# LIFE HISTORY OF THE RED WARBLER

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THE Red Warbler (*Ergaticus ruber*) ranges in the "Mountains of Mexico from Southern Chihuahua and Hidalgo south to Oaxaca" (Miller et al., 1957). Of the two described races, *E. r. melanauris* breeds in the high Sierra Madre Occidental biotic province (Goldman and Moore, 1945) of Chihuahua and Durango, but may winter at lower elevations. Moore, who described this race, considered it migratory on the basis of specimens taken at 5,600 feet near Batel, Sinaloa in October, 1958.

Between May 1963 and July 1965, I spent 550 hours studying the nominate race in Desierto de los Leones and Miguel Hidalgo National Parks near Mexico City. *E. r. ruber* occurs sparsely at the upper limit of conifers (12,000 feet) and increases in numbers throughout the fir belt (11,500 to 9,500 feet), decreasing again in abundance at the ecotone of pine woodland and non-forested land at the base of the mountains. Perhaps in response to milder climatic conditions in the Transverse Volcanic and Sierra Madre del Sur biotic provinces, the nominate form manifests little seasonal movement. I noted a few family groups moving into the foothill fir-pine ecotone in late summer, while young birds infrequently strayed into the lower pine-oak woodland (ca. 8,000 feet) in August, and a few adults descended into open pine woodland scrub (ca. 7,000 feet) during harsh weather in winter. Annual fluctuation in wintering parulid populations in Mexico is suggested by Smith's (1909) comment that Red Warblers were ". . . few when compared with the Red-bellied Redstart or Red-faced Warbler." This is exactly opposite to my findings in the same area fifty years later.

The Red Warbler breeds in the mature conifer forest where sunlight penetrates freely to the forest floor, such as the brushy edges of trails, watercourses, and windfalls. Since logging favors this species by increasing open areas, the population density in such severely logged locations as my study plots may exceed that found in undisturbed forests. Below the forest canopy, heavily shaded areas support small ferns and mosses whereas sunnier areas are thickly carpeted with the brushy legume, *Acacena elongita.* Small conifer stands isolated from the main forest are generally avoided, even when they appear to meet all the postulated requirements of a typical breeding area. Unpublished notes of Chester Lamb, Paynter (1952), and Zimmerman and Harry (1951) show that while the Red Warbler is basically a bird of the coniferous forest it can be expected in deciduous growth, but unlike its congener, the Pink-headed Warbler (*E. versicolor*), it has not yet been found breeding in such vegetation.

The Red Warbler frequents the "substory" and "middle level" foraging

zones of Miller (1963) and is more common in the latter. The species thus avoids direct competition with the Crescent-chested Warbler (*Vermivora superciliosa*) and the *Atlapetes* finches of the low-level shrubbery, and the wintering *Dendrocia* forms foraging in the tree crowns. Singing Red Warblers are often driven from the centers of their territories by wandering Audubon's Warblers (*D. auduboni*).

Mated pairs usually remain close together except during the post-breeding molt period or during severe winter weather. It is unusual to see more than two adults together but rarely two individual pairs may forage amicably together in mid-winter. Association with winter mixed-species flocks appears casual and is relatively infrequent. At such times, when disturbed by larger birds, Red Warblers do not normally exhibit displacement hostility toward smaller species such as kinglets (*Regulus*) or bushtits (*Psaltriparus*). On 17 March, 1965, a pair each of Slate-throated Redstarts (*Myioborus miniatus*) and Red Warblers foraged side by side in the same tree for an hour. Such tolerance between birds with apparently similar feeding methods and prey requirements seems remarkable, especially at the onset of their mutual breeding seasons.

The daily foraging area is quite small, often only a dozen meters square. The birds feed with quick repeated jabs into bark cracks and needle clusters, or glean the trunk crevices while hanging head down like a nuthatch. They may hover with the tail rapidly pumping up and down, probing like a hummingbird among the conifer needle fascicles. When feeding within deciduous growth, they do notably more fly-catching than bark-foraging. Foraging declines in the late forenoon. Many individuals then enter some shady spot where their brilliant color seems to disappear in the shadows. Here they rest from 30 seconds to several minutes, slumped down upon a branch, with closed eyes, often with the bill buried beneath the bend of a wing.

When the birds are awake and active, all movements are exceedingly quick with short pauses of spasmodic head-cocking punctuated by abrupt turns as the tail jerks nervously to-and-fro. The birds preen incessantly and without discernable pattern since the same plumage area is often redone during a single session. Males often preen vigorously after a conflict with another bird, and females may do so when disturbed while approaching the nest.

In March, 1965, an unusual example of crepuscular feeding was noted ten minutes before sunset when several pairs of Red Warblers appeared over a clearing to feed voraciously on a dense swarm of neuroptera flying over the open area. This continued well into dusk.

The normal flight is a few quick strokes, interrupted by a brief undulating glide. After crossing a clearing, the warbler glides on set wings the last few feet on into the foliage rather than halt at the outer extremities of the tree.

VOICE

Call notes are heard in diverse situations throughout the year, although with considerable reduction in rate during the molt. The Red Warbler's typical note is quite distinct from that of other sympatric parulids. Lowery and Dalquest (1951) suggested some resemblance to the note of the Golden-crowned Kinglet (*Regulus satrapa*). I would describe the call note as a sibilant *chi-ip* or *shee-ip*, with the terminal syllable "fussy" and rising in inflection, apparently caused by an increase in volume. Usually only one brid of a pair calls at a time, repeating the note every two to four seconds. Females utter a unique double note, a sharp *chip-chip* and may increase their call-rate to a trill when males prolong the interval between rounds of singing. Females also give an insect-like *buzzz* while driving other birds from the nest area. One mated female not yet building a nest gave a soft reedy trill followed by the double chip note. On 25 April 1965, a Sharp-shinned Hawk (*Accipiter striatus*) perched nearby caused a male warbler to utter a series of high-pitched *z-e-e-e-t* notes while holding its body motionless and bobbing its head. Another male, driving a wren (*Troglodytes*) from the nest, produced a raucous *sheeerrr-cheeeerrr* note. No obvious difference in notes or call rate was noted between breeding and non-breeding birds.

The male's song is complex, generally composed of three distinct note combinations. Usually, three forceful, clear notes are followed by a complex jumble of burrs, trills, and chips of lesser volume. One phonetic version from my notes was: *cheevy-cheevy-cheevy . . petle-petle-petle, chur chur*; Lea and Edwards (1950) noted one version as "*chivy, chivy chivvy, hu-r-r-r-r, chiv-chiv-chiv.*" Since there is much individual variation, up to six such series may be uttered, but three is about the average. A dry, reedy trill may terminate the series. Unmated birds incorporate a sharp clear *tchurr* never noted in songs of mated males. Gular movements continuing after cessation of audible song suggest other notes in a range beyond my hearing ability.

Courting males sing six to eight songs per minute, followed by silent periods of variable length. Mated birds move constantly, seldom giving two songs from the same perch and remain in sight of the female; unmated birds remain in one place comparatively longer, and infrequently sing in tree-tops.

On 14 March 1965, a bird sang a complete song while performing a display flight, while on 17 April a male known to be mated sang while making brief flights spanning three to four meter distances. Each landing terminated in an interesting redstart-like wing-and-tail fanning performance.

Most other species in this habitat increase their singing tempo as the afternoon skies darken during the summer rainy season, but the Red Warbler

sings only in the bright morning hours. Even during the dry winter months, calling diminishes whenever clouds form.

## TERRITORY AND COURTSHIP

By late February, most males are singing on well-defined territories. Concurrent with the increasing demands of bringing off the brood, the defended area is reduced in size and territorial behavior terminates in August when the young fledge and molt begins.

Prior to nesting, territory size varies depending on the number of males, vegetation density, and terrain configuration. Nine measured territories varied from 30 to 60 meters square, with an average size of 40 meters square. *Acacena elongita* provided most of the ground cover in these units and females always built their nests on the ground beneath this plant. Isolated sections of territories bisected by large clearings were ultimately left undefended.

Males challenge adjacent males by flying silently about three meters off the ground into the adjacent territory and immediately returning to the starting point. Series of such sorties may continue for 20 minutes, depending on the defender's response. Usually the reply is a lesser number of less extensive flights, but should a trespasser intrude too deeply into the territory or dare to alight, there invariably ensues a struggle in which both birds may fall to the earth silently locked in combat. The intruder is always ejected, and upon fleeing to its own territory, often breaks into song. Either bird may then preen, bill-wipe, or quickly rotate the rear quarters and rectrices as described by Hamilton (1959). While mated males sometimes expropriate parts of a single bird's territory, conflicts between adjacent conjugal males seldom result in any disruption of the previous boundaries. Two battling males once drifted into a third territory whose male attacked with one flight before adjourning to sing, and once five males (two of which were definitely new in the area) clashed in a spectacular encounter. I once saw a female attack a strange male. Another female repeatedly attacked her own mate after he had routed an intruder.

Courtship chasing begins in mid-March and varies from short darting flights by males toward females to extended pursuits through the understory. Following such flights, the birds sit inches apart and the male sings, often accompanied by soft calls from the female. Resumption of feeding and preening often follow several minutes of wing-flitting and fluffing of plumage. After a chase, the female often moves under the *Acacena* and creeps about pressing her breast into the ground as if seeking a nest site. Some males are so aroused by "site-seeking" that they fly down and strike their mates, especially if she pauses in an exposed situation. Such "pounces" are often of sufficient force as to knock the female off balance. One male made

long flights across his territory while his mate went through these site-seeking motions, but usually a male will perch and often sing with a soft, lispy quality while watching the female intently, or he may wait until she resumes her place in the conifers before he sings. One female "pounced" on a male approaching a site she had just vacated. On one occasion I saw a male doing the searching and singing song fragments while the female played spectator.

"Pouncing" may not be restricted to nest-site searching; any time a female is near the ground, the male may utter a sharp *see-ipp* and pounce at her. Such behavior ceases with the advent of nest-building for some pairs, while other males persist in pouncing up to the time of hatching of the eggs.

One male singing about four meters from his mate responded to her single soft note by gliding to her side with an almost "floating" flight. Although he landed so that their wings touched, copulation did not occur. After a moment, he moved away and sang two short song fragments while the female preened intensively. On another occasion, a male displayed to his mate by gliding about 15 feet from limb to limb on set wings.

On 21 March 1964, a male accompanied by two presumed females attacked a flycatcher (*Empidonax*) which ventured between him and the more distant of the two females.

### NEST-BUILDING

Nest construction was first noted on 14 March. The male neither assists the female in building the nest nor does he bring her food, but as an omnipresent observer, he watches her intently throughout the process and follows her during forays for food or material. If she momentarily leaves his view, he moves about the territory calling and singing song fragments. Should she pause while carrying material, he often "pounces" on her. She can be equally aggressive if he moves near the nest.

Nests are mostly composed of grass leaves and stems, but shreds of bark, fern-frond tips, conifer fascicles, and dead deciduous leaves may be included. The nests are woven about the stems of *Acacena* and are always well concealed by foliage. Exteriors bear varying amounts of fine moss and lichen, and all but one nest was lined with very fine shredded grass stems. The lining thickness varies considerably between nests. The unlined mid-June nest described by Elliott (1965) now appears to be exceptional, suggesting that late nests (re-nesting attempts?) may be atypical in construction. Two nests were cup-shaped and three oven-shaped, but no obvious correlation appeared between form and either plant cover type or density, or the time of completion during the breeding season. Skutch (1954) and Dawn (1963) found only oven-nests built by the Pink-faced Warbler in Guatemala. I noted that the Red Warbler builds the cup first and the dome later, while Skutch

noted that this sequence is reversed by the Pink-faced Warbler. (For a photograph of a nest in Oaxaca, see Rowley, 1966:193.)

Rim-to-rim nest cup measurements ranged from 12.5 cm to 15 cm, with depths of 8.2 cm to 11.5 cm. The cup of open nests averaged 5 cm across and deep, while oven-nest interiors averaged 6.5 cm wide and 7.2 cm deep. Oven-nest entrances averaged 4.5 cm wide and 3.8 cm high.

Construction proceeds in a steady, unhurried manner. Early in the season, seven females averaged three to five trips every two minutes, but as the April rains began, the pace slowed to one trip per minute. Later in the day, pauses of 10 to 12 minutes duration were spent feeding and preening. Nest material is taken from on or very near the ground, and as many as six grass stalks may be carried at once. Items are retained in the bill while new ones are gathered and any material dropped is ignored. Certain females remain 20 to 30 seconds at the nest while others make repeated hurried trips with material followed by a prolonged period at the site. This suggests building when a suitable accumulation is acquired but I cannot confirm this. A bird is typically very cautious in approaching the site. Each female has a certain perch close to the nest where she sits with her beak full of material and peers about for some time. Dropping in a quick plummet into the *Acacena* about a meter from the nest, the female covers the remaining distance concealed under the foliage.

One first-year bird (brown-edged remiges) exhibited disorganization and uncertainty in her nest building, as she wandered about for extended periods, preened incessantly, and uttered a soft rapid trilling while attempting to build. She brought such unsuitable material as leaves thrice her own size and was once flipped end-over-end when she attempted to fly between two closely spaced upright stalks with a six-inch long twig held in her bill. She abandoned her efforts after nine days. All other nests I observed were completed in four to six days.

### INCUBATION AND THE CLUTCH

Five of the nine nesting attempts that I observed reached the egg stage. Early in the breeding season, up to eleven days may elapse between nest completion and laying of the first egg; by May, laying follows immediately. Data from two nests indicate that eggs are laid on consecutive days, but when incubation actually begins is not yet known. On 14 June one nest had three recently hatched young and 3 other nests had 3 eggs each. Nest 65M1 had but two eggs when a predator reached it on 28 March, but the second egg had appeared only the previous morning suggesting that this clutch was not yet complete. One specimen label (Moore Collection no. 45819, 28 May 1946, Guerrero) bears the notation ". . . found nest with three eggs." Probably the average clutch is three eggs. After two young fledged from one nest on

12 June, two infertile eggs were found buried in the nest lining, suggesting a four egg clutch. All these data pertain to the nominate race. Nothing has been reported to date on breeding by *E. r. melanauris*.

The eggs exhibit a faint glossy white ground color which becomes duller as incubation proceeds. A wreath of densely concentrated, very small irregularly shaped cinnamon and russet spots rings the larger end of the egg. These spots decrease in quantity and size, and fade in color toward the egg's smaller end. Two eggs collected nine days after the start of incubation weighed 1.0 g each, the third 1.4 g. They measured 17 × 12.5, 17 × 13, and 16.5 × 13 mm. The two infertile eggs previously mentioned were only 15 × 12.5 mm each.

The male does not incubate nor does he approach the nest until the third or fourth day after the eggs hatch. During incubation, he remains at some distance from the nest and sings only "whisper-song" fragments. Despite his tendency to remain away from the nest during this period, he usually appears immediately at the female's side when she leaves the nest. "Pouncing" now disappears, but if his mate pauses while returning to the nest, the male becomes agitated and often moves toward the nest, calling rapidly. During the female's absence, the male reacts aggressively to any bird near the nest, but when the female returns, he generally ignores all other species, except wrens. These intruders elicit chases and a "threat-flight" in which the male warbler's wings produce a muffled, fluttering sound as the bird flies toward the wren.

Incubating females react to danger by sitting very tightly and may almost be stepped upon before the bird flushes. I often sat only a meter away from one relatively exposed nest and watched the female settle down and go to sleep. Although Dawn (1963) observed Pink-headed Warblers giving distraction displays, I did not see such behavior by the Red Warbler.

Events at nest 65M7 on 22 May suggest that the nest-site is as important as the nest itself. The female fluttered anxiously about while I photographed and then removed this nest which was in the incubation stage. After I departed she searched over an area of about 15 inch radius about the spot where the nest had been. I then placed the nest 70 cm from the original spot and again retired. The bird flew excitedly about, twice went to a twig 7 cm above the totally exposed nest, looked into it and then returned to the original spot, resuming her agitated search of this area for about four minutes. Finally, she mounted the twig over the nest, called once and dropped in, settling on the clutch. Minutes later, I approached to within a meter before she flushed. She could not be induced to re-enter the nest, although she did revisit the old site several times. The male appeared once briefly and departed without returning.

Females sit in oven-nests at a 45° angle to the long axis of the entrance, with their foreparts deep inside the bowl, tails protruding through the doorway. In cup nests, the female's eye is just level with the rim; thus, her brighter parts are covered and only the brown dorsum is exposed, rendering her quite inconspicuous.

Typical incubation rhythm is indicated by data from one female timed for 11 sessions on the clutch alternating with 12 recesses. The latter ranged from 3 to 19 minutes each, totaled 103 minutes and averaged 8.5 minutes. Sessions on the eggs ranged from 12 to 27 minutes, totaled 200 minutes and averaged 18.2 minutes. Twelve five-hour periods at two nests over a six day range indicate that the females were covering eggs about 66 per cent of the time.

My observations of incubation periods at five active nests parallel the findings of Skutch and Dawn for the Pink-faced Warbler. Dawn's (1963) April-nesting birds hatched in 16 days, two young fledging in 10 and 11 days respectively. Skutch's (1954) data, derived from three nests with five successful fledglings, are similar; his 11-day record referred to a "handled" bird and his 10-day bird was "frightened." The fledglings noted during my study left the nest after 10 and 11 days.

Austin (1961) gave typical data for warbler nestings as follows: Northern Egg Average 4–5 (6), Tropical Egg Average 2–3; Northern Incubation 11–14 days, Tropical Incubation 13–16 days; Northern Nestling 8–14 days, Tropical Nestling 12–14 days. The Red Warbler, which dwells in an essentially boreal environment, follows the trend of northern birds in its nestling period, but displays a tropical pattern in clutch size and incubation period.

### THE NESTLINGS

Only the female broods, lingering on the nest until well after dawn and returning regularly throughout the morning until the young attain thermoregulation on about the fourth day. Brooding occurs thereafter only during the afternoon rains and overnight. Five brooding sessions, during the third day of nest life ranged from 3 to 19 minutes, but exceptionally, a session may run to 35 minutes.

Both parents are extremely cautious. They approach the nest by swiftly flying close to the ground and neither bird visits the site while something they consider disturbing is near. Though singing is now uncommon, males will sit concealed and motionless, calling softly for minutes on end. This seems not visibly to affect the female's activities. Nest defense is intensified and even large nightingale thrushes (*Catharus*) near the nest are attacked. One female "pounced" on a nearby group of three juncos, knocking two of them off balance. The male may dart out at nearby squirrels and his

call-rate increases markedly. He may summon the female from the nest after she has brooded awhile, but until the third brood day the male will not approach the nest closely when she is absent. The adults often forage together near the nest, usually working on trees, while birds foraging far from the nest and individually do more fly-catching. This suggests the use of a less conspicuous feeding method while near the nest, but it may also involve the food requirements of the nestlings. By day three, most males assist the females in feeding the brood (male 64M1 was an exception, not approaching until the 7th day) and food items are still concealed in the mouth or throat. By day six the young can devour larger items and parts of caterpillars and small moths are often seen protruding from the adult's mandibles.

The nest cup is always scrupulously clean. The female devours the fecal sacs at the nest or carries them away. Only once did I see a male remove a fecal sac.

The youngest nestlings observed (two days old) weighed approximately 2.9 g. The posterior half of the crown exhibited minute traces of medium gray natal down about 2 mm long and a few isolated shorter tufts appeared on the humeral, marginal, and dorsal tracts. The eyes were closed. The mandibular tomium was bright yellow, the rest of the bill a shade darker. The tarsometatarsi and mouth-lining were soft pink. Only when the bill was tapped, could the young momentarily raise their heads with partially-opened gapes.

Three four-day old birds were found heaped in the bottom of the nest. Their eyes were not yet open and they did not raise their heads during handling. An unidentified mucous-like film covered the entire body of one bird and the head of another. The nestlings showed darker, thicker body down, but the forecrowns remained bare. Primary sheaths 2 mm long barely penetrated the skin. The marginal tract down had increased somewhat, but the femoral and ventral tracts remained bare. Body size had not increased appreciably (one bird weighed on a postage scale had only gained 0.5 g).

Seven-day old nestlings were found dozing with their faces toward the oven-nest entrance. They ranged in weight from 5 to 5.5 g. Plumage on the ventral wing and body surfaces was still lacking, but the primary sheaths were now 5 mm long and the young could momentarily sit erect. Although all were silent, their eyes were now open. They responded well to the slightest motion of a moth in the bill of a mock-up of an adult bird, and gaped when I touched the nest rim. Their tomia were a slightly duller yellow than on day three and the mouth/throat linings were bright blood red. Skutch (op. cit.) generalized that the mouth linings of nestling warblers are always yellow. However, he has since ascertained (pers. comm.) that this ". . . was

based chiefly on my observations of members of the tropical genera *Basileuterus* and *Myioborus* whose mouths quite regularly seem to be yellow inside. . . . Recently I have discovered that in *Vermivora gutturalis* and *Geothlypis chiriquensis* the nestlings mouths are yellow on the marginal parts and red on the deeper parts. . . ." Skutch did not recall the mouth colors of the Pink-faced Warbler. A very young bob-tailed juvenile male taken by A. R. Phillips on 1 July 1964 (ARP no. 3496) weighed 8 g (the weight of some adults) and showed the "gape, pale yellowish buff, mouth, bright orange."

### THE FLEDGLINGS

During the first few days out of the nest, juveniles frequent the low thickets, but when the remiges approach adult size (14–15 days after hatching), the fledglings move to the conifer mid-levels. They follow a parent bird, begging with a rapid *see-see-seep* call. As an adult approaches, the young tips-up the tail and spreads the half-opened, rapidly quivering wings on a horizontal plane. The begging call, interjected by squeaky notes, continues until food is placed in the gape. In addition to their own foraging efforts juveniles are fed by adults every one to three minutes. Older begging birds feed at about the same rate as their parents. Adults and young seek one another, but the vociferous young contrast with the silent adults. Young birds beg before redstarts and Wilson's Warblers (*Wilsonia pusilla*), but without response. One bob-tailed juvenile begged from a junco, but an adult Red Warbler swiftly placed itself between the two and displayed by extending its neck and rapidly fluttered its wings. The junco then flew off.

The remiges are fully grown when the dark tips of the juvenile plumage wear off changing the plumage color to buff. The fully grown youngster can now care for itself, as proven by its ability in fly-catching. Bob-tailed young attempting to feed in the latter manner are quite inept.

The adult males now become hostile toward their offspring and interfere with the females efforts to meet the youngs' demands. Three weeks after fledging, the females' attentions have similarly waned. Both adults attack the young, who often fight among themselves. Adults are now beginning the post-breeding molt and females particularly appear worn and ragged. Certain young birds still follow adults, but they no longer beg; they may even weakly return an older bird's attack. These independent young-of-the-year rarely call.

The mortality rate during nestings is very high. Of nine nesting attempts, five nests reached the completion stage and only two of these produced eggs which hatched. A four-egg nest fledged only two young, and three seasons of study disclosed only two out of thirteen pairs that attained the stage of feeding more than one young bird. Both these cases involved two young, and successful broods of three or more were never observed.

Double broods seem unlikely, and intraspecific nest helpers are no doubt rare considering the pronounced intraspecific hostility of this species.


## SUMMARY

The Red Warbler, a Mexican endemic and, at least in the south, non-migratory, is common in coniferous forests, ranging from about 8,000 to 12,000 feet above sea level, being most abundant at the lower middle altitudes. It prefers the mid-level of conifers along edges and sunlit clearings, where it remains in pairs throughout the year. It does not readily associate with winter groups of other species.

Courtship consists of chasing, "pouncing," special display flights and singing. Song, given by the male only, is heard from February to June. The songs of mated and single males are different.

During three seasons of study, nine nesting attempts were observed, five of which passed to the incubation stage. The female alone prepares the nest, which is built on the ground and may be either cup or oven-shaped.

The normal clutch is three eggs, but one clutch of four was recorded. The male does not incubate, but shares in feeding the young, although he usually does not approach the nest until three days after the eggs hatch. Eggs pip in about 16 days and fledging occurs 10 to 11 days later.

Three weeks after fledging, the young are fully grown and, preceding the inception of the Fall molt, are driven away by their parents.

Nestling mortality is high and only two out of 13 nests fledged more than one bird. Success of three eggs was never recorded.



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## LITERATURE CITED


AUSTIN, O. L., JR. 1961. Birds of the world. Paul Lamlyn, Ltd., London.

DAWN, W. 1963. Nesting of the Pink-headed Warbler. Nat. Hist., 72:28–31.

ELLIOTT, B. G. 1965. The nest of the Red Warbler. Condor, 67:540.

GOLDMAN, E. A. AND R. T. MOORE. 1945. The biotic provinces of Mexico. J. Mammal., 26:353.

HAMILTON, W. J. III. 1959. Aggressive behavior in migrant Pectoral Sandpipers. Condor, 61:161–179.

LEA, R. B. AND E. P. EDWARDS. 1950. Birds from the Patzcuaro region. Condor, 52:269.

LOWERY, G. H., JR., AND W. W. DALQUEST. 1951. Birds from the state of Veracruz, México. Univ. Kansas Publ. Mus. Nat. Hist., 3:531–649

MILLER, A. H. 1963. Seasonal activity and ecology of the avifauna of an American equatorial cloud forest. Univ. California Publ. Zool., 66:66–67.

MILLER, A. H., H. FRIEDMANN, L. GRISCOM, AND R. T. MOORE. 1957. Distributional check-list of the birds of Mexico. Pacific Coast Avifauna No. 33.

PAYNTER, R. A., JR. 1952. Birds from Popocatéptl and Ixtaccíhuatl, Mexico. Auk, 69:300.

ROWLEY, J. S. 1966. Breeding records of birds of the Sierra Madre del Sur, Oaxaca, México. Proc. of the Western Foundation of Vert. Zool., 1:193.

SMITH, A. P. 1909. Observations on some birds found in southern Mexico. Condor, 11:63.

SKUTCH, A. F. 1954. Life histories of Central American Birds. Pt. 1, Pacific Coast Avifauna 31.

ZIMMERMAN, D. A. AND G. B. HARRY. 1951. Summer birds of Autlán, Jalisco. Wilson Bull., 63:311.

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Waterfowl Migration Corridors East of the Rocky Mountains in the United States. By Frank C. Bellrose. Biological Notes No. 61, Illinois Natural History Survey, Urbana, Illinois, 1968: 23 pp. 6 maps. (Single copies available at no charge from the publisher.)

From an analysis of band recoveries; visual sightings of ground observers and aircraft observers; radar surveillance; formal waterfowl censuses; and the annual winter waterfowl inventory the author has arrived at updated versions of the Lincoln waterfowl flyway maps published years ago. Besides the informative text, excellent maps showing both the directions and intensities of the various flights are given for the fall migrations of the dabbling ducks, the diving ducks, and Canada Geese, and for both spring and fall migrations of Blue and Snow Geese.—G.A.H.

SYMPOSIUM: Introduction of Exotic Animals: Ecological and Socioeconomic Considerations. Sponsored by the Texas Chapter of The Wildlife Society at the 18th Annual Meeting of the American Institute of Biological Sciences. Published by the Caesar Kleberg Research Program in Wildlife Ecology, College of Agriculture, Texas A & M University, College Station. 1968. 25 pp. No price given.

A series of seven papers on this sometimes controversial subject, including two on quarantine and disease problems. All authors were more or less on the side favorable to introductions and the symposium would seem to have been rather one-sided.—G.A.H.