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LIFE HISTORY OF THE RED-LEGGED THRUSH (MIMOCICHLA PLUMBEA ARDOSIACEA) IN PUERTO RICO

by

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To the ornithologist the West Indies offer an assortment of field problems. In an area where it is unlikely that new species of birds will be discovered, and where the life histories of only a handful of birds are known, concentrated study of individual life histories becomes of prime importance.

This paper represents the third formal life history study of a resident Puerto Rican bird and the second of a passeriform.

BIAGGI's work (1955) on the Puerto Rican race of the Bananaquit (*Coereba flaveola portoricensis*) was the first life history done on the island with any degree of thoroughness. More recently RODRÍGUEZ-VIDAL (1959) made a three-year study of the Puerto Rican Parrot (*Amazona vittata vittata*), which has brought to light interesting information on its previously unknown breeding habits. SPAULDING (1937) wrote three short papers in which she set down her observations on the nesting habits of three native birds.

The works mentioned above plus a few scattered notes found in the literature on nesting, distribution, and eggs make up the largest part of the published information concerning the Puerto Rican avifauna. The paucity of information is evident when we consider that Puerto Rico has a total of 108 resident birds.

Little has been published on the life history of the West Indian Red-legged Thrush (*Mimocichla plumbea*). References to the thrush in Puerto Rico consist primarily of its inclusion in lists of birds seen on the island by various visiting ornithologists with perhaps a half-dozen remarks or so on the nest, eggs, and distribution.

The resident Red-legged Thrush, or "zorzal de patas coloradas" as it is called in Spanish, is the only representative of the avian family Turdidae on the island. The sexes are alike and the average length of adults is about 125 mm.

WETMORE (1922), in his investigations of bird remains from caves in Puerto Rico, found the bones of this thrush to be abundant. From Cueva Catedral, in Morovis, 40 right and 26 left humeri were secured. Remains were also found in three other caves. These have an estimated age of 100 to 2000 years, and their presence in the caves has been attributed to the deposition of pellets by owls. Either the Puerto Rican Barn Owl (*Tyto cavatica*), known only from fossil remains, or the Bare-legged Owl (*Otus nudipes nudipes*) could be responsible for these pellet remains. The Puerto Rican Barn Owl was known to roost in caves. The Puerto Rican Bare-legged Owl generally roosts in trees but WETMORE (1922: 320) states that he found bones of this species in several caves on the island. BENT (1938: 251) states that the Eastern Screech Owl (*Otus asio naevius*), which is comparable in size to the Puerto Rican Bare-legged Owl, has been known to feed on robins and even larger birds. So the

question is whether the Puerto Rican Bare-legged Owl was partly responsible for the Redleg thrush remains or whether this small owl was at times fed upon by the larger Puerto Rican Barn Owl. It is unlikely that the Puerto Rican Short-eared Owl (*Asio flammeus portoricensis*), has had anything to do with these thrush remains since its normal habitat is grassy marshes and lagoons. The remains indicate that at the times the deposits were made the Redlegs must have been common and well distributed on the island.

The present study of the Red-legged Thrush extended from August 1960 until July 1961. The main observations on nesting were made on the campus of the University of Puerto Rico at Mayagüez in the southwestern portion of the island. Other observations and investigations such as those pertaining to feeding habits and roosting were carried out on this campus and also on part of an 80-acre tract of land known as "La Finca Colegial". Some work was done on the grounds of the Federal Experiment Station in Mayagüez. On each area some trapping and color-banding was accomplished. During the course of the work specimens were collected and prepared. A limited number of eggs and nests were also taken.

Measurements are those indicated as being especially useful by BALDWIN, OBERHOLSER & WORLEY (1931). All weights are in grams and all measurements, except where noted, are in millimeters.

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SYSTEMATICS

Thrushes of the genus *Mimocichla* are peculiar to the West Indies. All the geographic races except one are confined to the Greater Antilles. These thrushes are closely related to members of the genus *Turdus*; indeed some workers do not recognize the genus *Mimocichla*, but merge it with *Turdus*. RIPLEY (1952: 18, 19) is in favor of supressing the genus since he feels that the presence of a strongly graduated, white-tipped tail, the principal morphologic character used to separate *Mimocichla* from *Turdus*, is not sufficient ground for maintaining the two as separate genera. I agree with BOND (1956: 128) and VAURIE (1957: 308) that *Mimocichla* should be retained as a separate genus, for the morphologic character stated above, because of the peculiar coloration of the orbital ring, bill, and legs, and on the basis of behavioral differences as well. At first glance the adults of the Red-legged Thrush appear to be very much like American Robins (*Turdus migratorius*). After numerous observations, however, one becomes aware that, even though the Red-legged Thrushes may resemble robins in many ways, in others they do not. They are much more secretive and shy in their mannerisms, as noted by WETMORE (1916: 92) and by BOND (1947: 166). VAURIE (1957: 309) remarks that in western Cuba Red-legged Thrushes at times behave very much like the American Robin but adds that some of their actions may be compared to those of the Catbird (*Dumetella carolinensis*) and the Mockingbird (*Mimus polyglottos*). The Puerto Rican Redleg does not resemble either of these two mimids in any of the mannerisms I noted.

The four species, *plumbea*, *ardosiacea*, *rubripes*, and *ravida*, of the genus *Mimocichla* as once recognized by RIDGWAY (1907: 79) have now been reduced to two (BOND, 1956: 128). *Mimocichla rubripes* and *M. ardosiacea* have been designated as geographic races of *Mimocichla plumbea*. *Mimocichla ravida* is a distinct species found

on Grand Cayman, and BOND (1956: 128) considers it to be a derivation from a form now extinct on Jamaica.

Mimocichla plumbea has been divided into six geographic races by BOND (1956: 128). These are: *M. p. plumbea*, northern Bahama

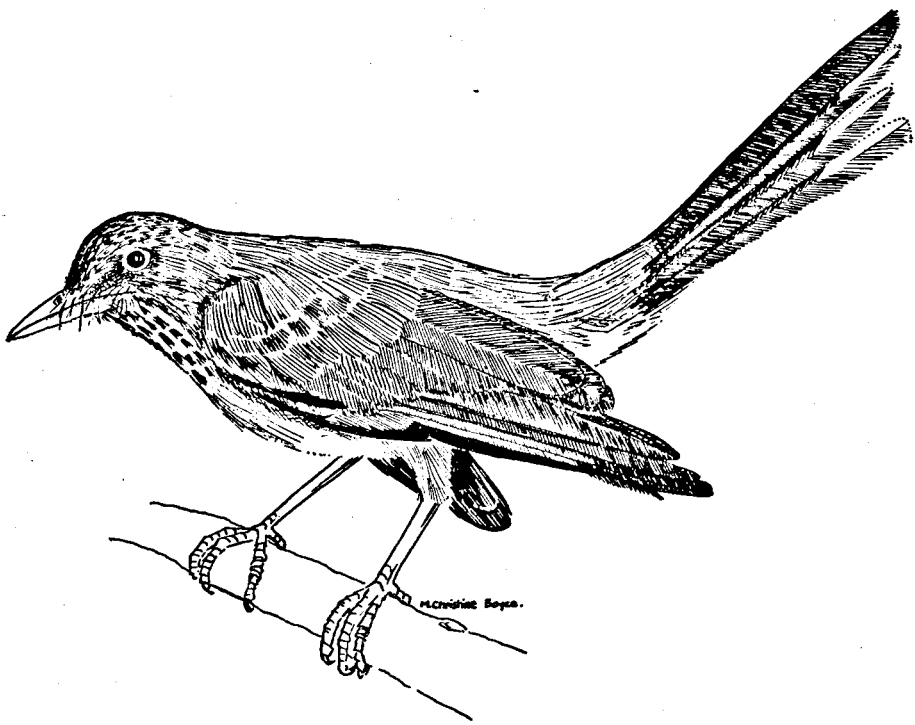

Fig. 1. The Red-legged Thrush of Puerto Rico (*Mimocichla plumbea ardosiacea*).

Islands; *M. p. schistacea*, extreme eastern Cuba; *M. p. rubripes*, central and western Cuba, Isle of Pines, and the Swan Islands; *M. p. coryi*, Cayman Brac; *M. p. ardosiacea*, Hispaniola (including Gonave and Tortue Islands) and Puerto Rico; and *M. p. albiventris*, Dominica. This last race is the only representative of the genus in the Lesser Antilles.

Of historical interest are the taxonomic changes that have been made with respect to the Hispaniolan and Puerto Rican populations. BRYANT (1867: 92, 93) was the first to separate the two populations.

His comments are as follows: "On comparing the series from Port au Prince, with that from Porto Rico, appreciable, though slight, differences can be detected, the bill and tarsi are brick red, instead of dull reddish-brown; the white tips of the tail feathers terminate obliquely toward the base, instead of being generally transverse;

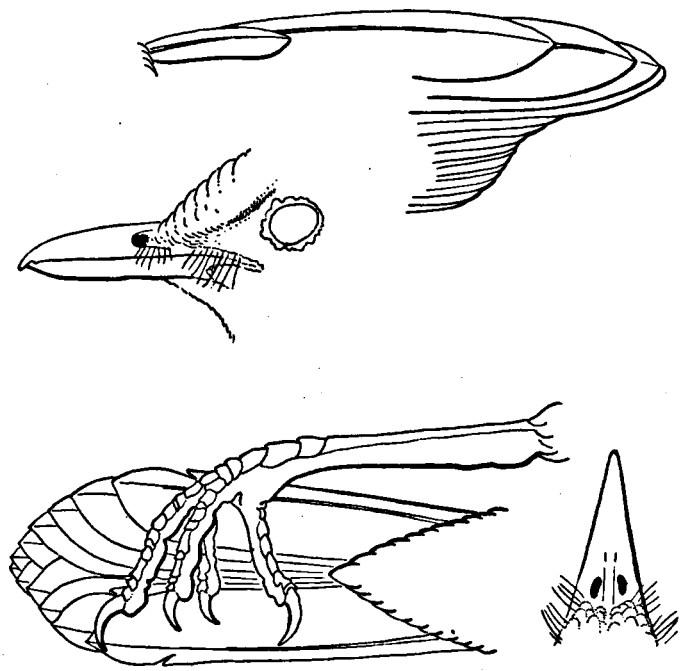

Fig. 2. Drawing showing some of the generic characters of the Red-legged Thrush (*Mimocichla plumbea*).

the bill is absolutely as well as relatively smaller; the wing is longer, the tail shorter... The Porto Rican bird may be called *Turdus ardosiaceus* var., *portoricensis*." WETMORE (1927: 491), in commenting on the birds from Puerto Rico, said that when taken in series they were larger in bill and tail measurements and had a more slate-gray color than the Hispaniolan birds, which have a bluish tinge. He added that some individuals from the two populations were indistinguishable in coloration. RIDGWAY (1907: 81) and HELLMAYR (1934: 446) referred to the Puerto Rican population as

distinct from that of Hispaniola, but HELLMAYR thought that it was an "exceedingly poor race" because of the slight differences in size and coloration of some specimens from the two populations. BOND (1956: 129), more recently, has considered the two populations as being racially indistinguishable.

Since the present paper is not a taxonomic study, I do not intend to carry the discussion of this problem much further. I have never visited the island of Hispaniola and my own opinions on the matter are based almost entirely upon a study of the literature. However, I have measured a series of 67 specimens of Red-legged Thrushes from Hispaniola and in Table 1 comparisons are made between these measurements and those of 113 specimens from the Puerto Rico population. It is evident that the Hispaniolan birds average smaller than the Puerto Rican birds.

TABLE 1.

Measurements of a series of 67 Red-legged Thrushes from Hispaniola compared with a series of 113 from Puerto Rico.

Item	Hispaniolan Population		Puerto Rican Population	
	Extremes	Mean	Extremes	Mean
Wing	112.0–133.5	121.5	115.0–137.4	125.1
Tail	91.2–122.0	106.6	97.1–129.0	113.6
Bill (from nostril)	14.0–19.9	17.1	15.0–20.0	17.7
Tarsus	34.5–42.5	38.3	35.0–42.3	38.6

Until more information can be adduced concerning the biosystematics of *Mimocichla plumbea* I accept BOND's conclusions that the Puerto Rican population is not racially distinct from the Hispaniolan.

SEX DETERMINATION

If there are external characteristics correlated with sex in Red-legged Thrushes, my studies have failed to demonstrate them. An internal check of the gonads is the only positive method of sexing these birds.

RIDGWAY (1907: 81) gives means and extremes of ten males and seven females of the Puerto Rican population as:

	Wing	Tail	Tarsus	Middle Toe
Male	122.5–138.5	107.5–123.0	38.0–40.5	21.5–24.5
	(128.9)	(115.1)	(39.5)	(23.5)
Female	121.5–130.0	102.0–120.0	36.0–39.0	21.0–24.0
	(126.3)	(115.5)	(37.4)	(22.5)

WETMORE's (1927: 491) measurements indicating means of 15 males and four females are:

	Wing	Tail	Tarsus	Culmen (at base)
Male	129.6	117.5	39.0	25.2
Female	125.8	112.2	37.9	25.0

TABLE 2.

A comparison of the measurements of 63 males and 32 females of the Puerto Rico population of the Red-legged Thrush.

Item	Male			Females		
	Extremes	Mean	Standard Deviation	Extremes	Mean	Standard Deviation
Wing (Chord)	120.0–137.4	127.3	4.7	115.4–131.0	123.1	4.5
Tail	103.4–129.0	116.6	6.7	97.2–119.6	112.2	6.4
Bill (from nostril)	15.0– 20.0	17.8	1.8	15.0– 20.0	17.7	1.5
Bill (at base)	7.0– 10.1	8.8	1.2	8.0– 10.1	9.1	1.0
Tarsus	37.0– 42.3	39.1	2.8	35.0– 40.1	37.5	1.5
Middle Toe	21.1– 26.9	24.0	1.6	21.0– 28.2	24.3	1.9

Item	Means for males and females	Difference between means (D)	D/E_D [1]	Probability of chance
Wing (Chord)	127.3–123.1	4.2	4.24	< 0.01
Tail	116.6–112.2	4.4	3.12	< 0.01
Bill (from nostril)	17.8– 17.7	0.1	0.345	0.73
Bill (at base)	9.1– 8.8	0.3	1.292	0.20
Tarsus	39.1– 37.5	1.6	3.63	< 0.01
Middle Toe	24.3– 24.0	0.3	0.765	0.44

[1] E_D = standard error of the difference = $\sqrt{E^2A - E^2B}$

E_A = standard error of sample A (males) = $\frac{\text{S.D.}}{\sqrt{63}}$

E_B = standard error of sample B (females) = $\frac{\text{S.D.}}{\sqrt{32}}$

During the course of the work I measured 63 male specimens and 32 female specimens. Six measurements were taken on each. Detailed information is tabulated in Table 2 and histograms for two of the six measurements are provided (figures 3 and 4). As the

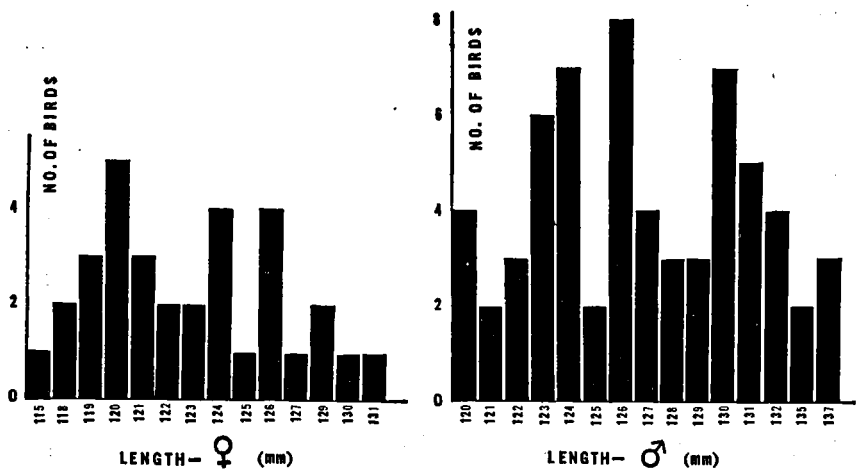

Fig. 3. Histograms of wing measurements of the Red-legged Thrush of Puerto Rico (*Mimocichla plumbea ardosiacea*).

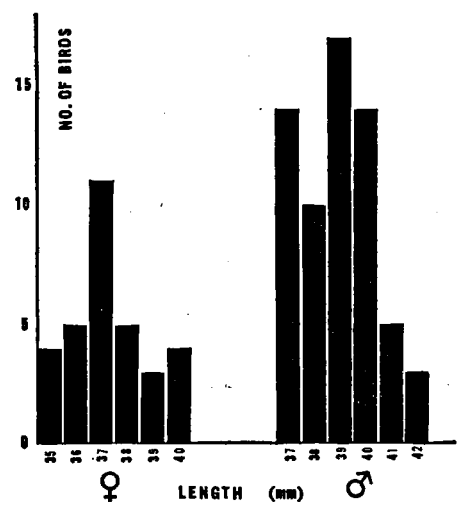

Fig. 4. Histograms of tail measurements of the Red-legged Thrush of Puerto Rico (*Mimocichla plumbea ardosiacea*).

table shows, three of the six measurements are statistically significant and seem to indicate that the males have longer wings (chord measurement), tails, and tarsi than the females. For example, the difference between the mean wing length of the male (127.3 mm) and the corresponding mean for the female (123.1 mm) is 4.2 mm. Can a difference of this magnitude be regarded as significant? The standard error of the difference between the two means indicates the probability of such a difference occuring by chance. The figure is less than 0.01. In other words in less than one out of 100 times would a difference of 4.2 mm be obtained purely by chance. Since a probability of less than 0.05 can be accepted as strong evidence that the figures tested represent a real difference between the variables, it appears that the difference is significant and that the wing length of males at large averages slightly larger than that of females. These same calculations were carried out for the other five measurements, but only in the lengths of the tarsi and tails did they prove to be significant at a similar level. It is worth noting here that the females are a trifle larger, in the series measured, as regards height of bill and length of middle toe. But the difference is not statistically significant.

Throughout this study sexes were differentiated, as far as possible, through behavior at the nest during the breeding season. It was assumed that the partner that sang was the male. Either the male or the female was trapped and color banded in such a manner as to insure recognition at the nest. During courtship males were readily distinguishable by their aggressive manners and habits of singing on the wing while pursuing the females.

General Activities

The Redleg prefers areas of tall trees and heavy undergrowth and is very common in the coffee plantations of hilly regions. Pastures with small streams running through them, and shaded by larger trees, are especially favored haunts. In southwestern Puerto Rico the thrush is well distributed, though usually it is not found in abundance in open country. I have found it to be scarcer, but still

common enough, in the higher mountains of the Maricao range. STRUTHERS (1923: 476) spoke of the Redleg as being common in citrus and coffee "fincas." At Cartagena Lagoon, in southwestern Puerto Rico, DANFORTH (1926: 125) found it to be a rare resident inhabiting the bamboo association.

I estimate that in the Mayagüez area *Mimocichla plumbea ardosiacea* is the fourth commonest bird. In my study areas only one species approximately equal to the thrush in size, the abundant Puerto Rican Grackle (*Quiscalus niger brachypterus*), was seen to be competing with the Redleg for food.

In the autumn and winter months general activities of the Redlegs are reduced considerably. During the day only a few thrushes are seen on the lower branches of trees and even fewer on the ground. The activities of the young or the adults are difficult to follow after nesting has been completed. After the young become independent of the adults the Redlegs enter a period of seclusion and quiescence and become cautious, wary, and very alert to disturbances. I have spent hours sitting in their favorite haunts during these periods without actually seeing more than a few scattered individuals. Thrushes that are disturbed or startled immediately begin to scold the intruder in a very boisterous manner, and apparently to warn other thrushes of the intrusion. During these periods they have impressed me as being highly excitable and abundantly endowed with nervous energy which they express by wing and tail jerking.

The rainy season in the Mayagüez sector extends from May until November, and during the period there is heavy precipitation in the form of short, convectional showers. Most of the rain comes in the afternoon, usually between the hours of 1 p.m. and 3 p.m. PICÓ (1950: 79) states that during the seven-month period of May to November Mayagüez receives about 80 per cent of its total annual rainfall. According to PICÓ the greatest contrasts of precipitation on the island are observed in the Mayagüez sector. Because of the mountain barriers east of them the western coastal valleys have to depend on convection for most of their rain. For the Mayagüez sector a 45-year record indicates an average annual temperature of 77.2 degrees F., and a 48-year record indicates an average annual precipitation of 80.41 inches.

During heavy rains the activities of the Redlegs are greatly restricted. They find protection, as best they can, under eaves of

buildings, in the dense growth of certain trees, and under the large, frondlike leaves of such plants as the banana. Rarely will thrushes be seen flying during a heavy downpour, and only when the rain begins to lessen in intensity will they venture out from their place of protection to forage. The disadvantages that heavy rains could impose on those Redlegs still nesting near the end of the breeding season remains a matter of speculation. But it seems reasonable to suppose that the heavier downpours cause destruction of nests and eggs in many cases. Young birds may be particularly affected; those that fall from the nest at an early age stand little chance of survival in prolonged rainy weather. Since the nests are such loosely constructed structures they are sometimes destroyed unless they are in a reasonably protected place.

I found a number of old nests that definitely showed effects of weathering. They appeared to be just a mass of loosely bound sticks with no semblance of the original structural pattern. During spring showers I observed the destruction of two nests, one of which had eggs, through the action of wind and rain. Also, in August 1960, I found a dead nestling that apparently had fallen from its nest during a heavy rain.

On 5 September 1960, a tropical hurricane passed 75 miles off the northeastern coast of the island. In the Mayagüez area there were no unusual weather disturbances until 6 September when fairly heavy winds and showers were experienced from about 11 a.m. into the late afternoon of the same date. That afternoon I made a check of one of my study areas; and to my great surprise, I saw not a single thrush during the two hours I spent in the area. I immediately suspected that the Redlegs had left the area for a more sheltered one. The possibility that they were high in the trees where I could not see them seemed unlikely for the heavy winds should have had a tendency to force the Redlegs to find shelter closer to the ground. My supposition that they had left the area was confirmed when shortly thereafter I found a group of 23 Redlegs congregated in small groups of threes, fours, and fives under the eaves of an abandoned building on the grounds of the Federal Experiment Station near the study area. It was clear to me that this situation was not a normal one for the Redlegs, since there was a good bit of confusion and aggressiveness being displayed among the thrushes. Apparently, the adverse weather conditions were the direct cause of this situation, for during the remainder of the study I never again saw Redlegs clustered together in such a fashion. SUTTON (1945: 605) mentioned finding birds seeking protection around buildings during a hurricane in Florida.

VOICE

No effort was made to keep records of the earliest and latest hours when Red-legged Thrushes were heard singing, nor was

information secured regarding the intensity of light and its possible relation to song. The Redlegs are by far the earliest birds heard singing in the morning in the Mayagüez area. Well before dawn, indeed as early as 3 a.m., they begin their choruses. But at the first sign of light the songs begin to dwindle, and by the time the sun has come up only a few thrushes are still singing. The second outstanding period of song comes in the evening at twilight. This period, however, has never struck me as being as impressive, with regard to the total volume of sound produced and numbers of Redlegs singing, as the morning choruses. In between the morning and evening periods, song virtually ceases at approximately 12 noon and resumes again by late afternoon.

Never during the study was a female heard to sing. Hence it is inferred that in this species only the males sing. The females, however, do utter a variety of calls. Redlegs sing in almost any situation except from the ground, and singing of males is common during sexual flights. These thrushes appear to show no preference as to song perches. I observed them singing from the tops as well as from the lower branches of trees.

The seasonal duration of song is apparently correlated with the breeding season although singing stops long before breeding activities have terminated. On 29 December 1960, I recorded the first Red-legged Thrush in song since the field work began in July 1960, and 22 days later I observed the first nesting activities. Song production appears to be at its height in April, but from then on it begins to lessen in total volume of sound produced and number of thrushes singing. By the end of May singing becomes sporadic, and by the first week of June hardly a thrush will be heard singing even though breeding may still continue into September.

DANFORTH (1926: 125) in commenting on the song of the Redlegs said that they sing from dawn to 7 a.m. and that their song is similar to that of the American Robin except that the Robin's notes are richer and more varied. DANFORTH reports that on the morning of 13 September 1928, after a hurricane, he heard a Redleg singing at daybreak from a leafless tree. It was the only bird he saw in the area. I question DANFORTH's remarks since I have never heard Redlegs in song this late in the year. It is not improbable that DANFORTH was referring to the call notes and not the song and erred in writing his field notes.

The song of the Redlegs is similar in some respects to that of the Pearly-eyed Thrasher (*Margarops fuscatus fuscatus*), and at the beginning of 1960 I sometimes

confused the song of the two species. The Thrasher's song, however, has far more volume to it. It is richer in tone and is also more variable in form. BOWDISH (1903: 20) also compared the song of the Redlegs with that of the Pearly-eyed Thrasher but felt that the Redleg's song was inferior in "variety, clearness and sweetness." WETMORE (1916: 92) said that the notes of the Redlegs were "not unpleasing" though repetition made them monotonous. BOND (1947: 166) found the song of the Redlegs to be "comparatively weak and hesitant, but not unpleasant."

I have experienced difficulty in setting the song down on paper. The following rendering, however, appears to express it fairly well: *chewéap — screeet, chewéap — screeet* ... The *chewé* portion of the song is on an ascending musical scale, while the note *ap* is on a descending scale. The second part of the song, *screeet,* is a higher pitched trill (at times ever more of a screech) issued more rapidly than the *chewéap* portion. Variations of the above pattern are: *chéa — screeet* or *ché — screeet.* Although the notes so far described seem to form the basic song pattern, I have heard others that are less commonly used and are quite different and may be examples of secondary song. These are: *chun, chun, chun* ... and *chú — an, chú — an* ... and *ché — a, ché — a* ... The commonly used song is slow and hesitating, and each complete phrase may take as long as four seconds to utter. There may be a long pause between the first (*chewéap*) and second (*screeet*) part of the song. Fifteen songs are the average number issued per minute.

The call notes of the Redlegs are made up of a number of disconnected nasal notes derived from a fundamental tone of high pitch and issued rapidly and repeatedly: *wéecha, wéecha, wéecha* ... or *wéeka wéeka wéeka* ... or *chu-wéek wéek wéek* or *wéek wéek chu-wéek* or *chu wéecha wéecha* or *chú-a-chu-wéek.* The alarm notes are much higher pitched, issued more rapidly, and form a stacatto effect: *week' week' week'* ... They are by far the most intense uttered by the Redlegs. Both sexes use the alarm notes freely when disturbed, especially during the breeding season. The utterance of the alarm notes is accompanied by a great amount of nervous behavior taking the form of wing and tail jerking.

WETMORE (1916: 92) has described the call of the Redlegs as a low "*wheur-a.*" BOND (1947: 166) described it as a loud "*wet-wet.*" BOWDISH (1903: 20) compared it to that of the Cuban Parakeet (*Aratinga euops*) and said that the calls of the two species were similar. DANFORTH (1926: 125) thought that the Redleg call resembled the call of the resident Sparrow Hawk (*Falco sparverius caribaearum*).

15

Food and Foraging

The Puerto Rican Redlegs forage for much of their food directly on the ground. Their ground-feeding mannerisms are similar to those of the American Robin. Upon alighting, they spend several minutes in a general surveillance of the area before beginning the search for food. In their usual methods of progression they run rapidly for a few feet with the head and anterior part of the body dipping forward. Then they stop abruptly, stand motionless for a few seconds, and begin to hop about in search of food. If disturbed on the ground they are quick to take cover in the trees or bushes, flying away rapidly and noisily. Groups of two or three birds may engage in foraging, but more commonly one finds only solitary individuals. The thrushes are thorough in their searchings: they investigate a variety of plant situations and move or turn over any object that they can in hope of finding a hidden seed or insect. During foraging they are constantly peering about, cocking their heads from side to side, always on the alert for a possible insect. Now and then, they will leap upward from the ground, with very little wing action, to a height of as much as six feet and pull down a flying insect. Foraging may carry the thrushes into such situations as grassy and weedy fields, bamboo growths, the banks of streams, and water-flooded fields.

Sometimes, but more rarely, they procure their bill of fare from the trees. In such cases they run rapidly along the larger branches and then hop leisurely from one smaller branch to another investigating each leaf cluster for insect larvae or a hidden beetle. At times tree cavities are thoroughly inspected and the debris in them scattered and efficiently probed for possible food. On 18 July 1960, I observed a thrush eating a drupe in a curious manner. It swallowed and regurgitateed the fruit five times before it picked another from the tree and continued eating.

Lizards, an occasional item in the diet of the Redlegs, are snatched up from the ground or they may be taken from a tree. On 16 August 1960, I saw a thrush chase a lizard around a tree trunk four times only to lose the animal.

Throughout the year Redlegs feed on a variety of animal and

plant matter. When the small-fruited bushes and trees bear drupes and berries, the Redlegs will be found feeding abundantly on them, and it is rare when or one two Redlegs cannot be flushed from such heavily laden trees as the Wild Fig (*Ficus* sp.). The fruits of the Royal Palm (*Roystonea borinquena*) and the Bourbon Palm (*Livistona chinensis*) are especially sought after when mature.

STRUTHERS (1923: 476) mentioned that the Puerto Rican Redlegs were feeding on seeds of the Royal Palm when he visited Maricao, P.R., in December 1921. WETMORE (1916: 92) reported that at Ciales, P.R., they fed on the fruits of a laurel (*Phoebe elongata*), the Moral (*Cordia sulcata*), and the Royal Palm.

Animal matter eaten consists mostly of small tree frogs such as *Leptodactylus albilabris* and *Eleutherodactylus* sp. An interesting point is that from personal observations I noted that tree frogs made up a large percentage of the diet of the nestlings from about their fifth day in the nest until they were fully fledged. Invertebrates eaten consist mostly of millipeds and a few insects. Infrequently also, as previously noted, the Redlegs may feed on lizards.

VAURIE (1957: 310), in speaking of the feeding habits of the Red-legged Thrushes (*Mimocichla plumbea rubripes*) of western Cuba, mentioned that he saw them feed on tiny ants and flies and on small red peppers of the genus *Capsicum*. DANFORTH (1931: 86) examined the stomach of a thrush from Puerto Rico on 13 September 1928 and found a Long-horned Grasshopper (*Neoconocephalus triops*) and the bones of a tree frog (*Eleutherodactylus* sp.). From the stomach of a Redleg on Gonave Island, Haiti, DANFORTH (1929: 372) recovered four seeds, a snail, a milliped, and a lamellicorn beetle (*Lachnosterna hogardi*). During another period DANFORTH (1935: 431) carried out investigations of a stomach of a *Mimocichla plumbea rubripes* from western Cuba and found that 90 per cent by count of its contents was insects and 10 per cent fruits. Of the insect matter, 40 per cent was cutworms. The stomach also contained three staphylinid beetles. According to DANFORTH (1929: 374) the stomach of a Redleg from San Juan, Dominican Republic, contained one seed and two cockroaches, one of the roaches being *Epilampra saublosa*.

According to examinations made by WETMORE (1916: 93) the stomachs of 32 Puerto Rican Redlegs contained 63.46 per cent vegetable matter and 36.54 per cent animal matter. His figures represent all the months from January to August. The breakdown of animal matter is as follows: Orthoptera, 1.22 per cent, of which the mole cricket (*Scapteriscus didactylus*) comprised 0.86 per cent; Coleoptera, 3.86 per cent; caterpillars and cutworms, 12.25 per cent;

Hymenoptera, 0.93 per cent, all ants; Hemiptera, 2.64 per cent; snails, 2.62 per cent; lizards and tree frogs, 8.41 per cent; Dermaptera and Myriapoda, 4.61 per cent. Vegetable matter consisted of a variety of drupes and berries, as well as some larger fruits.

During the course of the study I examined the contents of 22 stomachs, all months of the year being represented except June and July. The results are as follows: 14 per cent (three stomachs) contained only animal matter, 36 per cent (eight stomachs) contained both animal and plant matter, and 50 per cent (11 stomachs) contained only plant matter. My findings indicate, as those of WETMORE, that the thrush consumes more plant materials than animal. An interesting point is that the mole cricket, which made up 0.86 per cent of the orthopteran remains in WETMORE's findings of 1916, was not found in any stomach during my own investigations. In fact, my findings failed to reveal the presence of *any* orthopterans. I agree with WETMORE (1916: 93) that, though they consume a few insectivorous tree frogs and lizards, the Puerto Rican Redlegs should be considered beneficial to agriculture. Insects eaten by Redlegs are normally those considered harmful to agricultural crops. Never did I see them feed on any plant materials that are considered of value to man.

A more detailed account of stomach investigations for 1960 and 1961 is as follows:

Date	Sex	Findings
21 Aug. 1960	female	two drupes (*Vitex* sp.)
27 Aug. 1960	fledgling	one seed (*Vitex* sp.); one seed, Bourbon Palm (*Livistona chinensis*); fragments of unidentifiable plant matter
13 Sept. 1960	male	hind appendages, urostyle, and skin of a tree frog (*Leptodactylus albilabris*); one land mollusk (*Subulina octona*)
1 Oct. 1960	male	almost empty; a few fragments of unidentifiable plant matter
1 Oct. 1960	male	fragment of a milliped (Spirobolida); pieces of filoplumes; and unidentifiable plant matter
1 Oct. 1960	male	four seeds, Royal Palm (*Roystonea borinquena*); one large monocot seed; and bits of filoplumes
20 Nov. 1960	female	grit and fragments of plant and animal matter
20 Nov. 1960	male	two seeds of Royal Palm

Date	Sex	Findings
20 Nov. 1960	female	almost empty; a few fragments of unidentifiable plant matter
26 Dec. 1960	male	six large, greenish monocot seeds
26 Dec. 1960	female	fragments of a milliped (Spirobolida)
29 Jan. 1961	male	three caterpillars (Pyralidae); two ants (*Pheidole* sp.) and (*Solenopsis* sp.); two appendages of a roach; grit; pieces of filoplumes; and two small seeds
29 Jan. 1961	female	pieces of grit and two large seeds
26 Feb. 1961	female	one filoplume; one small, green leaf; fragments of ants (*Pheidole* sp.); and two millipeds
26 Feb. 1961	female	one ant (*Pheidole* sp.); bones of lizard (*Anolis* sp.); one land mollusk (*Subulina octona*); two twigs; and two ants (*Solenopsis* sp.)
26 Feb. 1961	male	pieces of filoplumes and unidentifiable plant and animal matter
26 Feb. 1961	juvenile	bones and skin of lizard (*Anolis* sp.); 29 large dicot seeds; and numerous tiny seeds
19 Mar. 1961	male	two filoplumes and 10 seeds
19 Mar. 1961	male	four greenish dicot seeds; fragments of ant (*Pheidole* sp.); one tiny spider; numerous elytra of coleopterans; and 13 tiny seeds
16 Apr. 1961	male	remains of a large beetle; bone fragments of lizards and tree frogs; and unidentifiable plant matter
16 Apr. 1961	female	grit; bones of a lizard (*Anolis* sp.); remains of ants (*Pheidole* sp.); two large green seeds; eight elongate, thin seeds; and pieces of twigs and bark
21 May 1961	female	unidentifiable plant matter

I know of one captive thrush, hand-reared as a nestling, that has been kept in a small cage for over four years. The bird is fed on a diet of egg yolk and bread that has been soaked in milk. It has retained a shiny plumage and the red color of the orbital ring, legs, and bill is quite vivid.

The zoological park in Mayagüez has had a Redleg in captivity for over seven months, and it seems to be doing very well. The zoo attendants feed it a variety of animal and plant foods upon which it has thrived. It has not lost its conspicuous coloration.

The plumage coloration of some birds is greatly affected by diet. Flamingoes and mynahs will immediately lose their brilliant colors in captivity when fed incorrect diets. Apparently the coloration of the plumage and bare skin areas of the Redlegs is not affected by diet.

Courtship and Territory

A published observation made by Wetmore (1916: 92), which is the only reference to the courtship of the Red-legged Thrush in

the literature, is as follows: "... near Mamayes in February, birds were seen going through a sort of mating display, male and female running about on the ground with heads drawn in, the tail spread wide, and thrown forward over the back, so that the white tips were prominent." As regards these remarks my own observations on courtship agree with those of WETMORE.

Mr. JUAN GONZÁLES, of the Marine Institute, University of P.R., supplied me with information on an interesting courtship display he observed near Mayagüez, in the small town of Rosario. The male was seen displaying in front of the female, on the ground and in the trees, with a small twig in its beak. During the display the female remained passive and seemingly uninterested in the entire procedure.

The sexual flights of males and females are a characteristic feature of courtship. Males, singing on the wing, chase the females through the trees with both birds swooping down within inches of the ground and then swerving up to come to rest on a nearby branch. The flight pattern is usually circular, and often the two birds will land on the ground and resume the chase on foot.

I had no difficulty in distinguishing these amatory pursuits from the hostile flights amongst males that also took place during courtship. The male-chasing-male pursuits were swifter affairs characterized by mid-air clashes that occasionally resulted in both birds plunging to the ground and remaining locked in combat for long periods.

During the autumn and winter months a few observations were made of Redlegs chasing each other through the trees in what were obviously examples of non-courtship flights. These flights, which were similar to the hostile flights of males that I observed during the breeding season, were characterized by tremendous bursts of speed and uncanny manuverability on the part of each thrush as it twisted and turned in flight. In an attempt to understand the nature of these flights I made sure that these were not instances of young birds chasing parent birds for food. In each case the participants were noted to be in adult plumage. I noted that the lead bird would at times be less than a hand's breadth apart from the pursuer. Many of these flights ended with an instantaneous mid-air clash, which sometimes terminated the pursuit. There is no doubt in my mind that these flights were hostile and not amatory.

The possibility that the Redlegs may defend some sort of winter territory cannot be ruled out, since in September, 1960, I made

observations on one Redleg that defended a small amount of ground for an 11-day period on the western perimeter of the Federal Experiment Station in Mayagüez. This thrush would not allow any birds to remain in an area that measured approximately 600 square feet. It was just as hostile to other species of birds as it was to its own. It guarded the territory while perched in a specific tree well within the territorial boundaries. These boundaries were not well defined and appeared to be somewhat elastic. The figure of 600 square feet was arrived at by observing the limits of the area of ground in which the Redleg appeared to be hostile. The thrush was far more hostile towards birds that flew to the ground. Those in the trees overhead, within the territory, were allowed to remain and were not bothered. But if they flew to the ground they were immediately set upon and driven out of the territory. At the termination of the 11th day the thrush apparently left the general area, for it was not seen again. NICE (1941: 464) defined a winter territory (*Type E*) as ' ... an area used as a feeding ground and defended against other birds of the species ... bird may show ... isolation, fixation and intolerance but no advertisement."

In 1961 the breeding population in Mayagüez was not large, and most of the nests were well isolated from each other. Therefore, intraspecific competition was at a minimum and information on territory was difficult to secure. Much more work needs to be carried out as regards territorialism in this species. The male seems to select the territory, but its defense is taken up by the female as well as by the male. The female is far more aggressive toward intrusions than the male. She is not hesitant by any means and will fly out at any large intruder using her beak and wings as weapons. The male usually keeps his distance, hopping from branch to branch, and issuing various calls. Trespassers are attacked and driven from the territory almost immediately in the first few days after it has been established. After the completion of the nest, however, the parent birds seem to be more tolerant and will allow other Redlegs to pass through the territory if they do not stop within it. They are tolerant to other species of birds to some degree. Birds of equal size to the thrush are more likely to be attacked. A Pearly-eyed Thrasher, however, was allowed in one instance to construct a nest within

50 feet of a Redleg nest. At no time did I notice any friction between the pair of Redlegs and the pair of Pearly-eyed Thrashers. Smaller birds such as honeycreepers and grassquits are completely tolerated within the Redleg territory. This is testified by the large number of honeycreeper and grassquit nests I discovered in the thrush territories.

Territories are small and usually less than one-quarter of an acre in size and they do not appear to overlap. There are indications that some Redlegs apparently do not establish much of a territory at all since I discovered an unusual case of two Redlegs nesting in the same tree not more than 25 feet from each other. I suspect that cases such as this must be rare during any one breeding season. When nests are placed in Royal Palms they are usually always in close association with nests of the Puerto Rican Grackle.

My meager notes on breeding territories would seem to indicate that those established by the Redlegs would more closely fit NICE's (1941: 458) *Type A*. This type includes all cases where the territory is used both for nesting and feeding. But in the case of the Redlegs I noted that some parents would go beyond the supposed boundaries of the territory to secure food for the nestlings. Some birds would travel long distances for this purpose. The male especially would be absent from the territory for long periods of time, and in many cases I was able to climb to the nest and record weights and measurements of the nestlings with only the female on the scene. This would indicate to me that the male was located at a considerable distance from the nest and was not able to hear the cries of its mate.

NESTS AND NEST BUILDING

The nest of the Red-legged Thrush is, for the most part, rather bulky and loosely constructed, although the inner cup may be well-woven and matted with softer and finer plant materials than the outer portion. The exterior of the nest may be made up of stout twigs, pieces of moss, string, paper, or roots. Candy wrappers, gauze, and tissue may also be used at times, and large pieces of cotton or some cotton fabric are found dangling from some of the nests. There seems to be a preference for cellophane, for some

of the nests have pieces of this material, notably cigar wrappers, stuck into them. Materials making up the outside of the structure are not well secured and hence the whole nest is likely to have an untidy appearance. For the most part the inner cup is lined with bamboo leaves and fibers of various palms. At times grasses, sedges, and needles of the West Indian Pine (*Casuarina equisetifolia*) are also used in the nest lining. The inner cup, which is usually oval, averages 70 mm in width by 100 mm in length.

Weights for 10 nests collected in the winter of 1960 and the summer of 1961, were established after each had been allowed to air-dry for a period of at least six weeks. The extremes for the nest weights were 70.1 and 110.7 grams; the mean weight was 88.7 grams.

On 30 March 1924, DANFORTH (1926: 125) found a nest of the Puerto Rican race in Mayagüez in a Guanábana tree (*Annona muricata*) at a height of nine feet from the ground. It was composed of shreds of bark, fine twigs, rotted burlap, a fern leaf, and three poultry feathers. Measurements for the inner cup were 76 × 114 mm and those for the outside were 102 × 152 mm.

BOWDISH (1903: 20) compared the nest of *Mimocichla plumbea ardosiacea* with that of the Wood Thrush (*Hylocichla mustelina*), while BOND (1947: 166) referred to nests of Puerto Rican Redlegs as being bulky and cup-shaped. WETMORE & SWALES (1931: 336) found that nests of Hispaniolan Redlegs contained appreciable amounts of mud and banana fibers. BENT (1949: 21) and HOWELL (1942: 554) both spoke of the use of mud in construction of nests of the American Robin. I noted that very little mud was used in construction of nests of the Puerto Rican Redlegs. BOND (1947: 372), describing the nest of the Dominican race of the Red-legged Thrush, mentioned that it was a "cup of rootlets, dead leaves, strips of palm leaf, and feathers."

I was unable to determine with certainty the details of nest site selection. My personal observations seem to indicate that males and females select the nest site together.

Nest sites vary considerably. In the Mayagüez area the Redlegs usually nest high in the trees and take pains to conceal their nests. Approximately two out of every three nests I located were in palms (especially Royal Palms) at heights well over 60 feet from the ground. At such heights it was virtually impossible to reach them for close observations. Climbing irons or a long extension ladder, neither of which I had at my disposal, would have been the only means by which I might have reached these nests. At times I found

that a long bamboo pole with a mirror affixed at one end was a useful aid for looking into some of the higher nests (from 20 to 35 feet) if there was not too much obstruction by foliage.

Towards the end of my field work JUAN GONZÁLEZ of the University of Puerto Rico faculty brought me a nest of the Puerto Rican Redleg that he had found in a Mango tree (*Mangifera indica*) at a height of 7 feet. Other than this record I have no others of nests placed lower than 12 feet from the ground, and I have only two at the 12-foot level. One of these was in a unique place. The bird had constructed it within the protected dome of a lamp on the university campus and had gained entrance to the interior of the lamp by way of a broken pane of glass. In all other instances nests were placed well over 25 feet from the ground. The forks of large trees are especially favored sites for nests. At times they may also be found within the tangled growth of Monstera (*Monstera deliciosa*), which grows as a vine on some of the larger trees. Ledges and eaves around buildings appear to be only occasionally used as nest sites. Some nests were placed in mango trees at the ends of branches where the leaves are densely clustered. Others were placed within the roots of wild orchids anchored high up in large trees such as the Rain tree (*Samanea saman*). I found no nests in bushes or shrubs. Nests were also found in such plants as the Coyore Palm (*Bactris acanthophylla*), the Climbing Fig Vine (*Ficus pumila*), the Cóbana tree (*Stahlia monosperma*), the Mahogany tree (*Swietenia mahogani*), and the Solomon Island Ivyarum (*Scindapsus aureus*), which grows as a vine on some trees.

WETMORE & SWALES (1931: 337) found nests of the Redlegs in Hispaniola at heights of five and 15 feet from the ground — one in an epiphyte. VAURIE (1957: 308) found two nests of *Mimocichla plumbea rubripes* in western Cuba at six feet from the ground in an open bush and at eight feet from the ground in a tangled sapling.

The shape of the nest depends upon the site. When placed on the ledges around buildings or on limbs of trees, the nests will be round or nearly so. But when placed in forks of trees they may assume an oval shape. Nests placed on ledges or under the eaves of buildings may have one or two of their sides flattened.

My observations indicate that the male takes no part in the building of the nest either in gathering materials or in actually

helping to build the structure. During construction of the nest the male may be off singing in a nearby tree or he may not be on the scene at all. At Nest 4 the male was not seen for the first time until the female began laying. In all cases noted, males showed little if any interest in the form or progress of the nest and only rarely visited it during its construction.

After the initial base of the nest is constructed the female shapes the inner cup with her own body by executing 360-degree turns while crouched in the nest. This operation is repeated with each visit to the nest with construction materials. At times females jumped up and down in the nests or even hopped to nearby branches above the nest and then pounced down upon the structure. Some females reached over the rims of the nests and pulled long fibers of grass or palm ribs into them. The female seems to spend no particular length of time building a nest. Some nests are complete in about a day and a half, whereas others require two or three days for completion. A few females were noted to be quite dedicated and rarely interrupted their nest building activities to rest. Others worked only sporadically and were absent from their chores for periods as long as four to five hours at a time.

The abandonment of completed and partially completed nests is common. Rain, wind, and unfavorable sites that are responsible for loss of portions of a nest may cause a female to begin work elsewhere. But those factors that cause abandonment of completed structures in favorable areas not threatened by wind and rain are not completely understood. During the course of this study I noted that one female built three different nests before she finally settled down to lay her eggs in the last nest she had constructed.

Eggs, Egg Laying, and Incubation

The eggs of the Puerto Rican Redleg are similar to those of many turdids. They are ovate and smooth, slightly larger than those of *Turdus migratorius migratorius*. The following description of the eggs from one nest will suffice here as a general description since these eggs showed the extremes of size and coloration that I noted

of eggs from other nests. I found the four eggs in question on 26 July 1960 at Nest 1. They ranged in color from an egg with a glaucous-green ground color speckled with reddish-brown to one with a very pale whitish-green ground color indistinctly speckled with brown. Measurements were: 32.0 × 22.0 mm, 30.1 × 22.0 mm, 30.0 × 22.0 mm, and 29.0 × 21.1 mm. Two eggs from Nest 2, found on 19 January 1961, measured 33.0 × 21.5 mm and 30.0 × 22.0 mm.

Included here are descriptions of eggs of the Puerto Rican Redleg and those of other races of *Mimocichla plumbea* as provided by various writers. With this information an interesting comparison can be made regarding the size and coloration of the eggs among the races of *Mimocichla plumbea*. BOND (1947: 166) in describing the eggs of the Puerto Rican Redleg said they were "whitish to pale greenish, heavily spotted." At another time BOND (1941: 372) remarked that the eggs of the Red-legged Thrush on Dominica were more similar in their markings to the eggs of the Puerto Rican Redleg than to those of the Red-legged Thrush in Haiti. He gave measurements for two eggs of the Red-legged Thrush on Dominica, as 28.4 × 20.3 mm and 29.2 × 20.8 mm. DANFORTH (1926: 125) in describing an egg found in a nest near Mayagüez, said it had "a putty-colored background" mottled with rufous-brown and measured 33.0 × 22.0 mm. At another time DANFORTH (1936: 135) described the eggs as being "de color blancuzco, con muchas manchas rojizas y color castaño." GUNDLACH (1878: 165) reported that the color of the eggs of the Puerto Rican Redleg was greenish-white spotted with reddish-brown. WETMORE & SWALES (1931: 336) in their description of the eggs of *Mimocichla plumbea ardosiacea* on Hispaniola said that the eggs were "pale glaucous-green covered with broad, poorly defined spots of cameo and walnut brown." They gave measurements of two eggs as 32.8 × 22.3 mm and 30.2 × 21.8 mm. They also pointed out a descriptive error on the part of VIEILLOT since he had originally described the eggs of the Red-legged Thrush on Hispaniola as being "blancs et tachetés de noir."

Egg laying for 1961 began in Mayagüez in January. I found the first eggs on the 19th of the month. The interval between the completion of the nest and the laying of the first egg varied at each nest studied. At Nest 6, which was complete by 25 March, the first egg was found on 27 March. At Nest 7, which was complete by 29 March, the first egg was found on 2 April. At Nest 2 the first egg was deposited the day after the nest was completed. Nest 8 was terminated on 19 July, and the first egg was deposited on the morning of the 24th. By the afternoon of the same day it was taken by a rat. The female did not lay again at this nest but continued to fly to it whenever I visited the structure with the mirror-pole

device. On the morning of the 29th of July she began to construct another nest, about 50 feet from the first, on a ledge of a building and some 55 feet from the ground. The ledge proved to be too small for the nest and after about six hours of work, during which time she lost parts of the nest, she gave up the site. I was not able to follow her activities, nor those of her mate, after the 30th of July.

After completion, the nest is rarely visited again until the time for egg laying, and during this period it is easy to suppose that the nest has been abandoned. An observer must be careful and fairly punctual with his observations if the establishment of egg laying times is to be achieved.

At Mayagüez all the eggs, at those nests studied, were laid early in the morning, usually between 7 a.m. and 10 a.m. At Nest 5 the first egg was found at 7:30 a.m. on 24 March and the second egg at 9 a.m. on 25 March. The second egg must have been laid between 7:30 a.m. and 9 a.m. on the 25th since there was only one egg in the nest when I visited it at 7:25 a.m. on that same date. At Nest 7 the first egg was found at 8 a.m. on 2 April but a day later it was missing and the nest was then abandoned. The interval between the laying of the eggs appears to be about 24 hours. Nest 4 had two eggs at 3:40 p.m. on 27 March, one of which was probably deposited on 26 March.

For the most part neither the male or the female seems to frequent the nesting area during egg-laying, and in all cases noted incubation began immediately with the laying of the last egg.

Information on clutch size is incomplete at this writing. I found four eggs to be a maximum number and one egg to be the minimum but two eggs is probably the normal clutch of the Redleg in Puerto Rico. GUNDLACH (1878: 165) reported that from three to six eggs had been found by him in nests of Puerto Rican Redlegs. Clutches of five or more eggs, if existent, must be uncommon. BOND (1941: 372, 1928: 509) mentioned three eggs as being a probable clutch for the Red-legged Thrush on Dominica and in Haiti.

The incubation period is here defined as being the interval of time between the laying of the last egg and the hatching of this egg when all the eggs hatch. It was difficult to establish the incubation

period with accuracy since time of laying and the beginning of incubation were not always possible to determine. In a few cases the eggs were eaten by rats before the completion of the clutch. At Mayagüez the incubation period extends for more than 11 days, but as yet I have not been able to calculate the period well enough to express it in terms of days plus or minus hours.

Incubation is carried out entirely by the female. At those nests studied, a change of mate was never observed during incubation, and no thrush known to be a male was ever seen to incubate. The incubating bird will leave the nest at times but then the nest remains unoccupied until she returns. Males do come to the nest during incubation, at which time they may spend a few minutes at the rim. Only twice during 16 hours of observation did I ever see a male feed its mate while she was attending the nest.

TABLE 3.

Some periods of attentiveness and inattentiveness by the female Red-legged Thrush at nest 3 during the incubation period (all times are in minutes).

DATE	*ATTENTIVENESS*				*INATTENTIVENESS*		*TOTAL TIME*
	Daily Average	Extremes in Length of	Percentage of	Periods of	Daily Average	Extremes in Length of	
20 Jan. 1961	26.7	1–72	77.9	7	8.6	2–17	240
21 Jan. 1961	33.3	14–43	74.0	4	11.8	6–16	180
23 Jan. 1961	34.5	13–76	76.7	4	10.5	6–11	180
25 Jan. 1961	21.8	4–53	72.7	6	9.8	3–16	180
28 Jan. 1961	48.0	23–79	80.0	3	12.0	9–14	180

Records of attentive and inattentive periods were made from direct observations accomplished in periods from three to four hours in length. The entire record shown in Table 3 was derived from Nest 3; it amounted to a total of 16 hours and included various periods of a day. The stages of incubation were from the second to the tenth day excluding days four, six, eight, and nine. Additional time was spent gathering data on incubation rhythm at two other nests. The data on incubation rhythm at Nest 3 (Table 3) revealed an average attentiveness during the five days of observations of nearly 33 minutes and an average inattentiveness for the same period of observations of nearly 12 minutes. The eggs were covered

about 76 per cent of the time. The presentation of nesting data in Table 3 follows the method of PITELKA (1941: 609).

Incubating females are extremely alert while on the nest and appear to carry out their task restlessly. They occupy themselves while on the nest by shifting the eggs (as many as 11 times per hour) and re-orienting themselves. Orientation appears to be without relation to surrounding objects. For the most part the females are not close sitters and are easily flushed from the nest. At nest 3 the female would fly off when I approached closer than 50 feet. Incubating birds were also seen to preen themselves and, more rarely, doze while on the nest.

The following field notes relate the activities of an incubating female, which was observed at the nest for a period of three hours on 21 January 1961.

Female on nest at 11:45 a.m., when observations begin; shifts eggs at 12:12 p.m.; dozes until 12:16 p.m., when she suddenly becomes alert to the surroundings; pants from 12:18 p.m. until 12:21 p.m.; at 12:40 p.m. rotates the eggs and re-orients herself; shifts eggs at 1:04 p.m. (up to this time the mate has not been seen in the territory); male comes to nest at 1:06 p.m. and immediately leaves; shifts eggs and re-orients herself at 1:44 p.m.; yawns and then snaps at a passing insect at 1:48 p.m.; shifts eggs at 1:51 p.m.; shifts eggs and re-orients herself at 1:56 p.m. and at 2:05 p.m.; at 2:16 p.m. she leaves the nest, flies about 70 feet to a mango tree and drops to the ground, catches a lizard, and swallows it. She returns to the nest at 2:23 p.m., shifts eggs and settles herself.

HATCHING OF EGGS AND DEVELOPMENT OF YOUNG

A rough approximation of the time required for the hatching of the eggs is about 24 hours. At Nest 3, at 10 a.m. on 29 January 1961, there was a clutch of unhatched eggs. At 1 p.m. on 30 January 1961, one of the eggs had hatched. The other egg hatched later that same day.

I was able to gather little information on the disposal of eggs shells. In January 1961, I found half of an egg shell about 50 feet from Nest 3 on the day that the eggs hatched. Undoubtedly the shell was from Nest 3.

The following account of development of the young is based on observations and measurements of three nestlings from two different nests. Average daily weights and measurements were as follows:

Age (Days)	Weight (grams)	Wing	Tarsus	Bill
2	11.3	19.5	12.0	4.9
3	16.4	21.7	17.7	5.2
4	27.1	28.5	21.2	5.5
5	31.5	32.5	24.1	5.7
6	41.1	41.9	26.8	6.0
7	47.5	55.6	28.6	6.1
8	55.7	62.0	30.0	6.9
9	60.4	66.1	32.2	7.1
10	64.5	69.1	34.0	7.3
11	67.3	71.2	36.2	7.6
12	71.8	72.6	38.3	8.7
13	74.9	77.0	38.4	9.1
14	78.5	82.4	38.5	10.0
15	79.3	87.6	38.5	10.0

Measurements were taken as follows: *Wing* — from the bend of the wing to the structure extending furthest distally. *Tarsus* — as in the adult. *Bill* — from the nostril to the tip of the bill.

From hatching to one day. — Eyes closed. Little if any control of the head. Whole body a pinkish color; bill yellowish. Faint *peeping* uttered every few seconds. Activities consist of moving of the wings, gaping, and flexing of the toes. Alar tracts visible under the skin as faint dots. Humeral tract has mouse-gray down. Blackish down (about 15 mm in length) on spinal and capital tracts with feathers of spinal tract just visible under the skin. No other tracts are visible. Internal organs visible through transparent skin of abdomen.

Two to three days. — Eyes closed. Still very little control of the head. Body pinkish but toes now more yelllowish. Much gaping at sound of parents calling in the distance. Feathers of capital tract visible as dots under the skin. Feathers of sternal region of ventral tract visible under skin but feathers of abdominal region of ventral tract are not as yet visible. Femoral tract now visible. No change in length of down.

Four to five days. — Eyes closed on fourth day but open for short periods of time on fifth. A bit more control of the head on the fifth day. Feathers of alar tract beginning to break through skin, and by fifth day they are exposed for 2 mm. The secondaries of the wings are exposed as well. Body now taking on a more yellowish

cast and losing its pinkish color. Caudal tract visible through skin on fourth day and ruptured through the skin by the fifth. By fifth day crural tract visible through skin.

Six to seven days. — Eyes closed most of the time; iris is a grayish-blue color. By seventh day birds are able to prop themselves up on their tarsi and wings. Shafts of primaries and secondaries of wings are about 4 mm in length. Bill whitish. In all tracts sheaths are either exposed or feathers are exposed from hidden sheaths. Beginnings of instinctive fear shown on seventh day when a new note is uttered by birds during handling — *chirup.*

Eight to nine days. — No important changes on eighth day. By ninth day rictal bristles have appeared. Feathers of abdominal region of ventral tract are white. Color of feathers in all other tracts, including those of the sternal region of ventral tract, are bluish. Abdominal feathers show a brownish cast intermingled with the bluish.

Ten to eleven days. — Good control of head by the tenth day. Down still present in capital and dorsal tracts. Feathers of ventral tract about equal in length to those of dorsal and humeral tracts. Rectrices about 8 mm in length. Crural tract feathers brownish in color. Birds can now move about by shuffling on the backs of their tarsi. Much distress shown by birds if placed on their backs or if their abdomens are stroked.

Twelve to thirteen days. — No important changes on these days except increase in feather lengths of all tracts. Birds now able to grasp with toes.

Fourteen to fifteen days. — Much activity observed on these days. Feather preening, looking over the rim of the nest, and wing exercising occupies much of the time of the nestlings. A great amount of fear shown towards handling by the fourteenth day. Birds assume a threat posture when placed on the floor and snap their bills together. Distress note is a very loud *chirup.* By the fifteenth day the nestlings can run about easily over the ground.

Eighteen days. — Birds are able to fly with short erratic spurts from one tree to another. One fledgling from Nest 3 was 40 feet up in a tree and approximately 150 feet from the nest on the eighteenth day after hatching.

Parental Care of the Young

Instances of the actual brooding of the young by the Redleg parents at those nests observed were few in number, even during adverse weather conditions such as wind and rain. When the parents were not feeding the nestlings either the female or male Redleg would assume a position at the rim of the nest where the activities of the parent would consist of the removal of fecal sacs from the nest, as these were defecated by the nestlings. On rare occasions when brooding did take place, it lasted for no more than two or three minutes at a time. Then the parent would fly away from the nest. After a nestling was banded, it would receive harsh physical treatment if either parent detected the presence of the band. The parent bird would then pick up the nestling by its banded tarsus and vigorously shake the young bird in an effort to dislodge the band.

Parents were observed swallowing fecal sacs from about the first day of hatching until the nestlings were five and six days old. After that the fecal sacs were carried away from the nest and dropped. It was interesting to note that at each visit to some nests the parents would search the nest and the young for the presence of droppings. Howell's remarks (1942: 583) in regard to the Robin that the presence of the adult may act upon the nestlings as a stimulus to defecate, may very well hold true in this species as well, for I have seen the Redleg parents carefully pick fecal sacs from the elevated anal openings of the nestlings. No doubt, because of improper functioning of the digestive system in the first few days after hatching, the feces of the young contain much nutritive matter, and the parents are able to injest the feces to their advantage. A few instances were observed where a nestling would move to the side of the nest and defecate over the rim, thus helping in nest cleanliness.

Feeding is carried out by the male and the female, but the female makes many more visits to the nest than the male. Contributions from the male are irregular, and he may disappear for long periods of time only to return to the nest without any food for the

young. The male's principal job during the nestling period seems to be that of a guard at the rim of the nest, where he will spend lengthy periods of time with head bent peering down at the nestlings, occasionally repositioning them with the aid of his bill. During a two hour period on 2 February 1961, when the nestlings at Nest 3 were four days old, the parents made 11 visits to the nest. Six of these 11 visits were for feeding purposes and the six were made by the female. Frequency of feeding based on averages obtained by counting the number of visits over a given period of time varied considerably and seldom showed regularity. The salient features of the feeding rhythm for a period of 14 hours at Nest 3 are summarized in Table 4.

TABLE 4.

Some periods of attentiveness and inattentiveness by the male and female Red-legged Thrush at nest 3 during the nestling period (all times are in minutes).

Date	Days after Hatching	Periods of Feeding (male and female)	Average Intervals Between Feedings	Extremes of Duration of Inattentiveness	*Total Time*
2 Feb. 1961	4	6	11.8	3–25	120
4 Feb. 1961	6	9	7.3	2–18	120
5 Feb. 1961	7	4	11.3	4–35	120
6 Feb. 1961	8	3	15.1	5–23	120
7 Feb. 1961	9	4	25.3	4–65	120
9 Feb. 1961	11	5	12.2	4–26	120
12 Feb. 1961	14	4	25.0	12–38	120

From about the first to the fourth day after hatching, food of the nestlings consist of partially digested grubs and some berries well mixed with saliva from the parent bird. The diet is varied by the inclusion of spiders and a few small insects. From about the fifth day until the young leave the nest, the diet consists almost totally of large drupes (mostly palm), tree frogs, and lizards. The feeding of tree frogs to the nestlings seemed to cause the parents difficulties. This was especially noticeable when the frogs were introduced feet first into the gaping mouths of the nestlings.

Comments on the Breeding Season

DANFORTH (1931: 86) found a young Redleg scarcely out of the nest on 10 September 1927, and in September 1926 he collected a "nearly ready-to-breed female." But in 1926 DANFORTH also collected thrushes that were in full molt in the month of June. WETMORE (1916: 92) found adult Redlegs molting in June and July, 1912, and collected thrushes in full molt in Maricao, P.R., on 3 June 1912. Skins of Redlegs from Ciales, P.R., collected by WETMORE on 15 July 1912, indicated the completion of the wing molt. In the latter part of April 1961, I observed a few Redlegs that were already in the postnuptual molt indicating to me that the breeding season may terminate early for some Redlegs or possibly that molting begins while some are still rearing young. By the month of May, however, there is no doubt that molting is in full progress, for then it was common to see the Redlegs in poor plumage condition, some of them completely without tail feathers.

WETMORE (1927: 490) mentions that June, with some variation in time in different parts of the island, marks the end of the breeding season for the Redlegs. DANFORTH's observations and my own indicate that some breeding still goes on up to (and including) the month of September. Just how much of this activity, if any at all, is associated with second or even third broods is not known. It is interesting to note, however, that of the seven pairs of Redlegs I studied in 1961 not one pair raised more than one brood of nestlings.

The following excerpts from my field notes on nesting (after both June 1960 and 1961) would seem to indicate that WETMORE's June mark does not necessarily mean the end of all breeding activities for the Redlegs.

26 June 1960. – A parent bird incubating four eggs was observed in a nest at a height of about 12 feet from the ground. Two days later the eggs were gone from the nest.

28 July 1960. – A partially completed Redleg nest was found under the eaves of the biology department greenhouse on the university campus. Two Redlegs were observed visiting the structure only occasionally, but they never completed the nest.

3 August 1960. – Two Redleg nestlings were found at the base of a Royal Palm in advanced stages of decomposition. Apparently they had fallen from a nest at a height of more than 50 feet from the ground.

20 August 1960. – At 9 a.m., while I was making observations in a wooded area on the College Farm, two Redlegs (adults) began to scold and protest vigorously as I moved towards a certain brushy area. Shortly afterwards, a partially feathered Redleg fledgling scampered from beneath a low bush and disappeared in the undergrowth.

23 August 1960. – A fully fledged Redleg with short rectrices was seen persistently bothering a parent bird for food on this date. The young bird was very much like the adult, the only difference being that the beak, legs, and orbital ring were pale yellow and the breast was a brownish color.

27 August 1960. – At 2 p.m. during a heavy rain a Redleg nestling of an undeterminable age was brought to me. It had apparently fallen from a nest and had been abandoned, for the parents were not seen. It was weak and died within an hour.

1 September 1960. – A juvenile, but fully feathered, Redleg with very short rectrices was caught in one of the upstairs offices on the second floor of the science building on campus. It had apparently entered the office through an open window. It was color-banded and released. I noted that its flight was rapid but rather erratic.

8 September 1960. – Observations were made of an adult thrush feeding a young bird on this date. [On 9 September the young bird was caught and color-banded.]

13 September 1960. – A young Redleg, apparently killed when it flew into the windshield of a passing automobile, was brought to me on this date. It was fully feathered except for the fold of skin anterior to the carpometacarpus. Sparse growth of feathers was noted in the chin region, on the thighs, at the nape, and around the malar region. The upper breast had the characteristic dusky tinge of young thrushes of this species. The rectrices were short.

19 July 1961. – Redleg nest construction was observed on this date. Later the nest was robbed of its only egg and the female began building another nest. [She never completed it.]

7 August 1961. – Two Redleg fledglings found in a nest in a Rain-Tree (at about 30 feet from the ground). They were about eight days old. The parents vigorously attacked me when I climbed to the nest.

Roosting and Late-hour Activities

In November 1961 I made a few observations on the roosting and late-hour activities of the Red-legged Thrush. All work was carried out on the grounds of the University of Puerto Rico and Federal Experiment Station in Mayagüez. The intensity of light appears to be the important factor governing the time at which the Redlegs begin to settle for the night.

Biaggi (1955: 16) observed that in Puerto Rico the maximum duration of light is 13 hours and 18 minutes. It occurs on 21 June, when the sun rises at 5:48 a.m.

and sets at 7:05 p.m. He found the minimum duration of light is 11 hours and one minute. It occurs on 21 December, when the sun rises at 6:51 a.m. and sets at 5:52 p.m. Depending upon atmospheric conditions, the twilight period may vary from 30 minutes to one hour. Darkness in winter falls about 6 p.m., and in summer about 7:30 p.m.

On the perimeters of the grounds of the Federal Experiment Station, which are illuminated throughout the night, I observed that most Redlegs began to settle for the night approximately 55 minutes after sunset. My field notes show extremes of 18 minutes and 65 minutes. With the aid of a six-volt headlamp I noted that no more than two Redlegs ever roosted together in any one place and more commonly, only one Redleg was found. The thrushes seemed to prefer the ends of the larger branches as roosting sites, usually those at heights of more than eight feet from the ground.

During the winter months the end of the day's activities for the Redlegs is a gradual thing and is hardly noticeable if one is not watching the thrushes during the evening period. During winter, and as darkness approaches, one by one and sometimes in groups of twos, the Redlegs slip away into the trees to settle for the night. There is usually very little confusion or noise among the thrushes, indeed noiselessness at which roosting takes place is one of the more evident things at this time.

The extensively illuminated campus of the University of Puerto Rico, however, presents an entirely different situation. The campus lamps remain on throughout the night and large numbers of Redlegs can be found feeding there until dawn. My observations, and those of other individuals, show that at practically any time between sunset and sunrise the Redlegs can be found active on the campus, but fewer thrushes are active between 12 midnight and 2 a.m.

On 14 November 1960 I spent the entire night on the university campus gathering information on these late-hour thrush activities. I found the Redlegs to be active until about 12:15 a.m., with a gradual decline in their numbers until about 2:30 a.m., when activities picked up again. Information reported to me by J. MALDONADO-CAPRILES establishes the presence of the Redlegs around porch lights of the faculty residences on the campus up to 10 and 11 p.m. BIAGGI and MALDONADO-CAPRILES have told me that the thrushes are feeding on the lawns of the university campus as early as 3 a.m. I have never seen these late-hour activities in other well-lighted areas. Apparently the virtual seclusion of the campus during

the evening as well as the fact that it remains brightly illuminated provides the Redlegs with favorable conditions for nighttime foraging. Insects drawn to the lamps also serve as an attraction.

Summary and Conclusions

During the period August 1960 to July 1961, I undertook a life history study of the Puerto Rican race of the Red-legged Thrush (*Mimocichla plumbea ardosiacea*) at Mayagüez, P.R., located in the southwestern sector of the island. This race is one of six races comprising the polytypic species *Mimocichla plumbea*. The genus is confined to the West Indies.

Examination and measurements of 63 male specimens and 32 female specimens indicate that the wings, tails, and tarsi of the males average slightly longer than in the females. Otherwise, there is no evident sexual dimorphism in the species.

Examinations of 22 stomachs of the Red-legged Thrush indicate that these birds consume more plant than animal materials. Plant materials eaten consist mostly of large drupes and berries. Animal fare consists mostly of tree frogs, lizards, and small insects.

Redleg territories are small, usually less than one-quarter of an acre in size, and they do not appear to overlap. The territory seems to be established by the male, but the female seems more active in defending the territory from intrusions.

The song of the Redleg is apparently correlated with the beginning of the breeding season, but song terminates long before all nesting activities have ended for the season. Song production begins in January and reaches its height in April. No thrush known to be a female was ever heard to sing, hence it is inferred that only the males sing. The Redlegs are pre-eminently morning singers, although evening choruses are also common. The characteristic song is a slow, hesitant *chewéap — screeet* and the call is a loud, nasal *wéecha wéecha wéecha.*

Nesting studies were chiefly based on seven nests, the complete history of which was not known in every case. Nest building starts as early as January and continues until as late as September. The nest site seems to be selected by the male and the female. The nest is a rather bulky and loosely prepared structure and may be

constructed of just about any available materials. The female is solely responsible for nest construction. The average nest weight is 89 grams. The nests are typically situated more than 25 feet from the ground in large trees, either in forks or on horizontal limbs. At times ledges and eaves around buildings are also utilized as nest sites. No nests were found in shrubs or low bushes, and none was situated lower than seven feet from the ground.

Two or three greenish-white eggs, irregularly splotched with brown, are laid, usually one a day until the clutch is complete. Incubation begins almost immediately after the laying of the last egg. The incubation period lasts more than 11 days, and incubation is carried out entirely by the female. Incubating birds are always alert while on the nest and appear to carry out their task restlessly. At one nest the incubation rhythm revealed an average attentiveness for a five day period of observation of nearly 33 minutes and an average inattentiveness of nearly 12 minutes.

Instances of the actual brooding of the young by the parents were few even during adverse weather conditions. The young are attended by both parents although the female will make far more visits to the nest with food than the male. The job of the male seems to be that of a guard at the rim of the nest, where he may spend long periods of time. Frequency of feeding varied considerably at each nest studied and seldom showed regularity, but on the average, the young were fed every 15 minutes. Food of the young consists mostly of drupes, small insects, tree frogs, and lizards.

The young at hatching are featherless, except for wisps of natal down on the humeral and cephalic tracts. Within a few days black dots, indicating the future distribution of feather tracts, appear under the skin. On the fourth and fifth day after hatching the contour feathers begin to break through the skin. The young generally leave the nest from the 12th day on, although if disturbed they may leave it earlier.

The postnuptual molt of the adults may begin as early as April, while some individuals are still rearing young.

Intensity of light appears to be the factor inducing birds to go to roost. At Mayagüez in November 1960, Redlegs began to settle for the night on the average 55 minutes after sunset.

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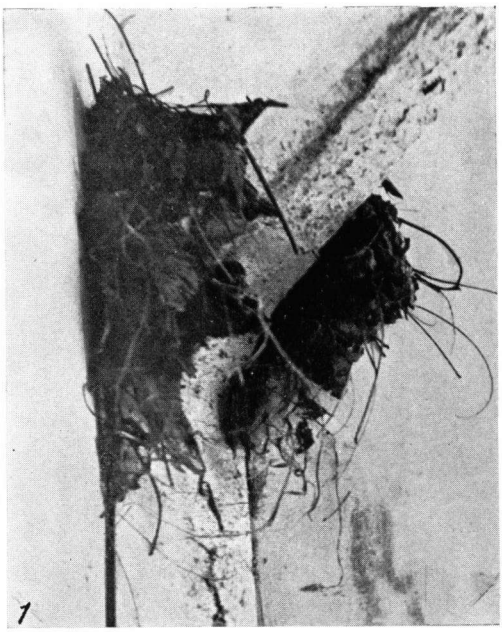

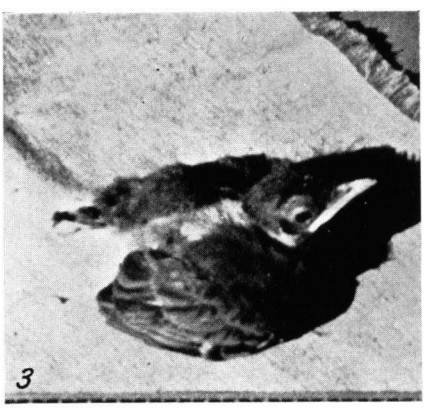

Plate I. – 1 Nest of the Puerto Rican race of the Red-legged Thrush situated under an eave of an abandoned building. – 2 A top view of the nest of the Puerto Rican Red-legged Thrush. – 3 A nestling of the Puerto Rican Red-legged Thrush, eleven days of age. – 4 A side view of the nest *2*.