Abbott, R.R. 1, Puslinch, Ont., Canada	1962
Conway, William G., New York Zoological Park, 185th St. & Southern Blvd., New York 60, N. Y.	1959
Cooke, Thomas Turner, 71 MacCulloch Ave., Morristown, N. J.	1959
*Cooper, Kenneth K(ing), Dunster Rd., Stanwood, Mt. Kisco, N. Y.	1958
Cope, James B(onwill), Earlham College, Richmond, Ind.	1949
Coppinger, Raymond P., Chestnut Hill Rd., R.F.D., Montague, Mass. 01351	1964
Corbett, Kenneth B., 3129 Marietta Ave., Lancaster, Pa. 17601	1957
Cornwell, George W(illiam), Dept. of Forestry and Wildlife, Virginia Polytechnic Institute, Blacksburg, Va.	1962
*Cors, Paul B(eaumont), 241½ West May Ave., Las Cruces, N. M.	1952
*Cottam, Clarence, Welder Wildlife Foundation, P. O. Box 1396, Sinton, Texas	1929
Cottrell, George William, Jr., Route 2, Hillsboro, N. H.	1941
Cottrille, W(illiam) Powell, 6075 Brown's Lane, Jackson, Mich.	1949
Cottrille, Mrs. W. Powell, 6075 Brown's Lake, Jackson, Mich.	1950
Coutlee, Ellen L(orraine), Dept. of Biological Sciences, Mount St. Mary's College, 12001 Chalon Rd., Los Angeles 49, Calif.	1961
Cox, George W., Dept. of Zoology, San Diego State College, San Diego 5, Calif.	1954
Cox, Geraldine H(ollon), P. O. Box 469, Washington, N. C.	1963
Coy, Roy E., St. Joseph Museum, St. Joseph, Mo.	1953
Cracraft, Joel Lester, Museum of Zoology, Louisiana State Univ., Baton Rouge 3, La.	1961
Craighead, William M., George School, Bucks County, Pa.	1962
*Crawford, Alan, Jr., White Horse Rd., Devon, Pa.	1949
Creager, Joe C(lyde), L. A. Cann Rd., Route 2, Ponca City, Okla. 74601	1947
*Creighton, William A., Box 1283, Cochrane, Ont., Canada	1963
Cringan, A. T., Dept. of Zoology, Ontario Agricultural College, Guelph, Ont., Canada	1961
†Crockett, David B., Dept. of Biology, Central Methodist College, Fayette, Mo. 65248	1955
Croft, Joseph E., 2366 Gladstone Ave., Louisville 5, Ky.	1956
Crouch, D. E., 1126 Ninth St., Bremerton, Wash.	1963
Crowder, Orville W., Box 1760, Washington, D. C. 20013	1961

Crowell, John B., Jr., 1227 Hallinan Circle, Lake Oswego, Ore.	1952
Crowell, Kenneth L(eland), Marlboro College, Marlboro, Vt.	1961
Cruickshank, Allan Dudley, 1925 Indian River Drive, Rockledge, Fla.	1939
Cullen, Peter, 5115 Graceland, Indianapolis, Ind. 46208	1956
Cunningham, James W., 3009 East 19th Terrace, Kansas City, Mo.	1935
Cunningham, Richard L., Everglades National Park, Flamingo, Fla.	1964
*Currie, Mrs. Neill Alexander, Jr., 1104 Brook St., Fayetteville, N. C.	1958
Curtis, Mrs. Vee K(aelin), 2412 Cohasset Rd., Chico, Calif. 95926	1950
Cuthbert, Nicholas L., Biology Dept., Central Michigan Univ., Mt. Pleasant, Mich.	1950
Cutler, Mrs. Betsey D., 2128 Great Highway, San Francisco 16, Calif.	1959
Cutler, David A., 8434 Temple Rd., Philadelphia, Pa.	1963
Dana, Edward Fox, 57 Exchange St., Portland 3, Me.	1939
Dana, Severyn Sharpe, 106 East Manning St., Providence 6, R. I.	1963
Dane, Benjamin, Division of Systematic Biology, Dept. of Biological Sciences, Stanford Univ., Stanford, Calif.	1957
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Daniels, Estrilla (Myrtle), 270 South Prospect St., Ravenna, Ohio	1959
Daniels, Mildred, 21925 McCauley Rd., Cleveland 22, Ohio	1959
Darby, Richard T., Prospect St., Sherborn, Mass.	1948
†Darden, Mrs. Colgate W(hitehead), Flicker Point, Algonquin Park, Norfolk 5, Va.	1943
Dater, Eleanor E., 259 Grove St., P. O. Box 111, Ramsey, N. J. 07446	1949
Davant, Mary, 861 North McLean Blvd., Memphis 7, Tenn.	1952
†Davenport, Mrs. Allan G., 39 Walcott Ave., Jamestown, R. I.	1959
Davey, Winthrop N(ewberry), 495 Hillspur Rd., Ann Arbor, Mich.	1941
Davidson, Mrs. W. F., 332 Summit Ave., St. Paul 2, Minn.	1953
Davis, Clifford Vernon, Dept. of Zoology & Entomology, Montana State College, Bozeman, Montana	1945
Davis, David E(dward), Dept. of Zoology & Entomology, The Pennsylvania State Univ., University Park, Pa.	1940
Davis, Jane S(trahn), Box 96, White Marsh, Va.	1948
Davis, John, Hastings Nat. History Reservation, Carmel Valley, Calif.	1939
Davis, L(ouie) Irby, Box 988, Harlingen, Texas	1933
Davis, Rolph, King City, R.R. 1, Ont., Canada	1963
†Davis, W(illiam) B., Dept. of Wildlife Management, College Station, Texas	1938
Davis, William Franklin, 423 West 46th St., Ashtabula, Ohio	1947
Davis, W. Marvin, Faculty Exchange, Univ. of Oklahoma, Norman, Okla.	1956
Davison, Verne E., Soil Conservation Service, P. O. Box 832, Athens, Ga.	1960
Davy, Roger H(ewson), 5547 North 13th Ave., Phoenix 13, Ariz.	1957
Dawn, Walter H(enry), 49-15 Skillman Ave., Woodside 77, N. Y.	1945
Deck, Robert Eugene, R.D. 5, Mechanicsburg, Pa.	1959
Deevey, Edward S(mith), Jr., Osborn Zoological Laboratory, Yale Univ., New Haven 11, Conn.	1948
DeFoe, Donald H., Elkmont, Gatlinburg, Tenn.	1962
DeGarmo, William Russell, Oak St., Norwell, Mass.	1946
DeGroot, Dudley Sargent, 16839 Bellota Drive, San Diego, Calif. 92128	1948
Dehner, Eugene W(illiam), St. Benedict's College, Atchison, Kan.	1944
†Delacour, Jean Theodore, c/o American Museum of Natural History, Central Park West at 79th St., New York 24, N. Y.	1944
Dempster, Rulon T., Chestnut Pkwy. at Ridley Creek, Waterville, Chester, Pa.	1959
Denham, Reginald (Francis), 100 West 57th St., New York, N. Y.	1948
Dennis, James R(ober), 4271 N.W. 10th St., Pompano Beach, Fla.	1961
Dennis, John V(alue), Box 389, Leesburg, Va.	1964
Denton, J(ames) Fred, 1510 Pendleton Rd., Augusta, Ga.	1935
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Dexter, Ralph W., Dept. of Biology, Kent State Univ., Kent, Ohio	1958
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†Dickerman, Robert W(illiam), Oficina Sanitaria Panamericana, Havre 30, Mexico 6, D.F., Mexico	1955
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Dillon, Olan W(illiam), Jr., Soil Conservation Service, Room 207, 1060 Bannock St., Denver 4, Colo.	1960
Dilts, Robert L., 9041 Briarclift Rd., Indianapolis 26, Ind.	1960
Dingle, Edward von Siebold, Huger, S. C.	1921
Dixon, James B(enjamin), 2266 Cranston Drive, Escondido, Calif.	1936
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Doane, Mrs. Blanche Evans, 232 Rosewood St., Birmingham, Ala. 35210	1947
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Donald, Mary (Frances), 6918 Belmont Lane, Milwaukee 11, Wis.	1951
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Dow, Douglas D(avid), Dept. of Zoology, Univ. of British Columbia, Vancouver 8, B. C., Canada	1963
Down, Edward H., 28 Lynton Mead, Totteridge, London N 20, England	1957
Downs, Mrs. James R(euel), Glebe Farm, South Londonderry, Vt. 05155	1959
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Drieslein, Robert L(ynn), 76 South Highland Ave., Lombard, Ill.	1944
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Dubke, Kenneth Howard, 918 State Line Rd., Elizabethton, Tenn.	1960
DuBois, Charlotte A., 400 South Edgewood, Greensboro, N. C.	1962
Duce, Mrs. Elizabeth R(andall), P. O. Box 396, Damaroscotta, Me.	1959
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Duebbert, H(arold) F(ranklin), Malheur National Wildlife Refuge, Burns, Ore.	1957
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DuMont, Philip A(tkinson), 4114 Fessenden St., N.W., Washington, D. C. 20016	1928
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Dunham, David W(arren), c/o Zoologisch Laboratorium, Kaiserstraat 63, Leiden, The Netherlands	1962
Dusi, Julian L(uigi), Dept. of Zoology & Entomology, Auburn Univ., Auburn, Ala.	1941
†Duvall, Allan J., Patuxent Research Center, Laurel, Md.	1958
Dvorak, J. L., 6125 Eddy St., Chicago, Ill. 60634	1958
Dyer, M(elvin) I(vor), Dept. of Zoology, University of Guelph, Guelph, Ont., Canada	1963
Dyer, William A., 402 John St., Union City, Mich.	1947
Dzubin, Alex, 306 W. P. Thompson Bldg., Univ. of Saskatchewan, Saskatoon, Sask., Canada	1956
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Eastman, John A., 471 E. 8th St., Holland, Mich.	1964
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Eckelberry, Don R(ichard), 180 Woodsome Rd., Babylon, N. Y.	1948
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Edwards, R(oger) York, Parks Branch, Dept. Recreation & Conservation, Victoria, B. C., Canada	1948

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Ellarson, Robert S(cott), 424 Univ. Farm Place, Madison 5, Wisc.	1948
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Emlen, Stephen T(hompson), Dept. of Zoology, Univ. of Michigan, Ann Arbor, Mich.	1964
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Eynon, Alfred E., Dept. of Biology, Upsala College, East Orange, N. J.	1947
Eyster, Marshall Blackwell, Box 545, Dept. of Biology, Southwestern Louisiana Institute, Lafayette, La.	1947
Fairfield, George M., 490 Merton St., Toronto 7, Ont., Canada	1962
Fales, John H(ouse), Ridge Rd., Neeld Estate, Huntingtown P. O., Md. 20639	1939
Falls, J. Bruce, Dept. of Zoology, Univ. of Toronto, Toronto 5, Ont., Canada	1948
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Farrand, H. F., 7 Guest Lane, Wilmington 9, Del.	1950
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Feenaty, L(eland) N(ewman), 9514 California Ave., Apt. C., South Gate, Calif. 90281	1953
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Feist, Irving, 58 Park Place, Newark 2, N. J.	1958
Fennell, Chester M(artin), 19291 Westover Drive, Rocky River, Ohio	1949
Ferguson, David S(owers), R.D. 1, Box 128, Philipsburg, Pa. 16866	1962
Ferguson, H(enry) Lee, Jr., Box 431, Fisher's Island, N. Y.	1964
Ferren, Richard Luther, Univ. of Maine, Orono, Me.	1959
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Ficken, Robert W., Dept. of Zoology, Univ. of Maryland, College Park, Md.	1957
Fillebrown, T(homas) S(cott), R.F.D., Lakeville, Conn.	1951
Finley, J(ohn) Scott, 1201 South Center Ave., Sioux Falls, S. D.	1949
Finucane, Thomas Wellington, 1434 Watauga St., Kingsport, Tenn.	1960
Fish, William Ralph, 5548 Linda Lane, Carmichael, Calif.	1950
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Fisher, James (Maxwell) (McConnell), Old Rectory, Ashton, Northampton, England	1960
Fisler, George F., Dept. of Biology, San Fernando Valley State College, Northridge, Calif.	1954
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Flieg, C. Michael, 3723 Hartford St., St. Louis 16, Mo.	1964
Follen, Don G., R.R. 1, Arpin, Wisc.	1963
Font, Miguel, 254 84th Rd., Floral Park, L. I., N. Y.	1964
Foote, R(ober) T(haddeus), P. O. Box 737, Milwaukee, Wisc. 53201	1957
Forbes, John Ripley, 5 Big Pines Rd., Westport, Conn.	1961
Ford, Norman L(ee), Museum of Zoology, Univ. of Michigan, Ann Arbor, Mich. 48104	1959
Ford, Thomas R(ober) T., 156 South St., Cadiz, Ohio	1958
Fordham, Stephen Crane, Jr., R.F.D. 1, Delmar, N. Y. 12054	1948
Forsythe, Dennis Martin, Dept. of Zoology, Utah State Univ., Logan, Utah	1962
†Foster, John H(awley), P. O. Box 204, Wayne, Pa.	1952
*Foster, Thomas Henry, Monument Rd., Bennington, Vt.	1950
Foster, William L(uther), Richmond High School, Richmond, Mo.	1961
Fox, Adrian C., Box 521, Ben Franklin Station, Washington, D. C. 20044	1937
Fox, Glen A., Box 783, Kindersley, Saskatchewan, Canada	1960
Fox, Robert P., 429 Newport Ave., Wollaston 70, Mass.	1953
Francis, George R(eid), 382 Hillsdale Ave., E., Toronto 12, Ont., Canada	1949
Franks, Edwin C(lark), 91 West 11th Ave., Apt. B, Columbus, Ohio 43201	1964
Frazier, Frank P(earsall), 424 Highland Ave., Upper Montclair, N. J.	1953
Frederickson, Leigh, Dept. of Zoology, Iowa State Univ., Ames, Iowa	1963
Frederickson, Richard William, Dept. of Biology, The City College, 139th St. and Convent Ave., New York 31, N. Y.	1947
Freeman, William, 1603 Wagon Wheel Lane, Lansing, Mich.	1959
Fretwell, Stephen DeWitt, 1219 Careton Drive, Raleigh, N. C.	1958
Freund, Rudolf, R.D. 2, Collegetown, Pa.	1963
Frevel, Kurt, 1207 West Park Drive, Midland, Mich.	1963
Fries, Waldemar Hans, 86 Cushing St., Providence 6, R. I.	1947
Fritz, Arnold W(arren), 7210 Hoverland N.E., Massillon, Ohio	1964
Frohling, Robert C(harles), Ludlow Ave., Belle Meade, N. J.	1949
Frost, Herbert Hamilton, Dept. of Zoology & Entomology, Brigham Young Univ., Provo, Utah	1941
Frye, O. Earle, Jr., Game & Freshwater Fish Commission, Tallahassee, Fla.	1940
Fuller, A(nne) Verne, Western Michigan Univ., Kalamazoo, Mich.	1952
Fuller, Margaret, 236 Jefferson Rd., Newark, Ohio	1960
*Fuller, William A., Woodcrest Parkway, Rockford, Ill.	1961
Funderburg, John B(roadus), Jr., Dept. of Biology, Florida Southern College, Lakeland, Fla.	1959
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Furniss, W. Todd, Office of the Dean, Univ. of Hawaii, College of Arts & Sciences, 1801 University Ave., Honolulu, Hawaii 96822	1961
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Gadacz, Thomas R., 3501 Lafayette, St. Louis, Mo.	1961
Gaede, Adela, 3903 East 176 St., Cleveland 28, Ohio	1951
Galley, Janet, Route 4, Box 98A, Norman, Okla. 73069	1964
Galati, Robert, 638 West Ave., Fullerton, Calif.	1955
*Galley, John E(dmond), P. O. Box 237, Midland, Texas	1945
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†Gammell, R(ober) T(theodore), Kenmare, N. D.	1943
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Garrey, Mrs. Walter E., 39 Orchard Ave., Waban 68, Mass.	1959
Garrity, Devin A(dair), 682 Forest Ave., Rye, N. Y.	1949
Gasche, Mrs. Arthur S., 1297 N.E. 103 St., Miami Shores 38, Fla.	1956
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Gates, Doris (Berta), Nebraska State Teachers College, Chadron, Neb.	1948
Gates, John M., Box D, Wisconsin Conservation Dept., Horicon, Wisc.	1957

Gaymer, Rosemary D(esirée), Apt. 13, 55 Erskine Ave., Toronto 12, Ont., Canada	1964
Gehman, Richard, 214 Main St., Venice, Calif.	1959
Gensch, Robert Henry, 3018 Pillsbury Ave., S., Apt. 101, Minneapolis, Minn.	55408 1939
George, John L(othar), Pennsylvania State Univ., School of Forestry, University Park, Pa.	16802 1939
George, William G(ordon), Dept. of Zoology, Southern Illinois Univ., Carbondale, Ill.	1957
Gerstell, Richard, 1046 Buchanan Ave., Lancaster, Pa.	1939
Gibbins, G(areth) W(illiam), 2978 Murray Ave., Norfolk 18, Va.	1961
Gier, Herschel T(homas), Dept. of Zoology, Kansas State College, Manhattan, Kan.	1937
Gifford, Harold, 3636 Burt, Omaha 3, Neb.	1936
Gilbert, Albert E(arl), 2231 N. Menard Ave., Chicago 39, Ill.	1957
Gill, Frank B., 493 Warwick Ave., West Englewood, N. J.	1960
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Gilreath, M. Ruth, Route 1, Box 115A, Travelers Rest, S. C.	29690 1952
Giltz, Maurice L(eroy), Dept. of Zoology & Entomology, 1735 Neil Ave., Ohio State Univ., Columbus 10, Ohio	1963
Glass, Mrs. William P., Box 186, Levy Station, North Little Rock, Ark.	1964
Glenny, Fred H(arry), Dept. of Biology, Fairleigh Dickinson Univ., Madison, N. J.	1958
Glick, Bruce, Box 185, State College, Miss.	1949
Glover, Fred A(rthur), Colorado Cooperative Wildlife Research Unit, Colorado State Univ., 243 Forestry Bldg., Fort Collins, Colo.	1947
Gobeil, Robert Eugene, Cole Rd., Biddeford, Me.	1963
Gochfeld, Michael, R.F.D. 1, Lexington Ave., Mohegan Lake, N. Y.	1961
Goebel, Herman J(ohn), 78-52 80th St., Brooklyn 27, N. Y.	1946
Goll, Peter, 4 East 88th St., New York 28, N. Y.	1963
Good, Ernest E(ugene), Dept. of Zoology & Entomology, Ohio State Univ., Columbus 10, Ohio	1937
Goodman, John David, Dept. of Biology, Univ. of Redlands, Redlands, Calif.	1944
Goodpasture, Mrs. Ernest W., 3407 Hopkins Lane, Nashville 12, Tenn.	1950
Goodridge, Alan G(ardner), 3421 Edgewood, Pittsfield Village, Ann Arbor, Mich.	1958
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Goodwin, Margaret S(hippen), 38 Oakburne Rd., West Chester, Pa.	1953
Gorton, Ralph J(ames), Box 211, 322 North Center St., Beulah, Mich.	1959
Goslin, Charles R(ussell), 726 East King St., Lancaster, Ohio	1940
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Grace, Mrs. Charles J., Wells Rd., Cheshire, Mass.	1959
Grant, Cleveland P(utnam), 245 Davis St., Mineral Point, Wisc.	1928
Grant, Richard, 111 East 9th St., Morris, Minn.	1961
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Green, Mrs. Janet Curtis, 1923 Greysolon Rd., Duluth, Minn.	1960
Green, N(orman) Bayard, Dept. of Zoology, Marshall Univ., Huntington 1, W. Va.	1943
Greene, Ruth A(lders), 2 Cherry St., Lakewood, N. J.	1963
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Greenwalt, Leon, 911 South Seventh St., Goshen, Ind.	1953
Gregory, Stephen S(trong), Box N, Winnetka, Ill.	1922
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Greussing, Mrs. Mary A., Route 1, Box 189, Mazomanie, Wisc.	1964
Griffee, W(illet) E., 510 Yeon Bldg., Portland 4, Ore.	1947
Griffin, Daude N., Dept. of Biology, East Texas State College, East Texas Station, Commerce, Texas	1958
Griffin, William W(elcome), 1225 Pine Ridge Rd., N.E., Atlanta 5, Ga.	1946
Griffith, Roger Braden, 547 Prindle St., Sharon, Pa.	1962
Grimes, Robert L., Box 154, Clarington, Ohio	1964
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Groesbeck, William M(aynard), 376 Seneca Rd., Hornell, N. Y.	1947

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Grube, G(eorge) E(dward), Science Dept., State Teachers College, Lock Haven, Pa.	1948
Gruenewald, Robert Franklin, Clifton, Ill.	1948
Grundset, E(dgar) O(luf), Biology Dept., Southern Missionary College, College- dale, Tenn.	1963
Guhl, A(lphaeus) M(atthew), Dept. of Zoology, Kansas State Univ., Manhattan, Kan. 66504	1948
Guillauden, Robert L., Professional Bldg., Park Ave. & Little Falls Rd., Falls Church, Va.	1956
Gullion, Gordon W(right), Forest Research Center, Univ. of Minnesota, Cloquet, Minn. 55720	1947
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Gunderson, Harvey Lorraine, Museum of Natural History, Univ. of Minnesota, Minneapolis 14, Minn.	1941
Gunn, W(illiam) W(alker) H(amilton), 455 Meadow Wood Rd., Clarkson, Ont., Canada	1945
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Haas, Richard A., 421 Sellery Hall, Madison, Wisc.	1964
Hacker, Carl S(idney), Dept. of Biology, Rice Univ., Houston 1, Texas	1962
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Haffner, Annette Petrina, 1704 Tremont St., Cedar Falls, Iowa	1961
*Hagar, Joseph A., Pleasant St., Marshfield Hills, Mass.	1949
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Halberg, Mrs. Henry N., 5809 North Country Club Blvd., Little Rock, Ark.	1953
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Hallauer, James E(dward), 338 North Hill Circle, Rochester, Mich.	1958
†Haller, Karl W., 1114 Grant Drive, Sherman, Texas	1934
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Hamilton, Robert B(ruce), 606 The Alameda, Berkeley, Calif.	1961
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Hamon, J. Hill, Dept. of Zoology, Indiana State College, Terre Haute, Ind.	1958
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Hancock, David, Zoology Dept., Univ. of British Columbia, Vancouver, B. C., Canada	1962
Handley, Charles O(vertton), 6571 Roosevelt Ave., S.E., Charleston 4, W. Va.	1925
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Haverschmidt, F(rancois), P. O. Box 644, Paramaribo, Surinam (Dutch Guiana), S. A.	1946
Hawksley, Oscar, Biology Dept., Central Missouri State College, Warrensburg, Mo.	1948
Haycraft, George J., 121 West Chestnut St., Leitchfield, Ky.	1963
Hays, Herbert E., 209 Queen St., Shippensburg, Pa. 17257	1956
Hearne, Mrs. Katherine Marston, 1029 Delaware St., Shreveport, La. 71106	1960
Heatwole, Harold, Dept. of Biology, Univ. of Puerto Rico, Rio Piedras, P. R. 00931	1963
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*Hefley, Harold M(artin), Panhandle A. & M. College, Goodwell, Okla.	1942
Heimendinger, Mary A(nne), Section of Birds, Carnegie Museum, Pittsburgh 13, Pa.	1955
Heig, Vincent A(lan), Minnesota Museum of Natural History, Minneapolis, Minn. 55455	1964
Hein, Dale, Wildlife Research Unit, Science Bldg., Iowa State Univ., Ames, Iowa	1963
Heintzelman, Donald S., 629 Green St., Allentown, Pa.	1960
Heiser, J(oseph) M(atthew), Jr., 1724 Kipling St., Houston 6, Texas	1939
Helbert, Hollen G(arher), 338 Monticello Ave., Harrisonburg, Va.	1952
†Helleiner, Frederick M., 86 Wood St., Kirkland Lake, Ont., Canada	1952
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Henderson, James C., P. O. Box 1532, Midland, Texas	1961
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Hensley, M(arvin) Max, Dept. of Zoology, Michigan State Univ., East Lansing, Mich.	1947
Henwood, Mrs. Ethel May, 306 West Michigan, Urbana, Ill.	1941
Herbert, Mrs. Richard A., Middleton, Del.	1949
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Hewitt, Oliver H., Fernow Hall, Cornell Univ., Ithaca, N. Y.	1943
Heye, Paul L., Dept. of Biology, Southeast Missouri State College, Cape Girardeau, Mo.	1961
Heywood, Philip B., 63 Beechmont St., Worcester 9, Mass.	1959
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Hibbard, Edmund Arthur, R.D. 1, St. Cloud, Minn.	1950
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Hicks, Thomas W(illiam), Dept. of English, Georgia State College, 33 Gilmer St., S.E., Atlanta 3, Ga.	1949
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Hinton, (William) Fred(eric), 308 Warren St., Greensboro, N. C.	1963
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Hostetter, D(avid) Ralph, Eastern Mennonite College, Harrisonburg, Va.	1937
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James, P(ercival) H(enry) R., Dept. of Psychology, Dalhousie Univ., Halifax, N. S., Canada	1958
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Jenkinson, Mary Caroline, Haywood County Public Library, Waynesville, N. C.	1952
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Johnson, J(ohn) C(hristopher), Jr., Biology Dept., Kansas State College, Pitts- burg, Kan.	1955
Johnson, Ned K., Museum of Vertebrate Zoology, Univ. of California, Berkeley 4, Calif.	1962
Johnson, Richard E., Zoology Dept., Montana State Univ., Missoula, Mont.	1962
Johnson, Robert A., R.D. 1, Bloomington, Ind.	1930
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Keller, Charles Edward, 3905 South Olney, Indianapolis 27, Ind.	1962
Kelly, Neil Thomas, 3681 Forest Hill Drive, Bloomfield Hills, Mich. 48013	1951
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Kenaga, Eugene E., 3309 Isabella Rd., Midland, Mich.	1949
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Kenyon, Karl W(alton), U.S. Fish & Wildlife Service, Branch of Wildlife Re- search, N.A.S., Sand Point, Seattle 15, Wash.	1948
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Kildow, T(homas) Monroe, Box 910, Tiffin, Ohio	1948
Kilgore, Delbert L(yle), Jr., 505 South Second St., Dodge City, Kan.	1964
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Killpack, Merlin L(eo), 1726 East 24th St., Ogden, Utah 84403	1950
King, John Arthur, Dept. of Zoology, Michigan State Univ., East Lansing, Mich.	1947
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Kleen, Richard L., St. Michaels, Md.	1955
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Klinstra, W(illard) D(avid), Cooperative Wildlife Research Lab., Southern Illinois Univ., Carbondale, Ill.	1958
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Knight, Charles Harold, 20700 Gladstone Rd., Warrensville Heights, Cleveland 22, Ohio	1959
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Knorr, Owen A(ibert), 730 Evergreen, Boulder, Colo.	1954
Koerker, Richard M(orton), 4103 Dyckman Rd., Midland, Mich.	1961
Kolb, C(harles) Haven, Jr., 5915 Meadow Rd., Baltimore 6, Md.	1937
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Kosaka, Ernest F(utoshi), P. O. Box 142, Kamuela, Hawaii	1961
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Kozlowski, Janet L., Route 1, Washburn, Wis.	1963
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Kraus, Douglas L(awrence), P. O. Box 57, Kingston, R. I.	1942
Krause, Herbert, Dept. of English, Augustana College, Sioux Falls, S. D.	1953
Krebs, Mrs. R. W., 98 Druid Hill Rd., Summit, N. J.	1946
Krieg, David C., 1 Amm St., Bradford, Pa.	1959
Krug, Howard H(enry), Chesley, Ont., Canada	1944
Krum, Kenneth, 37 Woolnough Ave., Battle Creek, Mich.	1964
Kuenzli, Walter A(rthur), Cleveland Zoological Park, Brookside Park, Cleveland 9, Ohio	1963
Kuhn, Kenneth H(erbert), 4503 North 64th St., Milwaukee 18, Wis.	1949
Kuitert, Louis Cornelius, Agricultural Experiment Sta., Univ. of Florida, Gaines- ville, Fla.	1938
Kunkle, Donald E., Box 121, Port Norris, N. J.	1956
Kuyava, Gary C(lement), U.S.D.A., ARS, PQD, 507 Federal Bldg., 121 Ellicott St., Buffalo 3, N. Y.	1959
Labisky, Ronald F., Sect. of Wildlife Res., Natural History Survey, Natural Re- sources Bldg., Urbana, Ill.	1956
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Laity, Mrs. Clifford, 2923 Sanders St., Butte, Mont.	1963
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Lancaster, Christine, 90 Appian Way, Keene, N. H.	1959
Lancaster, Douglas A(lan), Laboratory of Ornithology, Cornell Univ., Ithaca, N. Y.	1949
Land, Hugh Colman, Dept. of Biological Sciences, Northwestern State College, Natchitoches, La.	1950
Lanyon, Wesley E(dwin), American Museum of Natural History, New York, N. Y.	1955
Laperle, Marcel, P. O. Box 543, Sanatorium St., Gaspé, P.Q., Canada	1964
Larson, Harriet E., R.R. 2, Howard City, Mich. 49329	1963
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Leavitt, Benjamin Burton, Dept. of Biology, Univ. of Florida, Gainesville, Fla.	1947
Leberman, Robert C(harles), R.D. 1, Saeger Hill, Meadville, Pa.	1958
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Lees-Smith, D(erer) T(hayer), 75 School Lane, Addlestone near Weybridge, Surrey, England	1958
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Leffler, Sanford R(oss), 1398 Geneva St., San Carlos, Calif.	1964
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Lehman, William G(irwin), U.S. Naval Dental Clinic, Marine Corps Base, Camp Pendleton, Calif. 92055	1964
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Lewis, C. Bernard, The Science Museum Institute of Jamaica, Kingston, Jamaica, B. W. I.	1947
Lewis, Harrison F(lint), Sable River, Nova Scotia, Canada	1939
Lewis, Mary (Evelyn), 941 St. Philip St., New Orleans 16, La.	1957

Lewis, Thomas J., Jr., 2730 Jersey Ridge Rd., Davenport, Iowa 52803	1956
Lewis, William O(wen), Box 22, Ivy, Va.	1953
Libby, Mark L., New Harbor, Me.	1963
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Littlefield, Carroll Dwayne, Route 1, Friona, Texas	1960
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Lloyd, C(lark) K., 11 North Elm St., Oxford, Ohio	1925
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Lukes, Roy J(oseph), Box 114, Algoma, Wisc. 51201	1964
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Maxwell, Terry Clyde, 526 East 25½ St., San Angelo, Texas	1964
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Mayfield, G(eorge) R(adford), 414 Vanderbilt Place, Nashville 12, Tenn.	1917
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McAlister, J(ames) Don, 1723 Cardiff Rd., Columbus 21, Ohio	1949
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McBee, Mrs. Lena G(riffin), Wyatt, W. Va.	1957
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McCaskie, R(eginald) Guy, P. O. Box 241, Tahoe City, Calif.	1962
McClesney, Donald S., 207 Wynthrop Rd., (Solvay), Syracuse, N. Y. 13209	1963
McCleary, Ralph, 33 Lake Promenade, Toronto 14, Ont., Canada	1962
*McClure, H(owe) Elliott, Migratory Animals Pathological Survey, APO 323, Box 6119, San Francisco, Calif.	1942
McCormick, John M., 1827 Richards Rd., Toledo 7, Ohio	1951
McCosh, Gladys K., Beaver Dam Rd., R.F.D., Plymouth, Mass.	1957
McCoy, Mrs. Paul K., 302 East 6th St., Stuttgart, Ark.	1962
McCue, Earl Newlon, Box 104, Morgantown, W. Va.	1941
McCullagh, E(rnest) Perry, 2020 East 93rd St., Cleveland, Ohio	1937
McCullough, C(lyde) Robert, North Cheshire, Burton, Ohio	1953
McDonald, Malcom E., Bear River Research Station, P. O. Box 459, Brigham City, Utah	1936
McEntee, Mrs. Howard G., 940 Fairfield Ave., Ridgewood, N. J.	1948
McFarlane, Robert W(illiam), Dept. of Biology, Univ. of Florida, Gainesville, Fla.	1959
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McIlvain, John F(olwell), 519 East Penn Crest Drive, Langhorne, Pa.	1962
McKay, George M., 48 West 27th Ave., Vancouver 10, B. C., Canada	1963
McKinley, Daniel L(awson), Dept. of Biology, Lake Erie College, Painesville, Ohio	1948

McKinley, George G(ael), P. O. Box 468, Glasgow, Ky.	1945
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McKnight, Edwin T(hor), 5038 Park Place, Washington 16, D. C.	1936
McLane, Jack M(ilton), 1418 Washington St., Burlington, Iowa	1963
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Meanley, Brooke, Patuxent Research Center, Laurel, Md.	1950
Medina, Don(ald) R(aul), Museum of Vertebrate Zoology, Univ. of California, Berkeley 4, Calif.	1955
Mehner, John F., Mary Baldwin College, Staunton, Va. 24401	1949
Mellinger, E(nos) O(ren), Savannah National Wildlife Refuge, Route 1, Hardeeville, S. C.	1939
†Melone, Theodore G(ardner), Geology Library, Pillsbury Hall, Univ. of Minnesota, Minneapolis 14, Minn.	1947
Meltvedt, Burton W., Paullina, Iowa	1930
Mendinhall, Mrs. Dorothy A., "Damsite," R.D. 2, Chestertown, Md.	1964
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Menhennet, Mrs. William, 221 North Macdonald St., Mesa, Ariz. 85201	1961
Menninger, Phil B., 1930 Webster, Topeka, Kan. 66604	1949
Meritt, James Kirkland, 809 Saratoga Terrace, Whitman Square, Blackwood P. O., N. J.	1944
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Mery, Mrs. Sophia C., 345 Boston Ave. S.E., Bartlesville, Okla.	1955
Messersmith, Donald Howard, Dept. of Entomology, Univ. of Maryland, College Park, Md. 20742	1961
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Mewalt, L(eonard) R(ichard), Dept. of Natural Sciences, San Jose State College, San Jose 14, Calif.	1947
Meyer, Henry, Route 3, Box 206, Whitewater, Wisc.	1939
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Michaud, Howard H(enry), 301 East Stadium Ave., West Lafayette, Ind.	1938
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Miley, Theodore R., 18579 Edinborough, Detroit, Mich. 48219	1960
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Miller, Irene E., 670 N. St., Sacramento, Calif.	1955
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Miller, Lyle (DeVerne), 5795 Mill Creek Blvd., Youngstown 12, Ohio	1947
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Minot, John Granville, 244 Bratte St., Cambridge, Mass.	1957
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Mockford, Edward (Lee), Dept. of Biological Sciences, Illinois State Univ., Normal, Ill.	1946

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Monson, Gale, 5403 Inverchapel Rd., Springfield, Va.	1933
Montgomery, G(eorge) H(ugh), 4689 Westmount Ave., Westmount 6, P.Q., Canada	1964
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Moody, Frank B., 862 Spruce Ave., West Chester, Pa.	1962
Moody, Marjorie J., 1380 Veteran Ave., Apt. 1, Los Angeles 24, Calif.	1957
Moore, Betty Jean, 5944 Evanston Ave., Indianapolis, Ind. 46220	1961
Moore, Mrs. Myriam P(utnam), 9 Riverview Place, Lynchburg, Va. 24503	1964
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Morgan, Allen H., 114 Cochituate Rd., Wayland, Mass.	1958
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Morman, Robert H., 719 East Filer, Ludington, Mich. 49431	1964
Morrisette, Mrs. Mary Frances, Severn Point, Norfolk 5, Va.	1960
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Morton, Eugene Siller, R.D. 1, Hillcrest Rd., Ithaca, N. Y.	1959
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Mueller, Helmut Charles, Dept. of Zoology, Birge Hall, Univ. of Wisconsin, Madison, Wisc.	1949
Muhlbach, W(alt) L(auritz), 2013 Vine St., Berkeley 9, Calif.	1951
Mumford, Russell E(ugene), Dept. of Forestry and Conservation, Purdue Univ., West Lafayette, Ind.	1949
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Murray, George S(eldon), 227 North Hollywood Ave., Daytona Beach, Fla.	1962
Murray, J(oseph) J(ames), 6 Jordan St., Lexington, Va.	1931
Murray, Robert Charles, Dept. of Zoology & Entomology, The Ohio State Univ., 1735 Neil Ave., Columbus, Ohio	1964
Musselman, T(homas) E(dgar), 124 South 24th St., Quincy, Ill.	1940
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Nero, Robert William, Univ. of Saskatchewan, Regina Campus, Regina, Sask., Canada	1947
Nessle, James P., R.F.D. 1, Waterville, Ohio	1936
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New, John G., Dept. of Science, State University Teachers College, Oneonta, N. Y.	1946

Newberry, Andrew Todd, Hopkins Marine Station, Pacific Grove, Calif.	1952
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Newman, Robert J(ames), 655 Ursuline Drive, Baton Rouge, La.	1950
Nice, L(eonard) B., 5725 Harper Ave., Chicago 37, Ill.	1932
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Nielsen, Mrs. B. W., Route 1, Box 808, Kauffman Ave., Red Bluff, Calif.	1945
Niergarth, Grover G., 215 Florence, Highland Park, Mich.	1962
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Nollen, Carl James, 134 North Roosevelt, Topeka, Kan. 66606	1964
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Norman, James L(ee), 502 North 14th St., Muskogee, Okla.	1948
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Norris, Robert Allen, Tall Timbers Research Inc., Route 1, Box 112, Tallahassee, Fla.	1941
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*North, George W(ebster), 249 Charlton Ave. West, Hamilton, Ont., Canada	1941
†Novaes, Fernando C(osta), Museu Paraense Emilio Goeldi, Caixa Postal 399, Belem, Para, Brasil	1953
Novy, Frank O., 420 South Jefferson Ave., Saginaw, Mich.	1963
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Oberg, John C., 1608 Elm St., Rockford, Ill.	1963
O'Callaghan, Terence C., Maromala R.D., Bay of Islands, Northland, New Zealand	1954
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Olson, James G., 205 Marion Apts., 1263 Oak St., Eugene, Ore.	1960
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O'Neil, Norah Selby, 1311 Bonham St., Commerce, Texas	1949
O'Neill, John P(atton), 10723 Beinhorn Rd., Houston 24, Texas	1962
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Overing, Robert, 119 Willow Lane, Decatur, Ga.	1930
Overmire, Thomas G(ordon), 1523 Norfolk, Falls Church, Va.	1962
Owen, J(ames) B(unyan), 2930 North Hills Blvd., Knoxville, Tenn. 37917	1960
Owre, Oscar T., Dept. of Zoology, Univ. of Miami, Coral Gables, Fla.	1935
Packard, Gary C., Museum of Natural History, Univ. of Kansas, Lawrence, Kan.	1960
Palmer, Ralph S(imon), New York State Museum, State Educational Bldg., Albany, N. Y. 12204	1934
Palmquist, Clarence O(scar), 834 Windsor Rd., Glenview, Ill.	1945
Pangborn, Mark W(ite), 25 East 56th St., Indianapolis, Ind. 46220	1948
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Parker, William Edward, 444 South Main St., Hightstown, N. J.	1962
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Parks, Richard Anthony, 2303 Pembroke Place N.E., Atlanta 24, Ga.	1942
Parmelee, David F(reeland), Dept. of Biology, Kansas State Teachers College, Emporia, Kan.	1949
Parmeter, Benjamin D(avid), Armstrong Woods Rd., Guerneville, Calif.	1957
Parnell, James, Zoology Dept., North Carolina State College, Raleigh, N. C.	1963
Partridge, William H., Belgrano 363, Caseros B. A., Argentina, S. A.	1953

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Patterson, Joseph Richard, 3411 Picwood Rd., Tampa 12, Fla. 1962
Paul, Edith, 456 Colerick St., Fort Wayne, Ind. 1963
Paulson, Dennis R., Dept. of Zoology, Univ. of Miami, Coral Gables, Fla. 1959
Payne, Robert B(erkeley), Museum of Vertebrate Zoology, Univ. of California,
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Paynter, Raymond A(ndrew), Jr., Museum of Comparative Zoology, Harvard Univ.,
Cambridge 38, Mass. 1946
Peakall, David B., Upstate Medical Center, Dept. of Pharmacology, State Univ.
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*Pearson, Mrs. Carl E., 632 North Stone Ave., LaGrange Park, Ill. 1954
Peelle, Miles L., 1039 College St., Adrian, Mich. 1940
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Peffer, Mrs. Thomas A., 49 West Depot St., Hellertown, Pa. 1954
Penner, Lawrence R., Dept. of Zoology & Entomology, Univ. of Connecticut,
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Penney, Richard Lee, Dept. of Pathology, Johns Hopkins Univ., 615 North Wolfe
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Peterson, Alfred, Box 73, Brandt, S. D. 1931
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Petts, Mrs. Thomas A., 16201 Beaverland, Detroit 19, Mich. 1957
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Phillips, Richard S(tuart), 834 Liberty St., Findlay, Ohio 1944
Pierce, Fred J(ohn), Winthrop, Iowa 50682 1947
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Billing, Norman B(odén), 3 Cherry Lane, Westfield, N. J. 1960
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Pittman, James Allen, Jr., 2770 Smyer Circle, Birmingham 16, Ala. 1945
Pladies, Richard G(eorge), 417 West Main St., Whitewater, Wisc. 1964
Platt, Dwight R(ich), R.F.D. 2, Newton, Kan. 1959
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Poole, Earl L., 509 Sunset Rd., West Reading, Pa. 1960
Poole, Frederick P., 17 North Girard St., Woodbury, N. J. 1959
Poor, Hustace Hubbard, 36 Baldwin St., Hudson, Ohio 1935
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Porter, Richard Dee, 130 South Prince, Whitewater, Wisc. 1950
Porter, T(homas) Wayne, Dept. of Zoology, Michigan State Univ., East Lansing,
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Potter, N(athan) S. III, 58 Mariner's Court, Centerport, L. I., N. Y. 11721 1959
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Powell, Leon W., Jr., 10110 Grove St., Omaha, Neb. 1960
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Prager, Robert G., 2312 East Lake Shore Drive, Springfield, Ill. 1961
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Prescott, Kenneth Wade, State Museum of New Jersey, Trenton, N. J. 1946
Preston, Frank W(illiam), Box 49, Meridian Station, Butler, Pa. 1948
Preston, William C(onverse), Apt. 815, 1439 University Terrace, Ann Arbor, Mich. 1964

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Prior, Gertrude, Sweet Briar, Va.	1956
Prosser, Albert L(aurence), Box 98, 116 Main St., Springvale, Me.	1955
Puett, May Wilson, 1811 East North St., P. O. Box 1395, Greenville, S. C.	1959
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Puleston, Dennis, Brookhaven National Laboratory, Upton, N. Y.	1955
Pulich, Warren M(ark), 2027 Rosebud, Irving, Texas	1963
Putnam, Loren Smith, Dept. of Zoology, Ohio State Univ., Columbus 10, Ohio	1942
Putnam, William L(oyd), Research Dept., Canada Dept. of Agriculture, Vineland Station, Ont., Canada	1945
Quay, Thomas L., Dept. of Zoology, North Carolina State College, Raleigh, N. C.	1939
Quay, W(ilbur) B(rooks), Dept. of Zoology, Univ. of California, Berkeley 4, Calif.	1949
Quilliam, Mrs. H(elen) R(ose), R.R. 1, Kingston, Ont., Canada	1953
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Radabaugh, Bruce E., 1208 East Twelve Mile Rd., Royal Oak, Mich.	1963
Radke, Mrs. Eleanor L., 15255 Peach Hill Rd., Saratoga, Calif. 95070	1959
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Rahe, Carl W., 9005 Tioga Ave., Cleveland 5, Ohio	1931
Raible, Frank Roch, St. Fidelis Seminary, Herman, Pa.	1958
Raikow, Robert, 5271 Florida Ave., Detroit, Mich. 48210	1964
Raitt, Ralph J., Dept. of Biology, New Mexico State Univ., University Park, N. M.	1961
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Rand, Austin L., Chicago Natural History Museum, Roosevelt Rd. & Lake Shore Drive, Chicago 5, Ill.	1950
Randall, Clarence B(elden), 30 West Monroe St., Chicago 3, Ill.	1949
Randall, N(orman), 11 Homstead Crescent, Chatham, Ont., Canada	1964
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Randle, Worth S., 1707 Mears Ave., Apt. 1, Cincinnati 30, Ohio	1949
Rankin, Henry Ashby, Jr., Box 803, Fayetteville, N. C.	1960
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Rees, Earl Douglas, Dept. of Medicine, Univ. of Kentucky, Lexington, Ky.	1946
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Reynard, George B., 105 Midway, Riverton, N. J.	1950
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Richards, Tudor, Dublin, N. H.	1951
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Richardson, James Ingram, R.D., Mendham, N. J. 07945	1964

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Robertson, William B., Jr., 17300 S.W. 300 St., Homestead, Fla.	1962
Robins, Charles Richard, The Marine Lab., Univ. of Miami, Virginia Key, Miami 49, Fla.	1949
Robinson, Mrs. James C(arr), Route 1, Box 91, Brownsboro, Ala.	1959
Robinson, Peter J., 333 Crossman St., Jamestown, N. Y.	1956
Robinson, Thane S., Dept. of Biology, Univ. of Louisville, Louisville 8, Ky.	1952
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Rogers, John P., Gaylord Memorial Laboratory, Puxico, Mo.	1956
Rogers, Kay T(rowbridge), Univ. of California Medical Center, San Francisco, Calif. 94122	1952
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Romaine, Mrs. Lawrence B., Weathercock House, Middleboro, Mass.	1958
Roosa, Dean Melvin, Box 120, Route 1, Lehigh, Iowa	1964
†Root, Oscar Mitchell, Brooks School, North Andover, Mass.	1940
*Rorimer, Mrs. J. M., 3134 East Overlook Rd., Cleveland Heights 18, Ohio	1938
Rosche, Richard Carl, 48 Dartmouth Ave., Buffalo 15, N. Y.	1953
†Rositzky, Simon, 1605 Ashland Blvd., St. Joseph, Mo.	1953
*Ross, Charles Chandler, 710 Wolcott Drive, Philadelphia, Pa. 19118	1937
Ross, Hollis T., West Lawn, Lewisburg, Pa.	1956
†Ross, Mrs. Mary (Reeve) Spear, Route 1, Box 940, Marquette, Mich.	1953
Ross, Raymond Dudley, East Tennis Ave., Ambler, Pa.	1959
Rowe, William, P. O. Box 568, Brandenburg, Ky.	1962
†Rudd, Clayton G(lass), 315 Medical Arts Bldg., Minneapolis 2, Minn.	1944
Ruder, Clara Louise, 520 Franklin St., Wausau, Wis. 54401	1954
Rusk, Margaret S., 805 Comstock Ave., Apt. 10, Syracuse 10, N. Y.	1963
Russell, Stephen M(ims), Dept. of Biology, Louisiana State Univ., Lake Front, New Orleans 22, La.	1952
Rustad, Orwin A., 1134 East Division St., Route 1, Faribault, Minn.	1957
Rutter, Russell James, Box 794, Huntsville, Ont., Canada	1950
Ryder, Ronald A., College of Forestry, Colorado State Univ., Fort Collins, Colo. 80521	1952
Ryel, Lawrence (Atwell), U.S. 16 W., Box 195, Route 4, Lansing, Mich.	1951
Rylander, Michael K., Dept. of Zoology, Tulane Univ., New Orleans, La. 70118	1964
†Sabin, Walton B., 652 Kenwood Ave., Slingerlands, N. Y.	1945
Sadler, Douglas (Campbell), R.D. 2, Ida, Ont., Canada	1958
Salman, Dominic Henry, 2765 St. Catherine Rd., Montreal 26, P.Q., Canada	1959
Sanborn, Alvah W., Pleasant Valley Sanctuary, Lenox, Mass.	1951

Sands, James L(ester), 2917 Franciscan, N.E., Albuquerque, N. M.	1959
Sather, Kenneth L., Round Lake, Minn.	1959
Satter, John M., 7254 North Tuxedo St., Indianapolis 40, Ind.	1955
Sauer, Gordon C(henoweth), 6400 Prospect, Kansas City 32, Mo.	1949
Saugstad, N(els) Stanley, Route 4, Minot, N. D.	1939
Saunders, Aretas A(ndrews), P. O. Box 141, Canaan, Conn.	1934
Saunders, George B(radford), Box 131, Gainesville, Fla.	1926
*Saunders, Walter Grier, 21 Andrews Rd., Malvern, Pa. 19355	1962
*Sawyer, Dorothy, 419 Euclid Place, Syracuse 8, N. Y.	1937
Schaffer, Catherine, 1202 West Roscoe, Chicago 13, Ill.	1958
Schaffer, Elizabeth D., 8 Beechdale Rd., Baltimore 10, Md.	1960
Scharrer, Edward M(artin), 8590 Maple Rd., Route 1, Bridgeport, Mich.	1964
Scheetz, Mrs. Francis H(arley), 15 West Old Gulph Rd., Gladwyne, Pa.	1964
Scheider, Francis G., 6748 2nd St. N.W., Washington 12, D. C.	1960
Schemnitz, Sanford David, Deering Hall, Univ. of Maine, Orono, Me.	1961
Scherer, Lloyd E., Jr., Box 145, Lutsen, Minn.	1958
Schlonga, A(ndrew) M(atthew), 905 Locust St., Kansas City, Mo. 64106	1952
Schmid, John C., 24 Bowman Drive, Greenwich, Conn.	1958
Schneider, Evelyn, 2207 Alta Ave., Louisville 5, Ky.	1935
Schnell, Gary D(ean), 631 South Harlan Ave., Evansville 14, Ind.	1961
†Schmitzer, Albert, 155 Wild Hedge Lane, Mountainside, N. J.	1953
†Schorger, A(rlie) W(illiam), 168 North Prospect Ave., Madison, Wisc.	1927
†Schramm, R. M., 111 Park Ave., Lake Charles, La. 70601	1960
Schreiber, (Edwin) Dan(iel), Jr., New Mexico Highland Univ., Las Vegas, N. M. 87701	1961
Schreiber, Ralph Walter, 1471 Cleveland Rd., Wooster, Ohio	1964
†Schultz, Albert B(igelow), Jr., Penryn Park, Port Hope, Ont., Canada	1954
Schwab, Larry, Box 1065, West Virginia Univ., Medical Center, Morgantown, W. Va.	1963
Schwartz, Charles Walsh, 131 Forest Hill, Jefferson City, Mo. 65101	1950
†Schwartz, Paul (Alvin), Apartado 4640, Chacao, Estado Miranda (Caracas), Venezuela	1952
Schwilling, Marvin D., Route 1, Cheyenne Bottoms Refuge, Great Bend, Kan.	1951
Sciple, George W., 1549 29th Ave., Greeley, Colo. 80631	1951
Scotland, Minnie B(rink), 42 Continental Ave., Cohoes, N. Y. 12047	1938
Scott, D. M., Dept. of Zoology, Univ. of Western Ontario, London, Ont., Canada	1950
*Scott, Frederic R(oberth), 115 Kennondale Lane, Richmond 26, Va.	1947
Scott, Peter, The New Grounds, Slimbridge, Gloucestershire, England	1947
†Scott, Thomas G(eorge), Dept. of Fish & Game Management, Corvallis, Ore.	1936
Scott, W(alter) E(dwin), 1721 Hickory Drive, Madison 5, Wisc.	1938
Seaman, George Albert, P. O. Box 474, Christiansted, St. Croix, V. I.	1950
†Seeber, Edward L(incoln), 127 Fayette Ave., Kenmore 23, N. Y.	1944
Sefton, Mrs. Pennington, P. O. Box 865, Altamonte Springs, Fla.	1964
Sehl, Robert H., 1062 Welsh Rd., Philadelphia 15, Pa.	1962
Seibert, Henri C., Ohio Univ., Athens, Ohio	1941
Seibert, Robert F(rederick), 17 Canoe Brook Rd., Short Hills, N. J. 07078	1954
Semenov-Tyan-Shanskii, O. I., CCCP, Murmansk Oblast, Apatit, Lapland Zapoved- nik, U.S.S.R.	1964
Serhousek, Lillian, 1226 Second St. S.W., Cedar Rapids, Iowa	1935
Shaftesbury, Archie D., 315 Tate St., Greensboro, N. C.	1930
Shannon, Bernice, 3021 Eagle Pass, Louisville 17, Ky.	1949
Sharp, Ward M., Northeast Forest Exp. Station, P. O. Box 809, Warren, Pa.	1936
Sharpe, Roger S(tanley), Dept. of Zoology and Physiology, Univ. of Nebraska, Lincoln, Neb.	1964
Shaub, Benjamin Martin, 159 Elm St., Northampton, Mass.	1948
Shaughnessy, Winslow M(orse), Pennsylvania State Museum, Harrisburg, Pa.	1957
Shaver, Mrs. Jesse M., 1706 Linden Ave., Nashville 12, Tenn.	1962
Sheffield, O(ren) C(onway), 817 West Houston, Tyler, Texas	1954
†Sheffler, W(illiam) J(ames), 4731 Angeles Vista Blvd., Los Angeles 43, Calif.	1954
Shellenberger, Emmett L(ee), Akron Museum of Natural History, 500 Edgewood Ave., Akron, Ohio 44307	1954

- †Sheppard, Jay M., U.S.S. Preston (DD795), c/o Fleet P.O., San Francisco, Calif. 1961
- *Sherwood, Glen A(lan), Seney National Wildlife Refuge, Seney, Mich. 1964
- Shimanski, Walter, 115 Grove Ave., Woodridge, N. J. 1960
- †Shires, James E., Det. 4, 2nd Surveillance Squad, APO 105, San Francisco, Calif. 1951
- Short, Lester L(eRoy), Jr., Bird and Mammal Laboratories Fish & Wildlife Service, United States National Museum, Washington 25, D. C. 1953
- Short, Wayne, 1800 South Bayshore Lane, Coconut Grove, Fla. 1941
- Shuler, James B(ernard), Jr., 43 Kirkwood Lane, Greenville, S. C. 1954
- Sibley, Charles G(ald), Fernow Hall, Cornell Univ., Ithaca, N. Y. 1942
- Sibley, Fred C(harles), Bird Division, Smithsonian Inst., Washington 25, D. C. 1953
- Sick, Helmut M., Museu Nacional, Quinta de Boa Vista, Rio de Janeiro, G.B., Brasil 1951
- Sieh, James G., 702 North Lincoln St., Aberdeen, S. D. 1948
- Silverman, Rosalie J., 1013 Flemington St., Pittsburgh, Pa. 15217 1964
- *Simmons, Mrs. Amelia C., 2676 North Lake Drive, Milwaukee 11, Wisc. 1943
- †Simmons, Edward McIlhenny, Avery Island, La. 1942
- †Simmons, Grant Gilbert, Jr., Lake Ave., Greenwich, Conn. 1949
- Simmons, K(enneth) E(dwin) L(aurence), c/o Lamorna, Beechwood Ave., Tilehurst, Reading, Berks, England 1962
- Simon, Mrs. Julius J., 1401 Burchfield Rd., Allison Park, Pa. 15101 1964
- Simon, Stephen B(axter), 2918 Silver Hill Ave., Baltimore 7, Md. 1947
- Simpson, Mark (Baxter), Jr., 210 Ridgeway Ave., P. O. Box 167, Statesville, N. C. 1962
- Skutch, Alexander F(rank), San Isidro del General, Costa Rica, C. A. 1944
- Slack, Mabel, 1004 Everett Ave., Louisville 4, Ky. 1934
- Slavik, David J., 3426 Texas Drive, Dallas, Texas 75211 1962
- Sloan, Norman F(rederick), 1800 University, Entomology Annex, Univ. of Wisconsin, Madison 6, Wisc. 1959
- Slocum, Mrs. J. Fred, 29 Park St., Buffalo, N. Y. 14201 1959
- Smart, Robert W(illiam), 85 Butterfield Ave., Amherst, Mass. 1957
- Smith, Earl R(oy), Box 5271, New Orleans, La. 1957
- †Smith, Emily D., 19651 Glen Una Drive, Saratoga, Calif. 95070 1948
- Smith, Gordon H., Box 95, R.D. 1, Hubbardstown, Mass. 1962
- †Smith, Harry M(adison), 340 Acadia Blvd., Springfield 8, Mass. 1936
- Smith, Herman D., Box 123, Danforth, Ill. 1961
- Smith, H(erman) Granville, 3820 Martindale Blvd., Columbus 14, Ohio 1960
- Smith, John L., 1432 14th St., Nitro, W. Va. 1963
- Smith, Marion L(ucille), 429 South Willard St., Burlington, Vt. 1949
- Smith, Neal Griffith, Canal Zone Biological Area, Drawer C, Balboa, Canal Zone 1958
- Smith, Robert L(eo), Division of Forestry, West Virginia Univ., Morgantown, W. Va. 26506 1945
- Smith, W. John, Dept. of Biology, Univ. of Pennsylvania, Philadelphia, Pa. 19104 1964
- Smith, Wendell Phillips, 911 E St., North Wilkesboro, N. C. 1921
- Smith, William W(alter), 673 Milverton Blvd., Toronto 6, Ont., Canada 1963
- Smithe, Frank B., 7 Center Drive, Douglaston 63, N. Y. 1960
- Snow, Mrs. C. S., 2211 Chester Blvd., Richmond, Ind. 1950
- Snyder, Mrs. Charles H., 161 Del Mar Circle, Aurora, Colo. 80010 1962
- Snyder, Dana Paul, Dept. of Zoology, Univ. of Massachusetts, Amherst, Mass. 1949
- *Snyder, Dorothy E(astman), 12 South St., Marblehead, Mass. 1951
- Sooter, Clarence Andrew, U.S. Public Health Service Office Reg., 9th Floor, 1114 Commerce St., Dallas 2, Texas 1940
- †Sorrill, Mrs. Anna Marie, 2425 Third Place, Yuma, Ariz. 1950
- Southern, William E., Dept. of Biological Sciences, Northern Illinois Univ., DeKalb, Ill. 1954
- Sowl, LeRoy W(ayne), Lansing, Iowa 1964
- Spangler, Iva M., 128 East Foster Parkway, Fort Wayne, Ind. 1939
- Speier, O.F.M., Omer Thomas, Duns Scotus College, 20000 West Nine Mile, Southfield, Mich. 48076 1964
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Sperry, Charles Carlisle, 1455 South Franklin St., Denver 10, Colo.	1931
Sperry, John A., Jr., 104 North 8th St., Canton, Mo.	1957
†Spofford, Walter R(ichardson) II, Dept. of Anatomy, State Univ. of New York, Syracuse 10, N. Y.	1942
Springer, Heinrich K., P. O. Box 375, College, Alaska	1962
Spinkle, Mrs. Dorothy Scott, 1 Circle Drive, Momence, Ill.	1962
*Stabler, Robert M(iller), Colorado College, Colorado Springs, Colo.	1939
Staebler, Arthur E(ugene), Dept. of Biology, Fresno State College, Fresno, Calif.	1937
Stamm, D(onald) D(aniel), U.S. Public Health Service, C.D.C., Atlanta, Ga. 30333	1958
Stamm, Mrs. Frederick W., 9101 Spokane Way, Louisville 7, Ky.	1947
Stanford, Jack A., R.R. 3, Riverscene, Jefferson City, Mo.	1962
†Stark, Wilma R., 1915 Kalorama Rd. N.W., Apt. 509, Washington 9, D. C.	1939
Stasz, C(larence) E(mil), 179 Edgewood Ave., Audubon 6, N. J.	1953
Stauffer, Ralph Stanley, 208 West Irvin Ave., Hagerstown, Md.	1949
Stearns, Edwin I(ra), 206 Lynn Lane, Westfield, N. J.	1945
†Stein, Robert C., Laboratory of Ornithology, Fernow Hall, Cornell Univ., Ithaca, N. Y.	1951
Stensrud, Clyde L(loyd), Route 1, Box 84, Atchison, Kan.	1962
Stern, Gene, 1330 East Barringer St., Philadelphia, Pa. 19119	1964
Stevens, Charles E(mo), Jr., 615 Preston Place, Charlottesville, Va.	1947
Stevens, O. A., State University Station, Fargo, N. D.	1926
Stevenson, Henry M(iller), Dept. of Biological Sciences, Florida State Univ., Tallahassee, Fla.	1943
Stevenson, James O., Fish & Wildlife Service, Dept. of the Interior, Washington 25, D. C.	1933
Stewart, James R(ush), Jr., 2225 Meriwether Rd., Shreveport, La.	1954
†Stewart, Mildred, 2579 Queenston Rd., Cleveland 18, Ohio	1949
Stewart, Paul A., Patuxent Wildlife Research Center, Laurel, Md.	1925
Stewart, Robert Earl, 810 17th St. S.E., P. O. Box 1013, Jamestown, N. D.	1939
Stickel, David W(illiam), Zoology Dept., Univ. of Texas, Austin 12, Texas	1963
Stickley, Allen R., Jr., 803 Elkton Rd., Newark, Del.	1961
*Stine, Perna M., 1314 12th St., Zephyrhills, Fla.	1931
†Stoddard, Herbert Lee, Sherwood Plantation, Route 3, Box 139, Thomasville, Ga.	1916
Stone, Charles P(orter), Rice Experiment Station, Box 351, Stuttgart, Ark. 72160	1964
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Stoner, Emerson A(ustin), 285 East "L" St., Benicia, Calif.	1947
Stophlet, John J(ermain), 2612 Maplewood Ave., Toledo 10, Ohio	1934
Storer, Robert Winthrop, Museum of Zoology, Univ. of Michigan, Ann Arbor, Mich.	1938
†Storer, Tracy I(rwin), Division of Zoology, Univ. of California, Davis, Calif.	1928
Stout, Gary D(ean), Route 1, Box 293, Wisconsin Rapids, Wisc. 54494	1964
Stout, (Isaac) Jack, Route 1, Buckhannon, W. Va.	1962
Strauch, Joseph G(eorge), Jr., 1933 East Grant St., Corvallis, Ore.	1964
†Street, Phillips B(orden), Route 1, Chester Springs, Pa.	1946
†Strehlow, Elmer William, Box 1443, Milwaukee 1, Wisc.	1941
Strnad, Forest V., 21 Third St., S.W., Chisolm, Minn.	1962
Stroemgren, C(arl-Ivar), P. O. Box 309, Cathedral Station, New York 25, N. Y.	1964
Strosnider, Ruth C., 4115 Wisconsin Ave. N.W., Washington 16, D. C.	1959
Stull, W(illiam) D(eMott), 5 Mason Court, Delaware, Ohio	1952
Stupka, Arthur, Route 1, Gatlinburg, Tenn.	1935
†Sturgeon, Myron T., Dept. of Geography & Geology, Ohio Univ., Athens, Ohio	1934
Sturges, Franklin W., Southern Oregon College, Ashland, Ore.	1955
Stutesman, Philip, 1268 West Green St., Decatur, Ill. 62522	1962
Sullivan, John O., Dept. of Zoology, Montana State Univ., Missoula, Mont.	1964
Summers, Lawrence, Dept. of Chemistry, Univ. of North Dakota, Grand Forks, N. D.	1956
†Sundell, Robert A(ronold), 5763 Sanger Ave., Alexandria, Va. 22311	1951
*Suthard, James (Gregory), 1881 Raymond Ave., Long Beach, Calif. 90806	1936
Suthers, Roderick A(tkins), The Biological Laboratories, Harvard Univ., Cam- bridge 38, Mass.	1954

†Sutton, George Miksch, Dept. of Zoology, Univ. of Oklahoma, Norman, Okla.	1920
Swackhamer, Farris S(aphar) J(ames), 10 Herning Ave., Cranford, N. J.	1963
†Sweetland, David W., Daisy Hill, Chagrin Falls, Ohio	1953
Swinebrood, Jeff, Dept. of Botany & Zoology, Douglas College, Rutgers Univ., New Brunswick, N. J.	1953
Swisher, John F., Jr., 102 Roosevelt St., St. Charles, Ill.	1957
Tabor, Ava Rogers, 305 Canal Blvd., Thibodaux, La.	1940
Taft, Elizabeth A., 504 North Blakely St., Dunmore, Pa.	1963
*Tallman, William S(weet), Jr., 4 Linden Place, Sewickley, Pa.	1940
Talvila, Elmer, 1 Faulkland Rd., Scarborough, Ont., Canada	1954
*Tanner, James Taylor, Dept. of Zoology, Univ. of Tennessee, Knoxville 16, Tenn.	1937
Tate, James (Lery), Jr., Dept. of Zoology & Physiology, Univ. of Nebraska, Lincoln, Neb.	1961
†Taylor, Arthur Chandler, 309 North Drew St., Appleton, Wisc.	1929
Taylor, G(eorge) Thomas, Dept. of Science, Atlantic Christian College, Wilson, N. C.	1961
*Taylor, J(ohn) Kenneth, 128 Charles St., New York 14, N. Y.	1959
*Taylor, Joseph William, 590 Allen's Creek Rd., Rochester 18, N. Y.	1946
Taylor, Norman K., Zoology Dept., Univ. of Western Ontario, London, Ont., Canada	1963
Taylor, R(ober) L(incoln), Inverness Drive, Flintridge, Pasadena 3, Calif.	1947
*Taylor, Walter K(ingsley), General Delivery, Tech. Station, Ruston, La.	1964
Teale, Edwin Way, R.D. 2, Hampton, Conn.	1948
Terese, Russell J(oseph), 333 Oakwood, Park Forest, Ill.	1964
Terres, John K(enneth), P. O. Box 571, Chapel Hill, N. C.	1955
Terrill, Lewis McIver, Ulverton, R.D. 1, Melbourne, P.Q., Canada	1948
Thatcher, Donald M., 2916 Perry St., Denver, Colo. 80212	1962
Thomas, Edward S(inclair), 319 Acton Rd., Columbus 14, Ohio	1921
Thomas, Jack Ward, Box 491, Llano, Texas	1957
Thomas, Mrs. Rowland, 410 East Green St., Morrilton, Ark.	1937
Thompson, Daniel Q., Fernow Hall, Cornell Univ., Ithaca, N. Y.	1945
*Thompson, Katrina, 2039 Milford, Houston 6, Texas	1957
†Thompson, Marie E(vadne), 2717 Parkview Ave., Kalamazoo, Mich.	1953
Thompson, Max C., Box 385, Udall, Kan.	1956
Thompson, Milton D(ouhan), 26 Lambert Lane, Springfield, Ill.	1959
Thompson, Reynolds W(ardell), 1373 Redding Rd., Fairfield, Conn.	1959
Thompson, William Lay, Dept. of Biology, Wayne State Univ., Detroit 2, Mich.	1952
Thorne, Mabel E., 4431 Wilmette Drive, Fort Wayne 5, Ind.	1962
†Thorne, Oakleigh II, Thorne Ecol. Res. Sta., 1229 University Ave., Boulder, Colo.	1947
Thorpe, Heather G., 3435 Edgewood, Ann Arbor, Mich.	1959
Throne, Alvin L., Univ. of Wisconsin, Milwaukee, Wisc. 53211	1949
Tillman, Clifford, 492 Park Place, Natchez, Miss.	1959
Tipton, Samuel R., Dept. of Zoology & Entomology, Univ. of Tennessee, Knoxville, Tenn.	1959
†Todd, Mrs. Elizabeth D., Box 591, Kalamazoo, Mich.	1939
Todd, W(alter) E(dmond) Clyde, Carnegie Museum, Pittsburgh 13, Pa.	1911
Tomer, John S(haffer), 5911 East 46th St., Tulsa, Okla.	1954
Tomkins, Ivan Rexford, 1231 East 50th St., Savannah, Ga.	1931
Tomlinson, Roy E(ugene), Migratory Bird Population Station, Patuxent Wildlife Research Center, Laurel, Md.	1958
Tordoff, Harrison B(ruce), Museum of Zoology, Univ. of Michigan, Ann Arbor, Mich.	1947
Townes, George F(ranklin), Stokes Bldg., 318 Coffee St., Greenville, S. C. 29601	1953
*Townsend, Elsie White, Dept. of Biology, Wayne State Univ., 4841 Cass Ave., Detroit 2, Mich.	1938
*Townsend, Mrs. Frank, La Rue Rd., Newfoundland, N. J.	1958
Trainer, John E(zra), Dept. of Biology, Muhlenberg College, Allentown, Pa.	1952
Transue, Barrett D(ecker), R.D., Mt. Bethel, Pa.	1959
†Trautman, Milton B(ernard), Ohio State Museum, Columbus, Ohio	1932
Travis, Vaud A(ncil), Jr., 2 A Corner Place, Stillwater, Okla.	1955
Traylor, Melvin Alvah, Jr., 759 Burr Ave., Winnetka, Ill.	1947

Trost, Charles H., Box 181, Flint Hall, Univ. of Florida, Gainesville, Fla.	1959
*Turner, Mrs. M(ary) E(llis), Bryn Ayrton, Ebensburg, Pa.	1961
Twiest, Gilbert, Kellogg Community College, Battle Creek, Mich.	1962
Twomey, Arthur C(ornelius), Carnegie Museum, Pittsburgh 13, Pa.	1936
Tyler, Walter S., 304 Callender Lane, Wallingford, Pa. 19086	1963
†Uhler, Francis Morey, Patuxent Research Center, Laurel, Md.	1931
†Ulrich, Mrs. Alice E., 193 LaSalle Ave., Buffalo 14, N. Y.	1952
†Ulrich, Edward C., 193 LaSalle Ave., Buffalo 14, N. Y.	1952
Underdown, Henry T., 8216 Manor Rd., Elkins Park, Philadelphia 17, Pa.	1952
Urban, Emil K., Dept. of Biology, University College, Haile Selassie I Univ., P. O. Box 399, Addis Ababa, Ethiopia, Africa	1956
Ussher, Richard Davy, R.R. 1, Morpeth, Ont., Canada	1947
Uzzell, Ann, c/o T. M. Uzzell, Animal Behavior Lab., Univ. of Chicago, Chicago, Ill. 60637	1960
Vaden, Virginia (Mozelle), 4325 Bowser Ave., Dallas 19, Texas	1959
Vaiden, M(eredith) C(ordon), Rosedale, Miss.	1937
Valentine, Allen E., 606 Washington Ave., Alpena, Mich.	1957
*Van Blaricon, Robert P., 527 Lodge Lane, Route 1, Kalamazoo, Mich.	1958
Van Cleve, G(eorge) Bernard, 323 South Fairmount St., Pittsburgh 32, Pa.	1954
Vandervort, Charles C., Laceyville, Pa. 18623	1964
*Vanderbilt, Robert, Att. Miss Schreiber, 230 Park Ave., New York 17, N. Y.	1961
VanDeusen, Hobart M(erritt), 13 Stonewood Parkway, Montclair, N. J.	1941
Vane, Robert F(rank), 600 Dows Bldg., Cedar Rapids, Iowa	1946
Van Oosten, Jan Roger, 2011 Mountain View Drive, Mt. Vernon, Wash. 98273	1961
van Tets, G(errard) F(rederick), c/o C.S.I.R.O. Division of Wildlife Research, P. O. Box 109, City Canberra, A.C.T., Australia	1955
†Van Velzen, Willet T(heodore), Patuxent Wildlife Research Center, Laurel, Md.	1959
Van Winkle, William Mitchell, Jr., 31 Centre St., Rye, N. Y.	1962
Vарner, Don G., Box 382, Morrisonville, Ill. 62546	1964
†Vaughan, William C(oleman), Locust Grove Farm, River Rd., Youngstown, N. Y.	1941
Vaurie, Charles, c/o American Museum of Natural History, 79th St. and Central Park West, New York 24, N. Y.	1946
Verbeek, N. A. M., Dept. of Zoology, Montana State Univ., Missoula, Mont.	1963
*Vesey, George W., 1654 Greenwood Drive, South Bend 14, Ind.	1962
*Vesey, Mrs. George W., 1654 Greenwood Drive, South Bend 14, Ind.	1962
Vincent, Alvin, 6426 Currywood Drive, Nashville, Tenn.	1961
Vogh, Mrs. Mary, 1907 Jackson St., Commerce, Texas 75428	1960
von der Heydt, James A(rnold), P. O. Box 2433, Juneau, Alaska	1947
Vore, Marvin E(hner), 1128 North 8th Ave., West Bend, Wisc.	1947
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*Wade, Mrs. Emily V(anderbilt), 251 Old Billerica Rd., Bedford, Mass.	1959
Wagner, Mrs. C(ary) R., South Lane Farm, Utica, Ohio	1947
Wagner, Simon, 1160 Myrtle Ave., Brooklyn, N. Y. 11221	1964
Walding, Howard P(ayne), 606 East Main St., Madison, Ohio	1960
Walker, Charles F(rederic), Museum of Zoology, Univ. of Michigan, Ann Arbor, Mich.	1939
†Walker, Jayson A(lison), 89 Church St., Waterloo, N. Y.	1949
†Walkinshaw, Lawrence Harvey, Wolverine-Federal Tower, Battle Creek, Mich.	1928
Wallace, Charles Ray, Dept. of Zoology, Univ. of Arkansas, Fayetteville, Ark.	1964
Wallace, George J(ohn), Dept. of Zoology, Michigan State Univ., East Lansing, Mich.	1937
Walley, Harlan D(ean), 717 North Elm St., Sandwich, Ill.	1963
Walters, Cliff, Dutch Mountain Nursery, Route 1, Augusta, Mich.	1958
Walty, John B., 227 Wilfred Ave., Willowdale, Ont., Canada	1961
Wang, Arthur C., 1060 Monterey Ave., Berkeley, Calif. 94707	1964
*Wangensteen, Mrs. Owen H., 2832 River Rd. West, Minneapolis, Minn. 55406	1949
Ward, Gertrude L(uckhardt), Earlham College, Richmond, Ind.	1953

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Warner, Alex, Route 2, Peculiar, Mo.	1963
Warren, James R., 839 Lake Ridge Drive, Tallahassee, Fla.	1959
Warter, Stuart L., Museum of Zoology, Louisiana State Univ., Baton Rouge 3, La.	1956
Wasserfall, William, 22 Roycrest Ave., Willowdale, Ont., Canada	1956
Watson, Frank Graham, Old Hyde Rd., Weston, Conn.	1937
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Watson, John R(owe), Dept. of Zoology, Utah State Univ., Logan, Utah	1964
Watson, Robert J(ames), 2636 Marcey Rd., Arlington 7, Va.	1943
Weber, Louis M(arkus), 340 Crest Drive, Sherman, Mo.	1941
Webster, Clark G(ibbons), 4070 Kidd St., Alexandria, Va. 22309	1948
Webster, J(ackson) Dan, Hanover College, Hanover, Ind.	1939
Webster, Lois E(laine), 1949 Paris, Aurora, Colo.	1957
Weigel, Robert D(avid), Dept. of Biology, Illinois State Normal Univ., Normal, Ill.	1958
Weiland, Edwin C(arl), P. O. Box 97, Marquette, Mich.	1963
Weise, Charles M(artin), Dept. of Zoology, Univ. of Wisconsin-Milwaukee, Milwaukee 11, Wisc.	1949
Welch, Jack F(orrest), 2731 South Ogden St., Englewood, Colo. 80110	1964
Weld, Paul W(oodbury), 42 Pine Tree Lane, Rochester 17, N. Y.	1963
Weller, Milton W(ebster), Dept. of Zoology & Entomology, Iowa State Univ., Ames, Iowa	1950
Wellman, Mrs. Cora B(yard), R.D. 1, Pennington, N. J.	1951
Wells, LaRue, 807 West Liberty, Ann Arbor, Mich.	1953
Welty, Carl, Route 1, Beloit, Wisc.	1948
Wershofen, Pauline, LaMoille, Minn.	1958
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West, David A., Dept. of Biology, Virginia Polytechnic Institute, Blacksburg, Va. 24061	1955
*West, George C., Laboratory of Zoophysiology, Univ. of Alaska, College, Alaska	1956
West, Henry C(lopton), 4660 East 42nd St., Indianapolis, Ind. 46226	1953
Westcott, Charles A(llen), 704 Forest Ave., River Forest, Ill.	1960
Westman, Mrs. Francis, R.R. 4, Barrie, Ont., Canada	1962
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INDEX TO VOLUME 76, 1964

This index includes, in addition to the 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.

- Accipiter cooperii*, 279
striatus, 257
Actitis macularia, 157
 Adams, William H., Unseasonable record of Gannet in North Carolina, 187
Aegothelus cristatus, 151
Aëronautes saxatilis, 279
Ajrotes ajra, 149
Agelaius phoeniceus, 327
Alcedo atthis, 151
Amblyospiza albifrons, 152
Ammodramus savannarum, 325, 326, 327
Ammospiza, 153
Anas discors, 291
 erythrorhyncha, 362
 platyrhynchos, 124, 190
 strepera, 190
 undulata, 362
Andigena, 5
 Anhinga, 290
Anhinga anhinga, 290
 ruja, 149
 Annan, Ormsby, review by, 101-102
Anthus spinoletta, 152
 Anatomy, 50-61, 147-154
Apus melba, 151
Aquila chrysaëtos, 186, 384
 Araçari, Banana, 5
 Saffron-colored, 5
Aramus guarana, 149
 Arbib, Robert S., Jr., review by, 302-303
Ardea cinerea, 149
 melanocephala, 362
Arundinicola leucocephala, 152
Asio capensis, 362
 flammeus, 151
 otus, 151
Attila spadiceus, 151
Baillonius baillonii, 5
 Baird, James, Hostile displays of Rose-breasted Grosbeaks towards a Red Squirrel, 286-289
Balearica pavonina, 355, 360, 376
 p. ceceliae, 355, 356, 357, 358, 361, 367, 368, 375
 p. pavonina, 355, 356, 357, 358, 368, 375
 regulorum, 355, 374
 r. gibbericeps, 355, 356, 358, 360, 361, 366, 368, 375
 r. regulorum, 355, 356, 358, 359, 361, 369, 374, 375
 Banks, Richard C., and Lewis Wayne Walker, A hybrid Scaled \times Douglas Quail, 378-380
 Bates, Marston, Animal Worlds, reviewed, 206
 Beecher, William J., Reuben Myron Strong (memorial), 386-387
 Behavior, 170-171, 187, 189-190, 221, 286-289, 291-292, 351-354, 380, 382-383, 363-365
 Bell, Rondal E., A sound triangulation method for counting Barred Owls, 292-294
 Bittern, Cape, 362
 Blachly, Lou, and Randolph Jenks, Naming Birds at a Glance, reviewed, 302-303
 Blackbird, Red-winged, 166, 168, 327
 Tricolored, 168
 Bluebird, Eastern, 327
 Bock, Walter J., Bill shape as a generic character in the Cardinals, 50-61
Bonasa umbellus, 149
Botaurus stellaris, 149
 s. capensis, 362
Branta canadensis, 282
 Breckenridge, W. J., review by, 102-103
 Brown, Jerram L., The evolution of diversity in avian territorial systems, 160-169
Bubo bubo, 151
Bubulcus ibis, 290, 362
 Bufflehead, 119
Bugeranus carunculatus, 360, 362
 Bunting, Indigo, 142

- Burhinus oedicephalus*, 151
senegalensis, 151
 Bustard, Stanley, 362
 Bushtit, Black-eared, 226
Buteo galapagoensis, 351
lineatus, 125
Butorides virescens, 149, 290
Callipepla squamata, 378, 379
Camptostoma imberbe, 279
Canachites canadensis, 149
 Canary, 153
Canus latrans, 190
Capella nigripennis, 362
Caprimulgus carolinensis, 19
rociferus, 151, 226
 Cardinal, 53, 54, 58, 59, 140, 142, 325, 326, 327
 South American, 54
Carpodacus purpureus, 176, 182
 Carr, Archie, Ulendo, reviewed, 304
Casmerodius alba, 149, 290
 Catbird, 141
Cathartes aura, 149
Catharus aurantiirostris, 38
guttatus, 152
Catoptrophorus semipalmatus, 150
Centrocercus urophasianus, 149, 163, 164
Centropus, 151
Centurus carolinus, 382
Cercibis, 43
Chaetura pelagica, 151
Chamaepetes goudotii, 149
Charadrius, 150
semipalmatus, 157
 Chat, Yellow-breasted, 172
 Chickadee, Carolina, 140, 141
Chionis minor, 151
Chlamydotis undulata, 149
Choriotis australis, 149
kori, 149
 Chuck-will's-widow, 19-27, 74
Ciconia ciconia, 362
Circus ranivorus, 362
Cisticola lais, 152
Clamator glandarius, 151
Claravis pretiosa, 211, 228
 Clark, George A., Jr., see Parkes, Kenneth
 C. and ————
 Clement, Roland C., Annual report of the
 Conservation Committee, 306-312
Coccyzus americanus, 187
erythrophthalmus, 151
Cochlearius cochlearius, 149, 290
Colaptes auratus, 95
 Collins, Charles T., Fossil ibises from the
 Rexroad fauna of the upper Pliocene of
 Kansas, 43-49
Collocalia troglodytes, 151
Columba cayennensis, 216
fasciata, 219
f. albilinea, 220
flavirostris, 217
nigrirostris, 211, 214
speciosa, 211
subvinacea, 214
Columbigallina minuta, 227
passerina, 227, 228, 327
talpacoti, 211
Contopus sordidulus, 279
Conuropsis carolinensis, 68
Coracias garrulus, 151
 Coot, 186
Coragyps atratus, 149
 Cormorant, Brandt's, 162
 Couffer, Jack, The Song of Wild Laughter,
 reviewed, 106-107
 Cowbird, 325, 326, 327
 Brown-headed, 94, 96
 Coyote, 190
 Cracraft, Joel Lester, Observations on sun-
 bathing in the Yellow-billed Cuckoo,
 187
 Crane, Crowned, 355-377
 East African Crowned, 356, 360, 369
 Sandhill, 364, 373
 South African Crowned, 356, 359, 361,
 365, 366, 367, 369, 372, 373, 375
 Stanley, 360, 362, 373, 374
 Sudan Crowned, 356, 357
 Wattled, 360, 362, 363, 374
 West African Crowned, 355, 356
 Whooping, 310, 333
Creagrus furcatus, 347
 Crossbill, Red, 14
Crotophaga, 151
 Crow, 71, 362
 Common, 141
Crypturellus variegatus, 148

- Cuckoo, Yellow-billed, 141, 187
Curlew, Eskimo, 310
Cyanocitta cristata, 6
 stelleri, 225
Cypseloides niger, 295
Dana, Edward F., review by, 207
Davis, Donald G., Black Swifts nesting in a limestone cave in Colorado, 295-296
Davis, John, and Laidlaw Williams, The 1961 irruption of the Clark's Nutcracker in California, 10-18
Dendroica caerulescens, 96
 castanea, 167
 occidentalis, 327
de Schauensee, R. Meyer, The Birds of Colombia and Adjacent Areas of South and Central America, reviewed, 300-301
Dichromanassa rufescens, 149
Dickerman, Robert W., Cattle Egrets nesting in Mexico, 290
Dicrurus adsimilis, 152
Diomedea bulleri, 148
 epomophora, 148
 exulans, 148
Distribution, 5, 46, 68-93, 96-97, 266, 267, 278, 290, 295-296, 331-338, 339-346, 356-360, 361
Dove, Gray-chested, 235-239, 245
 Ground, 327
 Inca, 224, 227
 Mourning, 94-95, 141, 243, 244
 Rufous-naped Gray-chested, 211, 239-242, 244
 White-fronted, 211, 227, 229-235, 239, 240, 241, 244, 245, 246
 White-tipped, 211
 White-winged, 224-227
Dowitcher, Long-billed, 188-189
 Short-billed, 188-189
Dromaeus novae-hollandiae, 148
Dryocopus pileatus, 95
Duck, 124
Duck, Ruddy, 291
 Yellowbill, 363
Dumetella carolinensis, 152
Dunham, David W., Reproductive displays of the Warbling Vireo, 170-173
Eagle, Bald, 111, 120, 121-137, 186, 187, 308, 309
 Golden, 186, 309, 384-385
Eckelberry, Don R., A note on the toucans of northern Argentina, 5, Saffron Toucanet, painting by, facing page 5
Eckert, Allan W., The Great Auk, reviewed, 207
Edeburn, Ralph M., Black-legged Kittiwake in West Virginia, 294-295
Edwards, Ernest P., review by, 301-302
Egret, Cattle, 290, 362, 363
 Great, 290
 Snowy, 290
 Yellow-billed, 362
Egretta alba, 149
 thula, 149, 290
Epidonax trillii, 152
Eremophila alpestris, 152, 327
Ereunetes pusillus, 157
Erolia melanotos, 157
 minutilla, 150, 157
Esacus recurvirostris, 151
Estrilda, 152
Eudocimus, 44, 45, 46, 47, 48
 albus, 45
 ruber, 45
Eumeces fasciatus, 325, 326
Eupoda montana, 150
Falco peregrinus pealii, 119
 sparverius, 149, 323
Falcon, Peregrine, 119
Ficken, Millicent S., Nest-site selection in the American Redstart, 189-190
Fieldfare, 14
Finch, Purple, 176, 182
Flicker, Yellow-shafted, 95, 141
Florida caerulea, 149
Flycatcher, Acadian, 141
 Beardless, 279
 Black-tailed, 248-256
 Great Crested, 141
 Scissor-tailed, 98
 Sulphur-bellied, 278
 Sulphur-rumped, 248
 Traill's, 98
 Vermilion, 279
Food Habits, 5, 118-119, 122-125, 220, 323-330, 335, 343, 351
Fossils, 43-49
Fregata magnificens, 351

- minor*, 351
Fulica americana, 149, 186
ardesiaca, 149
armillata, 149
atra, 149
rufifrons, 149
Gavia adamsii, 148
arctica, 148
immer, 148
stellata, 148
 Gadwall, 190
Gallinago gallinago, 150
g. delicata, 150
Gallinula chloropus, 149
 Ganier, Albert F., The alleged transportation of its eggs or young by the Chuck-will's-widow, 19-27
 Gannet, 187
Garrulax pectoralis, 152
Geococcyx californianus, 151
Geospiza, 56, 59, 60, 153
magnirostris, 56
scandens, 56
Geotrygon costaricensis, 243
montana, 211, 242
Geronticus, 43
 Gnatcatcher, Blue-gray, 141
 Goldfinch, 235
 American, 142, 182
 Goose, 124
 Canada, 282
 Spurwing, 362
 Graber, Jean W., see Graber, Richard E. and ———
 Graber, Richard E. and Jean W. Graber, A Comparative Study of Bird Populations in Illinois, 1906-1909 and 1956-1958, reviewed, 204-206
 Crackle, Common, 325, 326, 327
Grallaria erythrotis, 151
squamigera, 151
Granatellus venustus, 384
 Grant, P. R., The nest of *Granatellus venustus* Du Bus, 384
 Grebe, Horned, 291
 Pied-billed, 291
 Gromme, Owen J., Birds of Wisconsin, reviewed, 207
 Grosbeak, Evening, 174-178, 179-185
 Rose-breasted, 286-289
 Groschoff, Vera I., see Roedelberger, Franz and ———
 Gross, Alfred O., Nesting of the Black-tailed Flycatcher on Barro Colorado Island, 248-256
 Ground-Dove, Blue, 211, 228, 240, 244, 245, 246
 Common, 227, 228, 244
 Plain-breasted, 227, 228, 244
 Ruddy, 211, 227, 244, 245, 246
 Grouse, Ruffed, 141
 Sage, 163
Grus grus, 374
canadensis, 364, 374
 Gull, Galápagos Swallow-tailed, 347-354
 Glaucous-winged, 119
 Great Black-backed, 339
 Herring, 127, 339
 Laughing, 350
 Ring-billed, 127
 Sabine's, 352
Guttera, 149
Gymnorhina leuconota, 152
 Hadedah, 362, 364
Haematopus bachmani, 150, 344
ostralegus, 150, 344
palliatius, 150, 339
Hagedashia hagedash, 362
 Hailman, Jack P., The Galápagos Swallow-tailed Gull is nocturnal, 347-354
Halcyon senegalensis, 151
Haliaeetus leucocephalus, 111, 121, 186
Halocyptena microsoma, 149
 Hancock, David, Bald Eagles wintering in the southern Gulf Islands, British Columbia, 111-120
 Harrier, Marsh, 362
 Hawk, 140
 Cooper's, 141, 279
 Galápagos, 351
 Red-shouldered, 125
 Red-tailed, 141
 Sharp-shinned, 257-267
 Sparrow, 323-330
 Heintzelman, Donald S., Spring and summer Sparrow Hawk food habits, 321-330
 Heintzelman, Donald S., and Carole J. Newberry, Some waterfowl diving times, 291

- Heron, Black-crowned Night, 98, 290
 Black-necked, 362
 Boat-billed, 290
 Green, 290
- Hespenheide, Henry A., Competition and the genus *Tyrannus*, 265-281
- Hesperiphona vespertina*, 174, 179
- Hirundo rustica*, 94, 152
- Hofslund, Pershing B., Proceedings of the Forty-fifth Annual Meeting, 313-320
- Holcomb, Larry C., Aggressive behavior of hen pheasant while protecting chicks, 380
- Hoover, Helen, The Long Shadowed Forest, reviewed, 107-108
- Houbaropsis bengalensis*, 149
- Howell, Thomas R., Notes on incubation and nestling temperatures and behavior of captive owls, 28-36
- Hummingbird, Ruby-throated, 141
- Hyalocichla mustelina*, 152
- Ibis, 43-49
 Glossy, 98
 Sacred, 362, 364
- Icteria virens*, 172
- Icterus nigrogularis*, 152
- Ictinia mississippiensis*, 187
- Iridoprocne bicolor*, 182
- Jameson, E. W., Jr., The Hawking of Japan, reviewed, 104-105
- Jaques, Florence Page, review by, 107-108
- Jay, Blue, 6-9, 84, 141
 Mexican, 168
 Scrub, 168
 Steller's, 87, 225, 226
- Jenks, Randolph, see Blachly, Lou and _____
- Joselyn, G. Blair, see Warnock, John E. and _____
- Junco, 328
- Junco*, 328
- Kale, Herbert W. II, Nesting of Purple Martins aboard a ship, 62-67
- Kingbird, Cassin's, 265, 270, 271, 272, 275, 276, 277, 279
 Eastern, 98
 Thick-billed, 265, 274
 Tropical, 265, 274
 Western, 265, 269, 270, 271, 272, 275, 276, 277, 279
- Kingfisher, 140
 Belted, 141
- Kiskadee, Great, 5
- Kite, Everglades, 310
 Mississippi, 187
 Swallow-tailed, 85
- Kittiwake, 347
 Black-legged, 294-295
- Lampribis*, 43
 rara, 44
- Lancaster, Douglas A., review by, 390-392
- Lanius collaris*, 152
 ludovicianus, 152, 279
- Lark, Horned, 327
- Larus argentatus*, 127, 339
 atricilla, 350
 brevirostris, 347
 delawarensis, 127
 fuscatus, 347-353
 marinus, 339
 sabini, 352
 tridactylus, 347
- Laterallus jamaicensis*, 149
- Leptotila cassinii*, 235, 240
 c. rufinucha, 211, 239
 verreauxi, 211, 229, 240
- Leptosomus discolor*, 151
- Leucophox thula*, 149
- Levaillant, Francois, Exotic Birds, reviewed, 105-106
- Lewis, Harrison F., review by, 298-299
- Ligon, J. David, Albinism in the Scissor-tailed Flycatcher, 98
- Limnecorax flavirostra*, 149
- Limnodromus griseus griseus*, 188
 scolopaceus, 188
- Lonchura cuculatus*, 152
- Lophortyx californicus*, 30, 378
 douglasii, 378, 379
 gambelii, 378
- Loxia curvirostra*, 14, 153
- Lullula arborea*, 152
- Lyons, Marjory D., see Thompson, Daniel Q. and _____
- Magpie, 166
- Mallard, 124, 132, 190
- Manacus manacus*, 164

- Manakin, Black and White, 164
 Man-o-war Bird, 351
 Marburger, Rodney G., see Thomas, Jack Ward and ———
Mareca americana, 190
 Martin, Purple, 62-67
 Martz, Gerald F., Mixed trio of Shoveler drake and Blue-winged Teal pair, 291-292
 Maxwell, George, see Putnam, Loren and ———
 Mayr, Ernst, Animal Species and Evolution, reviewed, 193-203
 McKinley, Daniel, History of the Carolina Parakeet in its southwestern range, 68-93
 Meadowlark, 327
 Eastern, 325
 Measurements, 44, 128, 253, 256, 275, 294, 358, 366-368, 373
Megascyle alcyon, 151
Meleagris gallopavo, 149
 g. intermedia, 292, 381, 384
Melospiza georgiana, 153
 melodia, 328
 Merganser, Common, 309
Mesembrinibis, 46, 47
 cayennensis, 44, 46, 47, 48
Mesophox intermedia, 362
Micrathene whitneyi, 151
Micropalama himantopus, 157
Microtus pennsylvanicus, 324, 325, 326
 Migration, 6-9, 155, 159, 188-189, 257-264
 Mink, 190
 Mockingbird, 74
Molothrus ater, 94, 96, 325, 326, 327
 bonariensis, 152
 Molts and plumages, 135, 136, 174-178, 255, 378-380, 381-382, 357, 360
Momotus momota, 239
Morus bassanus, 149, 187
 serrator, 149
Motacilla grandis, 152
 Motmot, Blue-diademed, 239
 Mountfort, Guy, The Wild Danube, reviewed, 106
 Murphy, The Peregrine Falcon, reviewed, 207
 Murray, Bertram G., Jr., A review of Sharp-shinned Hawk migration along the northeastern coast of the United States, 257-264
Muscivora forficata, 98
 tyrannus, 152
Mustela vison, 190
Mycteria americana, 149
Myiobius atricaudus, 248
 barbatus, 248
 b. sulphureipygius, 248
 sulphureipygius, 248
Myiodynastes luteiventris, 278
Neotis denhami stanleyi, 362
 Nesting, 19, 25-26, 28-35, 37-42, 62-67, 95, 97-98, 189-190, 212-213, 217, 217-219, 221-223, 224-227, 228, 230-235, 236, 239, 240-242, 242, 243, 248-256, 270, 271, 295-296, 335, 339-346, 384, 365-366
 Newberry, Carole J., see Heintzelman, Donald S. and ———
 Nickel, Walter P., Brown-headed Cowbird fledged, in Barn Swallow nest, 94; Brown-headed Cowbird fledged in nest of Black-throated Blue Warbler, 96; The effects of probable frostbite on the feet of Mourning Doves wintering in southern Michigan, 94-95
 Nightingale-thrush, Orange-billed, 38
Nipponia, 43
Nothura maculosa, 148
Notornis mantelli, 149
Nucifraga caryocatactes, 14
 columbiana, 10
Numenius phaeopus, 99
 tahitiensis, 150
 Nutcracker, 14
 Clark's, 10-18
 Nuthatch, White-breasted, 141
Nyctea, 151
 scaudiacae, 34, 151
Nycticorax nycticorax, 98, 149, 290
Nyctidromus albigollis, 151
Oceanodroma leucorhoa, 149
 melania, 149
Olor buccinator, 284, 331
 columbianus, 282, 331
 Oring, Lewis W., Predation on flightless ducks, 190
Ortalis vetula, 149
 wagleri, 149

- Ortygonax rytirhynchus*, 149
Osprey, 308
Otus asio, 151
Ovenbird, 142, 165
Owl, Barn, 28, 30-35
 Barred, 141, 292-293
 Burrowing, 28-30, 35
 Marsh, 362
 Screech, 141
 Snowy, 34, 35
Oxyura jamaicensis, 291
Oystercatcher, American, 339-346
 Black, 344
 European, 344
Paca, Lillian Grace, The Royal Birds,
 reviewed, 206
Pachyptila desolata, 148
Pachyramphus polychopterus, 151
Parakeet, Carolina, 68-93
Parasitism, 94, 96, 292
Parkes, Kenneth C., reviews by, 197-203,
 304
Parkes, Kenneth C., and George A. Clark,
 Jr., Additional records of avian egg
 teeth, 147-154
Parmalee, David F., Whimbrel: first speci-
 mens for Kansas, 99
Parnell, James F., and Thomas L. Quay,
 The summer birds of the Toxaway River
 gorge of southwestern North Carolina,
 138-146
Paroaria, 56
 capitata, 56
 coronata, 56
 dominicana, 56
 gularis, 56
Parus atricapillus, 152
 utricristatus, 152
 major, 165
Passer domesticus, 327
Paynter, Raymond A., Jr., review by, 300-
 301
Pelecanus erythrorhynchus, 149
 occidentalis, 149
Peterson, Roger Tory and the Editors of
 Life, The Birds, reviewed, 102-103
Petrochelidon pyrrhonota, 327
Pettingill, Eleanor Rice, review by, 207
Pettingill, Olin Sewall, Jr., reviews by, 104-
 105, 105-106, 106, 106-107, 108, 206, 206
Pewee, Eastern Wood, 98
 Western Wood, 279
Phaethon aethereus, 149
 lepturus, 149
 rubricauda, 149
Phainopepla, 279
Phainopepla nitens, 279
Phalacrocorax penicillatus, 162
Phasianus colchicus, 35, 97
Pheasant, Ring-necked, 97-98, 380
Pheucticus ludovicianus, 153, 286
Philohela minor, 150
Phimosus, 46, 47
 infuscatus, 44, 46, 47, 48
Phoebe, Black, 279
 Eastern, 98, 141
 Say's, 279
Phoebastria palpebrata, 148
Phoenicurus minor, 149
Physiology, 28-36
Pigeon, Band-tailed, 219, 220-224, 244
 Pale-vented, 216, 217
 Red-billed, 217, 245
 Ruddy, 214
 Scaled, 211, 212, 213, 244, 245
 Short-billed, 211, 214, 215, 216
Pilling, Norman B., and Robert W. Trowren,
 Tanagra trinitatis in Tobago, West
 Indies, 96-97
Pipilo erythrophthalmus, 16
 e. jalcinellus, 16
Piranga olivacea, 37, 153
Pitangus sulphuratus, 5, 151
Plectropterus gambensis, 362
Plegadis, 45, 46, 47
 chihii, 44, 45
 jalcinellus, 98
 gracilis, 43, 45, 48
Ploceus nigerrimus, 152
 xanthops, 152
Plover, Black-bellied, 157
 Semipalmated, 156, 157
Pluvianus aegypticus, 151
Podica senegalensis, 149
Podiceps auritus, 148, 291
 caspicus, 148
 dominicus, 148
 rolland, 148

- Podilymbus podiceps*, 148, 291
Pogonocichla stellaris, 152
Pooecetes gramineus, 327
 Populations, 116-117, 121-122, 138-146,
 282-285, 323, 327-330
Porphyrio porphyrio, 149
Porphyriops melanops, 149
Porphyryla martinica, 149
 Post, Peter W., and Gilbert S. Raynor,
 Recent range expansion of the American
 Oystercatcher into New York, 339-346
 Prairie Chicken, Attwater's, 310
 Predation, 190
 Prescott, Kenneth W., Constancy of in-
 cubation for the Scarlet Tanager, 37-42
Prionodura newtoniana, 152
Procellaria grisea, 148
Progne subis, 62
Prunella modularis, 152
Psaltriparus melanotis, 226
Pseudibis, 43, 44
Pteroglossus castanotis, 5
Puffinus auricularis, 148
griseus, 148
lherminieri, 148
 Putnam, Loren, George Maxwell, and
 Stephen Tilley, Sight record of the
 Glossy Ibis for the Bass Islands, Lake
 Erie, Ohio, 98
Pycnonotus barbatus, 152
cafer, 152
Pyrocephalus rubinus, 279
Pyrrhuloxia, 53, 54, 58, 59
Pyrrhuloxia, 50, 51, 54, 55, 56, 58, 60
sinuata, 50, 51, 52, 53, 54, 56, 57, 58, 59,
 60
 Quail-Dove, Buff-fronted, 243
 Ruddy, 211, 242, 244, 245, 246
 Quail, California, 30, 378
 Douglas, 378, 379, 380
 Gambel, 378, 380
 Scaled, 378, 379, 380
 Scaled \times Douglas, 378-380
 Quay, Thomas L., see Parnell, James F.
 and ————
Quiscalus quiscula, 325, 326, 327
Rallus elegans, 149
limicola, 149
Ramphocelus carbo, 152
Ramphastos discolorus, 5
sulfuratus, 238
toco albicularis, 5
 Raven, Common, 141, 143
 Raynor, Gilbert S., see Post, Peter W.
 and ————
Recurvirostra americana, 151
avosetta, 151
 Redstart, American, 142, 189
Rhea americana, 148
Rhegmatorhina gymnops, 151
 Robin, 141, 327
 Roedelberger, Franz, and Vera I. Groschoff,
 The Wonders of Wildlife, reviewed, 108
Rynchops flavirostris, 151
nigra, 151, 339
Rhynchotus rufescens, 148
Richmondena, 50, 54, 55, 56, 58, 60
cardinalis, 51, 52, 53, 54, 56, 57, 58, 59,
 60, 153, 325, 326, 327
phoenicea, 51, 52, 54, 55, 56, 59, 60
Rissa brevirostris, 347
tridactyla, 347
t. tridactyla, 294
Rupicola peruviana, 151
Sagittarius serpentarius, 362
 Saltator, Streaked, 38
Saltator, 56, 58, 60
albicollis, 38
a. guadelupensis, 57
atriceps raptor, 57
atricollis, 57
a. atripennis, 57
aurantiivirostris, 57
coerulescens hesperis, 57
c. grandis, 57
maxillosus, 56, 57
maximus intermedius, 57
sinilis, 57
 Sandpiper, Least, 156, 157
 Pectoral, 156, 157, 188
 Semipalmated, 156, 157
 Spotted, 140, 141, 143, 157
 Stilt, 157, 188
 White-rumped, 188
Sarciophorus tectus, 150
Saurothera vetula, 151
Saxicola dacotiae, 152
Sayornis nigricans, 279

- phoebe*, 152
saya, 279
Scardafella inca, 224, 227
Schennitz, Sanford D., Nesting association of Pileated Woodpecker and Yellow-shafted Flicker in a utility pole, 95
Schorger, A. W., Spring migration of Blue Jays at Madison, Wisconsin, 6-9; The Trumpeter Swan as a breeding bird in Minnesota, Wisconsin, Illinois, and Indiana, 331-338
Schwartz, Paul, Bird Songs from the Tropics, reviewed, 301-302
Scolopax rusticola, 150
Secretarybird, 362
Seiurus aurocapillus, 152, 165
Serinus canarius, 153
Setophaga ruticilla, 189
Shaub, Benjamin M., John James Audubon and juvenile Evening Grosbeaks, 174-178; Notes on the destruction of banded Evening Grosbeaks in Quebec in 1960, 179-185
Shoveler, 291-292
Shrike, Loggerhead, 279
Sialia sialis, 327
Skimmer, Black, 339, 341
Skink, Five-lined, 325, 326
Skutch, Alexander F., Life histories of Central American pigeons, 211-247
Snipe, Ethiopian, 362
Southern, William E., Additional observations on winter Bald Eagle populations: including remarks on biotelemetry techniques and immature plumages, 121-137; review by, 204-206
Speotyto cucularia, 28, 35, 151
c. floridana, 28
c. hypugaea, 28
Sperniestes cuculatus, 152
Spheniscus demersus, 148
Spinus, 235
tristis, 182
Spizella arborea, 328
passerina, 153, 328
pusilla, 328
Sparrow, 328
Chipping, 142, 328
English, 327
Field, 142, 328
Gambel's, 328
Grasshopper, 325, 326, 327
Song, 142, 166, 328
Tree, 328
Vesper, 327
Spatula clypeata, 291
Squatarola squatarola, 157
Stager, Kenneth E., The Role of Olfaction in Food Location by the Turkey Vulture (*Cathartes aura*), reviewed, 390-392.
Starling, 362
Steatornis caripensis, 151
Stercorarius longicaudus, 151
parasiticus, 151
pomarinus, 151
Sterna dougallii, 339
hirundo, 339
Stevenson, Henry M., review by, 103-104
Stickel, David W., Roosting habits of Red-bellied Woodpeckers, 382-383
Stork, White, 342
Strix aluco, 151
varia, 292
Strong, Reuben Myron, memorial, 386-387
Stupka, Arthur, Notes on the Birds of Great Smoky Mountains National Park, reviewed, 103-104
Sturnella magna, 325
Sula dactylatra, 149
leucogaster, 149
Swallow, 362
Barn, 94
Cliff, 327
Rough-winged, 140, 141
Tree, 182
Swan, Trumpeter, 284, 331-338
Whistling, 282-285, 331, 332, 334
Swift, Black, 295-296
Chimney, 141
White-throated, 279
Swinebroad, Jeff, Nocturnal roosts of migrating shorebirds, 155-159
Swisher, John F., Jr., A roosting area of the Bald Eagle in northern Utah, 186-187
Tanager, Scarlet, 37-42, 142, 143
Summer, 142
Tanagra trinitatis, 96-97
violacea, 97

- Tapera naevia*, 151
Taraba major, 151
 Taxonomy, 50-61
Tchagra, 152
 Teal, 118
 Blue-winged, 291-292
 Red-billed, 362
 Tern, 344-345
 Common, 339
 Roseate, 339
 Territory, 160-169
Tetrapteryx paradisea, 360, 362, 374
Thamnophilus doliatus, 151
Theristicus, 44
 Thomas, Jack Ward, Diagnosed diseases and parasitism in Rio Grande wild Turkeys, 292
 Thomas, Jack Ward, Calvin Van Hoozer, and Rodney G. Marburger. Notes on color aberrancies in the Rio Grande wild Turkey, 381-382; Wild Turkey behavior affected by presence of Golden Eagles, 384-385
 Thompson, Daniel Q., and Marjory D. Lyons. Flock size in a spring concentration of Whistling Swans, 282-285
 Thrasher, Brown, 141
Thraupis virens, 152
Threskiornis aethiopicus, 362
 Thrush, Rufous-collared, 225
 Wood, 141
Thyrothorus ludovicianus, 327
 Tilley, Stephen, see Putnam, Loren and ———
Tinamus major, 148
 Tit, Great, 165
 Titmouse, Tufted, 140, 141
Tityra semifasciata, 151
Tockus alboterminatus, 151
Todirostrum cinereum, 152
 Tomkins, Ivan R., Migration and habitat of Long-billed Dowitcher on the coast of Georgia and South Carolina, 188-189
 Todd, W. E. Clyde, Birds of the Labrador Peninsula and Adjacent Areas, reviewed, 298-299
Totanus flavipes, 157
 melanoleucus, 157
 Toucan, Rainbow-billed, 238
 Red-breasted, 5
 Toco, 5
 Toucanet, Saffron, 5, painting opposite page 5
 Yellow, 5
 Towhee, Rufous-sided, 16, 142
Toxostoma rufum, 152
Troglodytes troglodytes, 327
 Trowern, Robert W., see Pilling, Norman B. and ———
Turdoides bicolor, 152
Turdus albiventris, 152
 libyanus, 152
 merula, 152
 migratorius, 152, 327
 pilaris, 14
 rufitorques, 225
 Turkey, 292, 381-382, 384-385
Turnix suscitator, 149
Tyrannus crassirostris, 265, 267, 274, 275, 279
 melancholicus, 152, 266, 279
 m. chloronatus, 275
 m. occidentalis, 264, 275
 verticalis, 265, 266, 268, 270, 271, 272, 273, 274, 275, 278, 279
 rociferans, 265, 266, 267, 268, 270, 271, 272, 273, 274, 275, 278, 279
Tyto alba, 35
 a. guttata, 31
 a. pratincola, 28, 31
Upupa africana, 151
Vanellus vanellus, 150
 Van Hoozer, Calvin, see Thomas, Jack Ward and ———
 Vireo, 377
 Bell's, 172
 Hutton's, 172
 Philadelphia, 171
 Red-eyed, 140, 142, 171
 Solitary, 142, 172
 Warbling, 170-173
 White-eyed, 172
 Yellow-green, 172
 Yellow-throated, 141
Vireo bellii, 172
 flavirostris, 172
 gilvus, 170, 171, 172
 griseus, 172, 173

- huttoni*, 172
olivaceus, 171, 172
philadelphicus, 171, 172
solitarius, 172, 173
Voice, 212, 215, 217, 221, 224, 229-230, 240, 359, 374
Vulture, Turkey, 141
Walker, Lewis Wayne, see Banks, Richard C. and ———
Walkinshaw, Lawrence H., The African Crowned Cranes, 355-377
Wallace, George J., An Introduction to Ornithology, reviewed, 101-102
Warbler, 327
 Bay-breasted, 167
 Blackburnian, 142, 143
 Black-throated Blue, 96, 142, 143
 Black-throated Green, 142, 143
 Black-and-white, 140, 142, 143
 Canada, 142, 143
 Chestnut-sided, 142, 143
 Hermit, 327
 Hooded, 142
 Kentucky, 142
 Parula, 142, 143
 Pine, 142
 Prairie, 142
 Swainson's, 142, 143, 144, 145
 Worm-eating, 142, 145
 Yellow-throated, 142
Warnock, John E., and G. Blair Joselyn, Resting of wild pheasant hen, 97-98
Waterthrush, Louisiana, 142, 144
Weights, 128, 256, 358, 366, 373
Whimbrel, 99
Whip-poor-will, 141, 226
Widgeon, 118
 American, 190
Widowbirds, 362
Williams, Laidlaw, see Davis, John and ———
Wilson Ornithological Society
 Annual Report of the Conservation Committee, 306-312
 Josselyn Van Tyne Memorial Library, 192
 Membership, 61, 93, 159, 185, 289, 296, 354, 394-426
 Officers of, 392
 Ornithological News, 100, 191-192, 297, 388
 Proceedings of the Annual Meeting, 313-320
 Publication Notes and Notices, 208, 305
Woodpecker, Downy, 141
 Hairy, 141
 Ivory-billed, 74
 Pileated, 74, 95, 141
 Red-bellied, 382-383
Wren, Carolina, 141, 327
 Winter, 327
Xema furcata, 347
 sabini, 352
Yellowlegs, Greater, 157
 Lesser, 157, 188
Zapus h. hudsonius, 324, 325, 326
Zenaidra asiatica, 224-227
Zenaidura macroura, 94-95, 243
Zonotrichia leucophrys gambelii, 328

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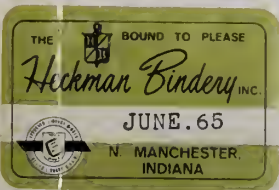
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