STUDIES ON THE FAUNA OF CURAÇAO AND OTHER CARIBBEAN ISLANDS: No. 91

FROGS OF THE GENUS ELEUTHERODACTYLUS IN THE LESSER ANTILLES

by

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The Lesser Antilles consist of those West Indian islands which extend from the Anegada Passage in the north to Grenada in the south.[1]) These islands are nomenclatorially divided into two major groups: 1) The Leeward Islands, including Sombrero, Anguilla, St. Martin, St.-Barthélemy [= St. Barts], Saba, St. Eustatius, St. Christopher [= St. Kitts], Nevis, Redonda, Montserrat,

[1]) ED. – Attention may be drawn to the fact that – in these '*Studies*' – the terms 'Lesser Antilles', 'Leeward Islands' and 'Windward Islands' are generally used in a different meaning (cf. Vols. II, p. 24; IV, p. 2; IX, p. 5; XIII, p. 22; XIV, p. 42, and XXI, p. 115) as follows: Lesser Antilles = Virgin Islands to Trinidad and Aruba. Windward Group = Virgin Islands to Grenada. Leeward Group = Los Testigos to Aruba. (Carribbees = Sombrero to Grenada.) Leeward Islands = [British denomination] Virgin Islands to Dominica. Windward Islands = [British denomination] Martinique to Grenada.

Barbuda, and Antigua, and 2) the Windward Islands, including Guadeloupe (with its satellites Marie-Galante, La Désirade, Les Saintes), Dominica, Martinique, St. Lucia, St. Vincent, Grenada, and Barbados. Geologically, the Lesser Antilles can be divided into two major groups: 1) those which are mountainous – the so-called inner-chain islands – which are younger and more recently volcanic (Saba to Grenada, and including the western or Basse-Terre portion of Guadeloupe, and Les Saintes), and 2) the older, gently rolling limestone islands – the so-called outer-chain islands (Sombrero to Marie-Galante, and including the Grande-Terre portion of Guadeloupe, La Désirade, and Barbados). The northern Leeward Islands may be additionally grouped according to the banks on which they lie: the Anguilla Bank (incl. Anguilla, St. Martin and St.-Barthélemy), the St. Christopher Bank (incl. St. Eustatius, St. Kitts and Nevis), and the Antigua Bank (incl. Antigua and Barbuda).

The Lesser Antilles extend for about 750 kilometers in a northwest to southeast direction on a slightly bowed arc. The mountainous inner-chain islands are generally very mesic, with the windward (eastern) coast wet and the leeward (western) coast dry; the latter lies in the rain shadow of the central mountains. This brief ecological statement is greatly oversimplified, since on some islands there are dry sections on the windward side (the Presqu'île de la Caravelle on Martinique is a notable example) and occasional sections of the leeward coast are better watered than is customary (the central western coast of Dominica and the western coast of Montserrat are examples). The central mountains vary in maximum elevation from 1975 feet (602 m) in St. Eustatius to 4813 feet (1456 m) in Guadeloupe; Guadeloupe, Dominica, and Martinique, in that order, have the three highest peaks in the Lesser Antilles.

Moderate and high elevations on the inner-chain islands are usually covered with rain forest, except where cultivation of bananas, cacao, and nutmeg has brought about the destruction of the forest. In even these cases, both nutmeg and cacao result in a well-shaded and leaf-littered pseudo-forest; only the cultivation of bananas – and unfortunately this crop is by far the most extensive of the Lesser Antillean crops – brings about the complete removal of

the original forest cover without a comparable replacement. Banana plantings do, however, provide a moist situation suitable for frogs. The lower outer-chain islands are generally rolling, at times with a range of higher hills; most are not completely flat, this condition being most closely approached by Anguilla and Barbuda. The highest elevation in the outer-chain islands is on St. Martin (1915 feet = 584 m). Although there is not the clear delimination of dry and wet areas in these lower islands as there is in the higher inner-chain islands, even here there are areas which are more mesic than others. At least the higher and hilly regions often support moderate forests or woods, at times now only in ravines where cultivation has not caused the obliteration of the former forest growth.

Despite the very adequate forest cover and high rainfall in many of the Lesser Antilles, the known amphibian fauna of these islands is small. Two species of *Leptodactylus* occur on several of the inner-chain islands, and a *Hyla* occurs on St. Lucia. The introduced *Bufo marinus* Linnaeus is now widespread and common. *Eleutherodactylus*, so abundantly represented in the Greater Antilles, fares hardly better: *E. martinicensis* has been reported from St. Martin, Saba, St. Eustatius, St. Christopher, Montserrat, Guadeloupe, Martinique and Grenada (BARBOUR 1937: 100) and recently a very distinct second species, *E. barlagnei*, has been described (LYNCH, 1965) from Guadeloupe. A third species, *E. johnstonei*, was described by BARBOUR (1914: 249) from Grenada; this name has fallen into disuse, due doubtless in part at least to the supposed confused history of the Grenadan frogs (BARBOUR 1914: 250). One other Lesser Antillean frog is of importance; *Hyla barbudensis* was named (AUFFENBERG, 1959: 251) on the basis of fossil material of Late Pleistocene or Recent age from a cave on Barbuda. This fossil *Hyla* is the only member of its family known from north of St. Lucia, and although there is no certain evidence that the St. Lucia *Hyla* itself is native, at least the genus occurs on that island today.

In the period between 1961 and 1965, I have had occasion to make herpetological collections on all of the major Lesser Antillean islands with the exception of Sombrero. In most cases, large series of frogs were collected on each island from a variety of localities and habitats, since it seemed likely that islands with such a diversity of ecologies might well support a variety of species. In these endeavors I have had the financial assistance in part of National Science Foundation grant G-6252 for col-

lections made on the islands of Grenada and St. Vincent in late 1961. In the field I have had the enthusiastic and capable assistance of Messrs. RONALD F. KLINIKOWSKI, DAVID C. LEBER, DENNIS R. PAULSON, and RICHARD THOMAS. To these men I wish to extend my sincere appreciation for their assistance. Additionally, Mr. IVAN NARODNY of La Haut Estate, Dominica, not only made my stay on that island most pleasant and profitable, but also served to introduce me – as only a resident can – to that island which is the most beautiful and unspoiled of all the Lesser Antilles. Père ROBERT PINCHON of the Seminaire Collège de Fort-de-France served in the same generous capacity on Martinique. Both have my sincere thanks for the courtesies and labor which they extended and exerted for us.

Due to the large collections amassed by myself and parties (designated Albert Schwartz Field Series – ASFS) I have made no particular effort to borrow comparative material from other collections. I have had access to the extensive collections of the Museum of Comparative Zoology at Harvard University (MCZ) under the curatorship of ERNEST E. WILLIAMS, and have borrowed a few pertinent frogs from the American Museum of Natural History (AMNH), the Rijksmuseum van Natuurlijke Historie (RNH), and the University of Florida Collections (UF), through the courtesy of CHARLES M. BOGERT, GEORGE W. FOLEY, M. S. HOOGMOED, Jr., WALTER AUFFENBERG, and LEWIS D. OBER. I am very grateful to JEAN GUIBÉ of the Muséum National d'Histoire Naturelle (MNHN) for allowing me to examine the syntypes of *E. martinicensis* (Tschudi), and to both DORIS M. COCHRAN and Dr. WILLIAMS for assistance and advice in matters of literature and taxonomic legalistics.

Specimens collected by us on Grenada and St. Vincent in late 1961 have been placed in the American Museum of Natural History, and paratypes of new forms have been donated to the above collections, as well as to the Museum of Natural History, University of Kansas (KU), the United States National Museum (USNM), the Carnegie Museum (CM), and the University of Illinois Museum of Natural History (UIMNH). Specimens in the collections of P. WAGENAAR HUMMELINCK (PWH, with station numbers in italics, specimens presented to RNH at Leiden and the Zoölogisch Museum (ZM) at Amsterdam), DENNIS R. PAULSON (DRP), and RICHARD THOMAS (RT) have also been included in the present study. The illustrations are once again the work of David C. LEBER, to whom I am most grateful.

I have examined 2,840 frogs from the Lesser Antilles, Trinidad, Tobago and northern South America of which the complete suite of measurements and ratios was taken on 938. Of the entire lot, 1,341 are from the ASFS, RT and DRP collections and were collected by myself and parties, and the balance is from other institutions. The advantage of having such a quantity of material, of which a large percentage (44%) was observed in life and freshly preserved, is obvious.

SYSTEMATIC ACCOUNT

Eleutherodactylus urichi (Boettger, 1894)

Hylodes urichi BOETTGER, 1894, Journ. Trinidad Field Nat. Club *2*, p. 88. Type locality – Trinidad.

Distribution: Trinidad, Tobago, Grenada, and St. Vincent (Figs. 7–10); reported on the South American mainland from Venezuela and the Guianas (RIVERO, 1961: 75–76) and specimens examined from Guiane Française and Guyana in the present study.

Definition: An *Eleutherodactylus* of the *auriculatus* group characterized by a combination of moderate size (snout-vent length of males to 27 mm, of females to 39 mm), relatively long hindlimbs (tibia/snout vent 49.7 to 60.0, both sexes combined), dorsal pattern variable, from absent to consisting of a scapular W, the lateral arms of which reach the upper eyelids, followed by a broad and distinct chevron and a pair of large dark spots on the dorsum above the groin, hindlimbs with usually three or four fairly narrow dark crossbars, red or orange to brownish-orange on the hindlimbs, and lacking inguinal glands.

Remarks: *E. urichi* was described on the basis of two syntypes from Trinidad; BOETTGER's description is sufficiently detailed to allow the name to be associated with the species which now bears the name. Most pertinent is the color description which states that the hindlimbs were "carmine-red". The size of the two syntypes is 20.5 and 20 mm, and this small size is well borne out by recently taken Trinidadian frogs. RIVERO (1961: 76) commented on the small size of Trinidad (versus Venezuelan) specimens, and noted that the largest of ten Trinidad frogs measured 24 mm in snout-vent length, whereas a male and female from Venezuela measured 29 and 31 mm respectively. Of 116 Trinidad specimens presently available, the largest male measures 21.5 mm and the largest female 25.9 mm. The small size of Trinidad *urichi* seems well established. In this regard it is interesting to note that of only four specimens from Tobago, the two adults – both of which are females – lie at the upper extreme or exceed the Trinidad females, with snout-vent lengths of 24.4 and 29.5 mm.

RIVERO's comments on the size of Venezuelan and Trinidadian *urichi* are even more pertinent when frogs from the Lesser Antilles are compared with those from Trinidad. Lesser Antillean females exceed both Trinidad and Venezuelan specimens in snout-vent length, and Lesser Antillean males reach a larger size than their Trinidadian relatives. Trinidad females become gravid at a snout-vent length of 20.5 mm, whereas Grenada females become gravid at 21.5 mm and St. Vincent

females at 23.5 mm. Not only are there differences in size between topotypical *urichi* and the more northern populations, but there are also consistent differences in coloration and pattern between Trinidad, Grenada, and St. Vincent frogs. Accordingly, I propose the following names for the Lesser Antillean populations.

Eleutherodactylus urichi euphronides, new subspecies

Holotype: MCZ 43229, an adult female, from Grand Etang, 1700 feet (519 meters), St. Andrew Par., GRENADA, one of a series collected by David C. Leber and Albert Schwartz on 25 February 1961. Original number 11129.

Paratypes: ASFS 11130–37, same data as holotype; USNM 157880–83, UF 21494–98, CM 40579–83, KU 93337–41, UIMNH 61641–42, same locality and collectors as holotype, 19 Feb. 1961; UIMNH 61643, same locality as holotype, A. Schwartz, 21 Feb. 1961; AMNH 74536–44 + seven untagged specimens, same locality as holotype, R. F. Klinikowski, A. Schwartz, 20 Nov. 1961; MCZ 2975–76, 51755–58, same locality as holotype, G. M. Allen, 9–10 Sep. 1910; ASFS X7125–28, RT 424–27, 0.75 mi. (1.2 km) NE Grand Etang, 1600 feet (488 m), St. Andrew Parish, Grenada, 22 May 1963, A. Schwartz, R. Thomas; ASFS X7176, 1 mi. N Vincennes, 1400 feet (427 m), St. David Parish, 24 May 1963, R. Thomas; MCZ 31560, Mt. Horn Cacao Station, Mt. Horn, St. Andrew Parish, V. Quesnel, 11 March 1964; MCZ 2961–62, St. George's, St. George Parish, G. M. Allen and C. T. Brues, 9–11 Sep. 1910; MCZ 2910–30, 2932–35, 51760–69, St. George's, St. George Parish, C. T. Brues, 28 Aug. 1910; ASFS 11122–24, 8 mi. (12.8 km) NE St. George's, ca. 1000 feet, St. George Parish, D. C. Leber, A. Schwartz, 25 Feb. 1961.

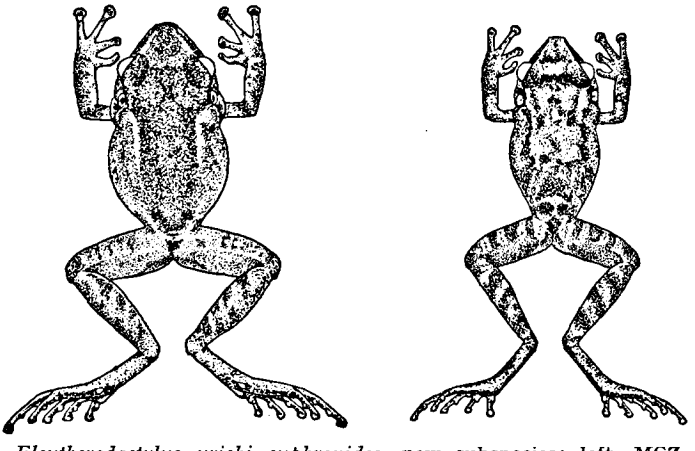

Fig. 1. *Eleutherodactylus urichi euphronides,* new subspecies; left, MCZ 43229, holotype from GRENADA, snout-vent length 39.0 mm; right, ASFS 11122, paratype from GRENADA, snout-vent length 32.6 mm.

Distribution: The island of Grenada, West Indies (Fig. 9).

Diagnosis: A subspecies of *E. urichi* characterized by large size (males to 27 mm, females to 39 mm snout-vent length), absence of a pair of black scapular dots and often with a complete dark scapular W, and concealed surfaces of hindlimbs reddish to bright orange in young and subadults, but changing to rich brownish-orange in adults.

Description of holotype: An adult female with the following measurements (in millimeters) and ratios: snout-vent length 39.0; head length 15.8; head width 16.8; diameter of tympanum 2.5; diameter of eye 5.9; naris to anterior corner of eye 5.2; femur 18.2; tibia 21.0; fourth toe 18.0; tibia/snout-vent length ratio (T/SV) 53.8; head width/snout-vent length ratio (HW/SV) 43.1; head width/tibia ratio (HW/T) 80.0. Head slightly broader than distance from snout to posterior border of tympanum; snout decidedly truncate with nares prominent at anterior end of canthus rostralis; diameter of eye greater than distance from naris to anterior corner of eye; diameter of tympanum slightly less than one half diameter of eye, distance from tympanum to eye slightly greater than diameter of tympanum; tympanum oval, the vertical diameter slightly greater than the horizontal. Interorbital distance 4.8, less than diameter of eye. Digital discs present and well developed, those on fingers 3 and 4 distinctly larger than those on fingers 1 and 2, disc of finger 3 the largest and equal to about four-fifths size of tympanum. Fingers long and slender, unwebbed, 3–4–1–2 in order of decreasing length; subarticular tubercles gray, prominent. Toes long, with vestigial webs, 4–3–5–2–1 in order of decreasing length; subarticular tubercles prominent, gray. Heels overlap strongly when femora held at right angles to body axis. Inguinal glands absent. Dorsum smooth; upper eyelids with very low rounded tubercles. Throat smooth, belly granular; abdominal disc moderately well developed, especially posterolaterally. Dorsal surface of fore- and hindlimbs smooth. Posterior face of thighs with low, rounded, juxtaposed, pavement-like granules. Tongue small, nicked, free behind, its greatest width equal to about one half that

of floor of mouth. Vomerine teeth in two small, triangular, patch-like series, enclosed within the inner margins of the choanae and separated from the choanae by a distance equal to about two-thirds the diameter of a choana, the two series separated from each other by a distance equal to slightly more than the diameter of a choana. Choanae completely visible when viewed from below.

Coloration of holotype: Dorsum in life rich brown and patternless except for a very vague darker narrow interocular bar and a pair of vague dorsal spots above the groin; sides slightly paler, grading into the creamy color of the venter. Fingers pale yellowish-tan, discs dark brown; antebrachia vaguely crossbarred. Hindlimbs brown dorsally, very vaguely crossbarred; concealed surfaces rich brownish-orange, this color occurring also in the groin and along the anterior face of the thighs (Fig. 1). Throat and underside of forelimbs and most of hindlimb heavily stippled with dark brown, extending onto the chest; proximal half of underside of femora dull orange. Iris dark golden-brown above, dark brown below.

Variation: The paratypes include 57 specimens which I consider adults. In the following series of measurements (and in all subsequent mensural data unless otherwise indicated), I have determined the smallest gravid female, and then computed the data for that sex utilizing all females, gravid or not, which exceeded the smallest gravid female in snout-vent length. Depending on the size of the series available, the 20 largest males were taken as representative of size of that sex; if there were less than twenty males available, as is the case in some samples, I have measured only those males which are obviously large and likely sexually mature. Thirty-seven adult females (including the type) have the following measurements and ratios (means in parentheses): snout-vent length 21.5–39.0 (27.8); head length 9.0–15.8 (11.6); head width 9.0–16.8 (11.8); tympanum 1.3–2.5 (1.8); eye 3.2–5.9 (4.2); naris to eye 2.5–5.2 (3.7); femur 10.2–18.2 (13.3); tibia 12.2–21.0 (15.4); fourth toe 9.8–18.0 (12.7); T/SV 49.7–60.0 (55.2); HW/SV 39.5–44.5 (41.9); HW/T 70.9–84.5 (76.0). Data from 20 males are:

snout-vent length 21.7–26.8 (24.3); head length 8.4–11.2 (9.8); head width 8.8–11.2 (9.8); eye 3.3–4.4 (3.8); naris to eye 2.6–3.8 (3.2); femur 10.6–12.8 (11.6); tibia 12.2–14.4 (13.2); fourth toe 9.8–11.7 (10.7); T/SV 50.4–59.9 (54.4); HW/SV 38.0–43.2 (40.4); HW/T 68.5–81.2 (74.4).

The dorsal coloration is generally some shade of brown, most often a rich reddish-brown. The dorsal pattern is quite variable, ranging from specimens like the holotype which lack any discernible pattern except for a faintly indicated darker interocular bar and a pair of vague darker spots above the groin. The dorsal pattern itself, when expressed, may have the complete complement of a broad dark W-shaped scapular figure, followed by a broad dark reversed V or chevron in the center of the back, in turn followed by the two spots above the groin. There may be a pale middorsal stripe which extends from the occiput to above the vent; this band may be even further expanded laterally to give a typical picket pattern. The snout is usually somewhat paler than the balance of the dorsum, and is separated by the dark interocular bar which in turn is often rather ill defined. The hindlimb banding is again quite variable; many specimens have only faint or vague bands like the type, whereas others (usually subadults and juveniles) have the legs very boldly crossed by three or four bands on the three leg segments; the paler interspaces on the limbs may have faint shadow-bars included. In life, the concealed surfaces of the thighs are bright orange in young specimens, and in adults these areas are overlaid with brown to give a rich brownish-orange coloration. The bright concealed surface coloration may also involve the crus and pes and be very extensive, and may also extend into the groin. All specimens seen in life had some indication of the bright coloration somewhere on the hindlimbs, but the bright orange may be either restricted or extensive. The tones of the concealed surface pigmentation were recorded in life as Pl. 4A12 in a specimen which was extensively colored and Pl. 5H12 in one which was restrictedly colored (all color designations from MAERZ & PAUL, 1950). There is regularly a dark brown to blackish postanal triangle on the posterior faces of the thighs. The ventral surfaces are usually creamy to whitish, and the throats are heavily stippled with dark brown in most cases. In males

the vocal sac is not large and not conspicuously glandular. A dark brown tympanic streak from the eye over the tympanum to above the forelimb is a common feature. Specimens which are prominently patterned dorsally usually have the pattern continuing onto the sides in the form of one to four broad diagonal bars; these bars are the continuations of the dorsal chevron and groin spots, as well as an additional pair of diagonal lines lateral to the scapular W. The structural details ascribed to the type agree with those in the remainder of the series.

Comparisons: *E. u. euphronides* differs from *E. u. urichi* in being larger and in details of pattern and pigmentation. The series of 15 male *E. u. urichi* has the following measurements and ratios: snout-vent length 16.7–21.5 (19.1); head length 6.1–8.5 (7.5); head width 6.4–8.0 (7.2); tympanum 0.9–1.6 (1.3); eye 2.2–3.5 (2.9); naris to eye 1.9–2.6 (2.1); femur 7.8–10.6 (9.3); tibia 8.8–11.1 (10.3); fourth toe 6.5–9.0 (7.8); T/SV 50.7–59.1 (53.9); HW/SV 35.7–40.2 (37.7); HW/T 63.5–74.3 (70.2). Thirty-nine females have the following data: snout-vent length 20.5–25.9 (22.0); head length 8.0–10.3 (8.8); head width 7.7–9.8 (8.6); tympanum 1.2–1.6 (1.4); eye 2.7–4.0 (3.2); naris to eye 2.1–3.0 (2.5); femur 9.5–12.7 (10.8); tibia 11.0–13.2 (12.0); fourth toe 8.2–10.1 (9.0); T/SV 51.0–60.0 (54.4); HW/SV 36.2–42.2 (37.9); HW/T 64.8–81.7 (69.8). Comparison of these data with those for *euphronides* indicates that the latter reaches a larger size in both sexes (the greatest difference being in the females, which are strikingly larger in *euphronides*); the means of all measurements in both sexes are consistently larger in *euphronides*. In some categories, especially in males, there is little or no overlap between the low extreme of *euphronides* and the high extreme of *urichi* (snout-vent length, head length, head width, naris to eye, femur, tibia, fourth toe). The discrepancy in size between the two populations is very marked when both series are compared simultaneously, since *urichi* in general resemble in size young and subadult *euphronides*.

The most conspicuous differences in pattern between *urichi* and *euphronides* are that the former regularly lacks a scapular W, and regularly has a pair of small dark brown or black dots in the position

of the two posterior tips of the W in *euphronides*. The dorsal chevron is very rarely expressed, and may be limited to only a pair of middorsal dark smudges. Four specimens have a pale picket pattern dorsally, none has a middorsal pale stripe, and three are distinctly different in having a rich chocolate brown dorsal picket with strikingly pale creamy and contrasting sides. The same variation in distinctness in leg barring occurs in *urichi* as in *euphronides*, but the leg bars appear to be even less regularly distinct in the former than in the latter. The concealed surfaces of anterior faces of the femora of recently collected Trinidad specimens were noted as being red, and BOETTGER considered the coloration of this member in the syntypes as carmine red. A simple glance at the dorsal pattern of specimens of *urichi* and *euphronides* suffices to distinguish them, since the pair of scapular dots in *urichi* never occurs in *euphronides*.

Remarks: *E. u. euphronides* is widespread on Grenada (Fig. 9), occuring at elevations from sea level to at least 1700 feet (519 meters) and presumably higher. Although my own experience indicates that it is restricted to the very wet and forested uplands, the series from St. George's suggests that it is also coastal in more suitable localities; I do not imagine that it occurs in the arid Point Saline area. In the uplands, as at the type locality, *euphronides* was collected calling from 3 to 4 feet above the ground on leaves and trunks of trees up to 3 feet in diameter in the very wet rain forest. The call is a two-note call, the second note higher than the first, and the first note fainter and less accented than the second. A favored site for non-calling individuals was the abundance of epiphytic bromeliads which occur low on the trees and in easy reach of the collector. I assume that these bromeliads are the diurnal retreats of *euphronides*; however, one individual was taken from under a plank adjacent to the lake at Grand Etang. At the locality northeast of Grand Etang, a few *euphronides* were taken on grass and low herbs in a small montane meadow surrounded by forest and nutmeg; in this situation the males were not calling despite the usual very wet conditions. Occasionally *euphronides* is active in the late afternoon, since one specimen was taken from the ground in a cacao grove well before dark.

There are four specimens of *E. urichi* from Tobago. Two of these (ASFS T148, T204) are the females which have previously been mentioned as being at the upper extreme and larger than any of the thirty-nine Trinidad females studied. The remaining two frogs (MCZ 27787, 27960) are both juveniles with snout-vent lengths of 14.5 and 14.3 mm. The smaller female is gravid. One female is dorsally patternless and the other has a pair of scapular dots; one juvenile has a picket pattern and the other has the complex dorsal pattern of *euphronides*. Taking into consideration all the features of these four specimens, the Tobagan population seems intermediate between *urichi* and *euphronides*, but closer to the latter. This parallels the situation in lizards of the genus *Bachia* (THOMAS, 1965a), wherein the Tobagan populations of *B. alleni* are intermediate between the Trinidad subspecies *trinitatis* and the Grenada

subspecies *alleni*, but closer to the latter. Such a situation is difficult to rationalize, since Tobago is separated from Trinidad by a much narrower passage than it is from Grenada, and it would be expected that the Tobagan populations would be nearly identical with those from the nearer Trinidad. Possibly additional material from Tobago will alter this interpretation.

Since I have concerned myself primarily with the insular rather than South American mainland populations of *E. urichi*, I have not made special effort to examine material from the continent. I have studied thirteen specimens from South America, two of which are from Guiane Française and eleven from Guyana; one other frog (AMNH 4221) is questionably from Guiane Française. All but two are extremely discolored and desiccated specimens, and the two fresh individuals are juveniles. Rarely is any definitive pattern still visible. The lot includes only five adult specimens (three females, of which only the largest is gravid, and two males). It is possible that some or even all of these old specimens are misidentified as *E. urichi*, and in their present condition it would be difficult to say otherwise. The males are like Trinidad specimens in snout-vent length, but the females reach a slightly larger size (27.4 mm versus 25.9 mm in Trinidad frogs). A complete scapular W is a regular feature, in contrast to the pair of scapular dots in *E. u. urichi*. In both sexes, the T/SV ratio is remarkably low (42.3–45.7 in males, 39.4–50.2 in females), and is thus distinctly lower than the same ratio in Trinidad specimens, with no overlap between the two populations. Mere inspection of the mainland *urichi* shows that they are much shorter limbed than insular specimens. From these brief remarks, based upon hardly adequate material, it is obvious that specimens of *E. urichi* from the South American mainland are not identical with specimens from Trinidad. Until fresh mainland material becomes available, it would not be profitable to diagnose the mainland populations; it is conceivable as well that specimens from the Guianas and Venezuela (whence I have examined no material, but have relied on RIVERO's comments; 1961: 75–76) are not identical *intra se*.

Specimens examined (other than *E. u. euphronides*):

E. u. urichi: TRINIDAD, *St. George Co., Diego Martin Ward*, Four Roads, 1 (MCZ 3255); *St. Ann's Ward*, Port-of-Spain, St. Ann's Valley, 3 (MCZ 13094–96); *Tacarigua Ward*, El Tucuche, 1000–2000 feet (305–610 meters), 1 (MCZ 17558); El Tucuche, 2000–3000 feet (610–915 m), 13 (MCZ 17559–60, 17562–67, MCZ 19901–03 + two untagged specimens); El Tucuche, 1 (AMNH 55805); Maracas Valley, 10 (MCZ 44921–30); Churchill-Roosevelt Highway, 10.5 milepost), 1 (AMNH 55806); Mt. St. Benedict, 3 (AMNH 52850 + two untagged spec.); *Arima Ward*, Aripo Valley, 1000–2500 feet (305–763 m), 2 (MCZ 21407–08); Arima Valley (various localities), 59 (AMNH 55800–02 + four untagged spec., AMNH 55788–90 + eight untagged spec., AMNH 55791–93, AMNH 55794–96 + three untagged spec., AMNH 55797–99 + seven untagged spec., AMNH 62879–81, AMNH 70456–59 + one untagged spec., AMNH 70460–64, AMNH 70465, AMNH 70466, AMNH 70467, AMNH 70468–72, AMNH 73777); Morne Bleu, 11 (AMNH 55779–81 + three untagged spec., AMNH 55782–84 + one untagged spec., AMNH 55804); Heights of Guanapo, 3 (AMNH 55785–87); Aripo Heights, approximately 3 mi. (4.8 km) N Eastern Main Road, 1 (ASFS T98); Santa Cruz Valley, 7.5 mi. (12 km) N San Juan, 1 (ASFS T105); stream on Morne Bleu, by the 10.5 milepost, Arima-Blanchisseuse Road, 4

(MCZ 27956–59); between *St. George* and *St. Andrew cos.*, El Cerro del Aripo, 1 (AMNH 55803); county indeterminate, La Seiva, 1 (MCZ 3240).

E. u. urichi × *euphronides*: TOBAGO, nr. Hillsborough Dam, 1 (MCZ 27960); 3 mi. (4.8 km) N Mount St. George, 1 (ASFS T204); 4 mi. (6.4 km) N Pembroke, 1 (ASFS T148); near Speyside, 1 (MCZ 27787).

E. urichi subsp.: GUYANA (= British Guiana), Georgetown, 5 (AMNH 18981–82, AMNH 21403–04, AMNH 21413); Demerara, 1 (AMNH 23129); Demerara River, 3 (AMNH 13534–36); Onora Creek, 1 (AMNH 43669); Shudikar-wan, 1 (AMNH 46247). GUIANE FRANÇAISE, trail from Sophie to La Grève, 2 (MCZ 44557–58); "Oppronsque, Frontier River" (data questionable), 1 (AMNH 4221).

Several years ago, BENJAMIN SHREVE of the Museum of Comparative Zoology had completed a manuscript describing a new subspecies of *E. urichi* from the Lesser Antilles; for various reasons this manuscript was never published, and he has relinquished his interest in these frogs to me. It is only fitting that Mr. SHREVE's name be associated with *E. urichi* since he had done part of the ground work on this species in the Antilles. Accordingly, I propose, for the populations of *E. urichi* on St. Vincent, the name

Eleutherodactylus urichi shrevei, new subspecies

Holotype: MCZ 43230, an adult female, from Lowrt, 1000 feet (305 meters), St. Andrew Parish, ST. VINCENT, one of a series collected by David C. Leber and Albert Schwartz on 7 March 1961. Original number 11243.

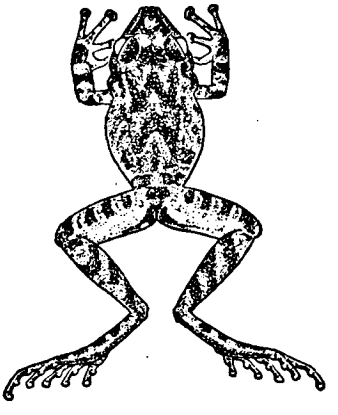

Fig. 2. *Eleutherodactylus urichi shrevei*, new subspecies; MCZ 43230, holotype from ST. VINCENT, snout-vent length 33.0 mm.

Paratypes: ASFS 11244–48, ASFS 11253–57, USNM 157884–89, UIMNH 61644–46, UF 21499–501, same data as holotype; DRP 2078–79, same locality as holotype, D. R. Paulson, 26 Dec. 1961; MCZ 51452–56, summit of Mt. Soufrière, ca. 3000 feet (915 m), St. David Parish, St. Vincent, G. Gorman, 30 March 1964; MCZ 19814–17, edge of the crater, Mt. Soufrière, Charlotte Parish, J. G. Meyers, Nov. 1924.

Distribution: The island of St. Vincent, West Indies (Fig. 10).

Diagnosis: A subspecies of *E. urichi* characterized by large size (males to 23 mm, females to 34 mm snout-vent length), absence of a pair of black scapular dots and often with a complete scapular W or a pair of paler dorsolateral stripes, and concealed surfaces of hindlimbs red or reddish-orange, never brownish, even in adults.

Description of holotype: An adult female with the following measurements and ratios: snout-vent length 33.0; head length 13.3; head width 14.0; diameter of tympanum 2.0; diameter of eye 4.5; naris to anterior corner of eye 4.5; femur 17.0; tibia 19.5; fourth toe 16.6; T/SV 59.1; HW/SV 42.4; HW/T 71.8. Head slightly broader than distance from snout to posterior border of tympanum; snout decidedly truncate with nares prominent at anterior end of canthus rostralis; diameter of eye equal to distance from naris to anterior corner of eye; diameter of tympanum slightly less than one half diameter of eye, distance from tympanum to eye about equal to diameter of tympanum; tympanum oval, the vertical diameter slightly greater than the horizontal. Interorbital distance 4.2, less than diameter of eye. Digital discs present and well developed, those on fingers 3 and 4 distinctly larger than those on fingers 1 and 2, disc of finger 3 the largest and equal to about four-fifths size of tympanum. Fingers long and slender, unwebbed, 3–4–1–2 in order of decreasing length; subarticular tubercles gray, prominent. Toes long, with vestigial webs, 4–3–5–2–1 in order of decreasing length; subarticular tubercles prominent, gray. Heels overlap strongly when femora held at right angles to body axis. Inguinal glands absent. Dorsum smooth; upper eyelids with very low rounded tubercles. Throat smooth, belly granular; abdominal disc moderately well developed. Dorsal surfaces of fore- and hindlimbs

smooth except for a few large low tubercles on the crura. Posterior face of thighs with low, rounded, juxtaposed, pavement-like granules. Tongue small, nicked, free behind, its greatest width equal to about one half that of floor of mouth. Vomerine teeth in two very small patch-like series, enclosed within the inner margins of the choanae and separated from the choanae by a distance equal to about two-thirds the diameter of a choana, the two series separated from each other by a distance equal to slightly more than the diameter of a choana. Choanae completely visible when viewed from below.

Coloration of holotype: Dorsum in life rich brown with the following pattern. A broad dark interocular bar bordering the snout posteriorly, the snout having a pair of pale spots just anterior to the interocular bar and some pale marbling near the tip; a broad dark brown scapular W, its outermost arms somewhat indistinct but approaching the upper eyelids, its median portion almost touching the interocular bar; a rather vague brownish chevron on the dorsum, posterior to the W; a pair of broad brown spots above the groin, these spots almost forming a transverse bar across the dorsum above the groin. Sides red, with a series of about four or five diagonal and irregular bars. Forelimbs brown with three antebrachial crossbars and a single distal dark brown spot near the elbow on the brachium; fingers pale tan, discs brownish dorsally. Hindlimbs tan with a distinct red suffusion on the thighs; dorsal surface of the thighs barred anteriorly with four bold brown bars (and with shadow bars in the paler interspaces), and the posterodorsal surface bright red (Pl. 4G11); in the preserved specimens, this results on the thigh in two distinct bands on the upper face of the thigh: an anterior band which bears the crossbars and a posterior one which lacks bars and which is red (Fig. 2). The crura are dark reddish-brown, with three rather indistinct but broad dark brown crossbars, and with the interspaces much marbled with dark brown; pes marbled dark brown and reddish-tan. Ventral surface creamy, with some isolated stippling on the throat and along the posteromedian faces of the thighs; underside of both fore- and hindlimbs red, concolor with the concealed surfaces.

Variation: Twelve adult females have the following measurements and ratios: snout-vent length 23.5–34.2 (28.3); head length 9.3–14.0 (11.3); head width 9.3–14.6 (11.5); tympanum 1.4–2.0 (1.6); naris to eye 2.6–4.5 (3.7); femur 11.5–17.0 (13.7); tibia 13.2–19.5 (15.8); fourth toe 10.3–16.6 (12.5); T/SV 51.5–59.9 (55.9); HW/SV 37.5–42.7 (40.6); HW/T 66.7–81.0 (73.0). The same data for thirteen males are: snout-vent length 20.8–23.4 (22.1); head length 8.0–9.9 (8.6); head width 8.0–9.9 (8.6); tympanum 1.2–1.5 (1.4); eye 3.0–3.9 (3.5); naris to eye 2.4–3.2 (2.8); tibia 11.5–13.9 (12.2); fourth toe 8.6–10.7 (9.4); T/SV 50.0–59.2 (55.3); HW/SV 35.0–40.9 (38.8); HW/T 65.9–73.0 (70.3).

The series of paratypes shows much the same variation in dorsal pattern as does *E. u. euphronides*. Some specimens are patternless or virtually so above, whereas others have the full pattern even more boldly delineated than the holotype. The interocular bar is always present, and often delimits the much paler coloration of the snout. Six frogs have prominent to fairly prominent tan dorsolateral stripes. The hindlimb barring is almost always very bold, and the paler (red in life) posteriodorsal face of the thigh is always very obvious and in distinct contrast to the anteriodorsal face which bears the bars, thus imparting an almost bicolor condition to the thigh. Two specimens have a bold and broad pale bar between the eyes anterior to the dark interocular bar; this pale bar is a common feature in various members of the *auriculatus* group. The dorsal coloration varies between rich wood brown and rich tan. The venter is creamy, usually with some heavy stippling on the throat in adults. The postanal dark triangle and the dark supratympanic line are regular features, the former being even more prominent because of its occurrence within the red posteriodorsal band on the thigh.

Comparisons: The comparison of *E. u. urichi* and *E. u. shrevei* is easily dismissed; the former is much smaller and has a pair of dorsal dark spots in the scapular region, and the thighs do not have the distinctly bicolor appearance of *shrevei*. The races *shrevei* and *euphronides* are very close, but can be easily differentiated by the thigh pattern in both living and preserved specimens, since *shrevei* has a distinctly bicolor thigh and *euphronides* lacks it. This

condition is due to a basic difference in pigmentation between the two forms, since in *euphronides* the coloration of the concealed surfaces is brownish-orange in adults, whereas in *shrevei* the concealed surfaces are red. The extensive red pigmentation on the sides and undersurfaces of the limbs in *shrevei*, although not a constant feature in this subspecies, has not been observed in *euphronides*. The concealed surface pigmentation in *shrevei* is regularly less dark than in *euphronides*.

The differences in size between *shrevei* and *euphronides* are slight. *Euphronides* is known to reach a larger size in both sexes than *shrevei*; means of the two races in all measurements are close, but *euphronides* averages higher in all except for naris to eye, femur and tibia in females. Means of the three ratios are comparable, the greatest difference being between the HW/T in both sexes. Possibly additional specimens of *shrevei* will strengthen this difference.

Remarks: The topotypical series of *E. u. shrevei* was collected at night in and about the edges of rain forest in an extensive cleared area adjacent to the tributary of the Dalaway River at the end of the road from Buccament Bay into the interior. Males were calling the two-note call from the leaves of trees and shrubs, and females were most often encountered on the ground or on the leaves of herbaceous plants.

Although there are few locality records for *E. u. shrevei* on St. Vincent, I imagine that the species is quite common, at least in the well-forested interior. The altitudinal range of 1000 to 3000 feet, and the known geographic distribution in the southeast and the north-central portions of the island indicate that much of the mountainous region in the interior is suitable and likely inhabited by *E. u. shrevei*.

Except for *Leptodactylus validus* Garman (COCHRAN, 1938 : 148, and personal observation), no amphibian has been reported from the Grenadines which lie between St. Vincent and Grenada. In a four weeks' visit thoughout these islands, RONALD F. KLINIKOWSKI and I encountered no *Eleutherodactylus* and heard none calling, despite moderately rainy conditions. It is possible that these islands are not sufficiently mesic and well forested for *E. urichi*; although several are fairly high (Carriacou, Union, Bequia, and Canouan have peaks in excess of 800 feet; KINGSBURY, 1960 : 4) and support forests, these forests are not the rich and cloud-wrapped rain forests of the higher interiors of the Windward Islands.

Eleutherodactylus johnstonei Barbour, 1914

Eleutherodactylus johnstonei BARBOUR, 1914, Mem. Mus. Comp. Zool. *44* (5): 249.
Type locality – St. George's, St. George Par., Grenada.

Distribution: Grenada, Barbados, St. Vincent (incl. Young's Island), St. Lucia, Martinique; Antigua, Barbuda, Montserrat,

Nevis, St. Christopher, St. Eustatius, Saba, and St. Martin (Figs. 9–13, 16); introduced in Jamaica and Bermuda.

Definition: An *Eleutherodactylus* of the *auriculatus* group characterized by a combination of small size (snout-vent length of males to 25 mm, of females to 35 mm), relatively short hindlimbs (tibia/snout-vent 36.8 to 50.0, both sexes combined), dorsal pattern variable but usually showing at least one chevron (sometimes followed by a second dorsal chevron) in the scapular region, often with prominent dorsolateral stripes and/or a median dorsal pale hairline, a single broad crural crossbar bordered with paler, no red on the hindlimbs or in the groin, and lacking inguinal glands (Fig. 3).

Discussion: *Eleutherodactylus johnstonei* was described on the basis of two syntypes (MCZ 2759, MCZ 51754) from St. George's, St. George Parish, Grenada. From the outset, the name *E. johnstonei* has traveled an erratic road, to which BARBOUR (1914: 249) made the initial contribution.

Quoting the "brief history" of *E. johnstonei* on Grenada as outlined by G. M. ALLEN, BARBOUR noted that " 'Mr. Septimus Wells tells me that this small piping frog was introduced about 25 years ago [*i. e.* about 1885] from Barbados, and has since spread up country. It is, of course, absent from the forests of the high region

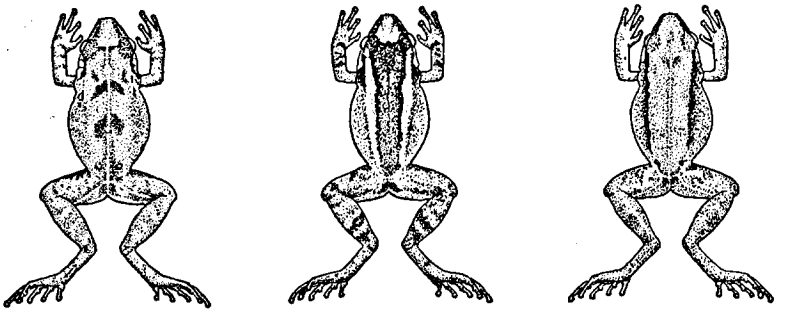

Fig. 3. *Eleutherodactylus johnstonei*, showing three dorsal patterns; specimens from MARTINIQUE: left, ASFS X6531, Habitation Dizac, 1.5 km W Le Diamant; center, ASFS 18638, 3 km NE Tartane; right, ASFS X6401, 7 km SE Fond-St.-Denis, 2000 feet.

about Grand Etang. I heard the last one near the side of the highway about three miles above St. George's.' I am loath to designate as types of a new species individuals from a locality of which the species is not truly a native. Since, however, no specimens are available from Barbados, and the species was also possibly introduced there, there is no alternative but to use the material at hand." On the following page, BARBOUR noted that Colonel FIELDEN, writing in 1889, stated that *Hylodes martinicensis* (= *E. johnstonei*) was a recent introduction, since twenty years previously it was unknown on that island, and that BELLIN, writing in 1758, stated that no frogs nor toads occurred at that time on Barbados. Thus, to summarize the above data, it seems that *E. johnstonei* first appeared on Grenada about 1885 and on Barbados about 1879. The species is such a conspicuous element of the fauna of both islands today, and also of the islands to the north that it seems unlikely that it had been previously overlooked on both Grenada and Barbados. If the species has been introduced on *both* islands, the introduction most likely has come from St. Lucia or St. Vincent, both of which are British islands which have long maintained intercourse with Barbados, and perhaps the frog was brought thence to Grenada. On the other hand, considering the geographically compact distribution of *E. johnstonei* on the inner-chain southern Windwards, one wonders if the species has not always been native to Grenada (and possibly to Barbados as well), and that these earlier observers were simply in error about the status of frogs on these two islands.

The name *E. johnstonei* has gradually fallen into disuse, possibly in part due to the above confused situation. COCHRAN (1938: 148) noted that DANFORTH collected two specimens from Grand Etang on Grenada in 1937 (note that at least by this date *E. johnstonei* had "reached" the interior uplands where it was specifically stated not to occur in 1910), but a single specimen from St. Vincent was regarded as *E. martinicensis*. BARBOUR (1937), in listing the Antillean herpetofauna, made no mention of *E. johnstonei*, and presumably by that date he considered it a synonym of *E. martinicensis*. GRANT (1959: 98), while discussing the Barbadian fauna, gave a concise history of Barbadian frogs, and stated that *E. martinicensis* was found on that island; his incisive comment that "The species *johnstonei* has been dropped from the literature" sums up the current status of the name.

This deteriorating situation has been due to several factors: 1) uncertainty of the applicability of the name *Eleutherodactylus martinicensis* (Tschudi); 2) lack of certainty as to the number of species of the genus on any particular island, and 3) confusion and dependence on the past literature as to what had been reported from each island. In actuality, the situation is not particularly complex, and field experience in the Windward Islands and, even more pertinently, examination of the syntypes of *E. martinicensis*, has allowed resolution of the problem. Aside from the species *E. urichi*, *E. barlagnei*, and another diminutive species from Guadeloupe described beyond in the present paper, the *martinicensis-johnstonei* representatives on the Windward Islands (south to north) may be tabulated as follows: Grenada 1 — St. Vincent 1 — St. Lucia 1 — Martinique 2 — Guadeloupe 1 — Dominica 1. (The situation in the Leeward Islands will be discussed below, and is not pertinent here.)

There are two forms (or possibly groups of forms) involved, one northern and occuring as far *south* as Martinique, and one southern and occurring as far *north* as Martinique. It is perhaps unfortunate that Martinique is the island with two species, since the syntypes of *E. martinicensis* (as indicated by the name itself) were presumed to have been collected by PLÉE on Martinique. The problem thus resolves itself into which of the two Martinique species is properly regarded as *E. martinicen-*

sis; this question will be discussed in detail beyond. At least one species on Martinique is identical with specimens of *E. johnstonei* from Grenada. After examination of the syntypes of *E. martinicensis*, I am convinced that the name is properly applicable to the northern of the two Windward Island species; thus *E. johnstonei* Barbour is a valid form, and quite distinct from *E. martinicensis* (Tschudi). Parenthetically, it is noted that all the material BARBOUR had available from Martinique at the time of the description of *johnstonei* was of the upland Martinique species *martinicensis*; thus his two Grenada specimens were quite distinctly different from what he correctly assumed to be *martinicensis*.

The Leeward Islands portion of the range of *E. johnstonei* includes St. Martin, Saba, St. Eustatius, St. Christopher, Nevis, Montserrat, Barbuda and Antigua. I have examined specimens from all of these islands. From St. Eustatius and St. Martin, "*E. martinicensis*" was reported by DUNN (1934: 110). There are specimens in the British Museum (Natural History) from St. Eustatius which I have not examined. The first record for St. Martin is based on a reference of COPE (1870). I can now verify the existence of *E. johnstonei* on St. Martin and St. Eustatius from many specimens which were collected by Dr. P. WAGENAAR HUMMELINCK in 1949 and 1955.

The Leeward Island distribution of *E. johnstonei*, and the hiatus between the southern and northern populations, is peculiar. The species is absent from Guadeloupe and Dominica, but occurs to the north of Guadeloupe on Montserrat and Antigua, and to the south of Dominica on Martinique. In the Leewards themselves, it appears to be absent from Anguilla and St. Barthélemy (which share the Anguilla Bank with St. Martin). Of the two Leeward Islands whence *E. johnstonei* is presently unknown, at least St. Barthélemy seems suitable ecologically, and Anguilla seems at least adequate. I have visited both islands and have neither heard nor collected *E. johnstonei* on them. The stillness of the nights on St. Barthélemy is startling to anyone who is accustomed to hearing tropical frog choruses.

In size, *E. johnstonei* is a somewhat variable species on the eleven islands whence I have examined specimens in detail, although the variation is not striking nor in my opinion of taxonomic significance. The maximum size is reached by males from St. Vincent (25.2 mm snout-vent length), with males from the other islands ranked as follows: Antigua (24.4), Grenada (24.3), Martinique (23.6), St. Lucia (23.5), Barbuda (22.9), Barbados (21.9), Saba (21.2), St. Christopher (20.7), Montserrat (20.6), Nevis (19.8). The largest female is from St. Lucia (34.8), with females from the other islands as follows: Barbuda (32.3), Grenada (31.6), Martinique (31.1), Antigua and Saba (29.7), St. Vincent (28.2), Barbados (27.5), St. Christopher (27.3), Nevis (27.0), Montserrat (24.4). The smallest gravid female is from Montserrat (16.9), with minimally sized gravid females from the other islands as follows: Martinique (19.0), Grenada (19.4),

Nevis and Saba (19.7), Antigua (21.4), St. Lucia and Barbados (21.5), St. Christopher (22.0), St. Vincent (24.2), Barbuda (27.0). The largest mean of snout-vent length of males is 23.7 (St. Vincent), the smallest is 18.4 (Montserrat); the largest mean of snout-vent length of females is 29.1 (Barbuda), the smallest is 20.3 (Montserrat). LYNN (1957: 54) commented on the unusually small size (17.5 mm) of a gravid "*E. martinicensis*" from Antigua; this specimen is doubtless referrable to *E. johnstonei*, and lowers the minimal gravid size for the species on that island.

Examination of Table 1 shows that, although the means and extremes of the remaining eight measurements are variable between the islands, there is general agreement between the various populations of *E. johnstonei* throughout its range. Noteworthy is the extremely small size of frogs from Montserrat and the large size of Barbuda females. Specimens from the Leeward Islands (with the exception of Barbuda females) are in general smaller than frogs from the Windward Islands. In fact, statistical test of this difference shows that the Leeward and Windward populations are significantly different in this single character; presumably similar tests on some other measurements would yield similar results. However, I can detect no differences other than that of size between the northern and southern populations and in fact the Barbuda females weaken this size difference also. I do not feel that the northern – southern populations are worthy of nomenclatorial recognition.

In the Windward Islands, Barbadian frogs average smaller in all dimensions, but are very close (especially in females) in most means to specimens from Martinique. In general, the highest means in all measurements in males are those from St. Vincent, and in females, from Grenada.

Considering males from the eleven samples, the mean T/SV varies between 40.4 (St. Vincent) and 45.7 (St. Christopher, whence only two males were examined); mean HW/SV between 34.3 (St. Vincent) and 38.7 (St. Christopher); mean HW/T between 82.1 (Saba) and 87.6 (Grenada). In females, the mean T/SV varies between 39.1 (Barbuda) and 45.7 (Nevis, whence only four females were examined); mean HW/SV between 35.8 (Barbuda) and 38.7 (St. Christopher); mean HW/T between 83.4 (Martinique and Bar-

TABLE 1.

Means and extremes of nine measurements and three ratios of samples of *Eleutherodactylus johnstonei* from eleven major islands.

(The sample from Saba was not measured except as indicated.)

MALES	N	*Snout-vent length*	*Head length*	*Head width*	*Tympanum*	*Eye*	*Naris to eye*
Saba	7	20.8 (19.7–21.2)		7.3 (6.7–7.7)			
St. Christopher	2	19.3 (17.9–20.7)	7.0 (6.9–7.1)	7.5 (7.2–7.7)	1.1 (1.0–1.2)	2.5 (2.3–2.6)	2.0 (1.9–2.1)
Nevis	4	19.1 (18.3–19.8)	7.0 (7.0–7.1)	7.3 (7.1–7.5)	1.3 (1.2–1.4)	2.8 (2.7–2.9)	2.0 (1.8–2.1)
Montserrat	11	18.4 (17.6–20.6)	6.7 (6.0–7.5)	6.9 (6.3–7.7)	1.3 (0.9–1.4)	2.6 (2.4–2.8)	1.9 (1.7–2.2)
Antigua	17	21.9 (19.8–24.4)	7.5 (6.8–8.1)	7.9 (7.0–8.8)	1.3 (1.0–1.5)	3.0 (2.5–3.3)	2.1 (1.6–2.5)
Barbuda	8	20.5 (17.9–22.9)	7.2 (6.4–7.9)	7.5 (6.6–8.1)	1.2 (1.1–1.3)	2.7 (2.6–3.1)	2.1 (1.8–2.3)
Martinique	25	21.3 (19.7–23.6)	7.4 (6.7–7.9)	7.8 (7.2–8.5)	1.4 (1.2–1.6)	2.9 (2.5–3.4)	2.2 (1.8–2.8)
St. Lucia	16	21.6 (19.8–23.5)	7.5 (6.9–8.4)	7.6 (6.8–8.8)	1.4 (1.1–1.7)	2.9 (2.5–3.4)	2.1 (1.8–2.5)
St. Vincent	10	23.7 (22.3–25.2)	7.7 (7.1–8.2)	8.2 (7.3–8.6)	1.4 (1.2–1.5)	3.0 (2.6–3.2)	2.3 (1.9–2.7)
Grenada	25	22.4 (21.3–24.3)	7.7 (7.0–8.2)	8.0 (7.5–8.8)	1.4 (1.2–1.7)	2.9 (2.4–3.3)	2.3 (1.9–2.9)
Barbados	16	20.6 (19.4–21.9)	7.1 (6.5–7.8)	7.4 (6.8–8.4)	1.3 (1.0–1.5)	2.7 (2.3–3.0)	2.0 (1.7–2.5)
FEMALES	**N**	***Snout-vent length***	***Head length***	***Head width***	***Tympanum***	***Eye***	***Naris to eye***
Saba	19	23.8 (19.7–29.7)		8.7 (7.0–11.6)			
St. Christopher	26	24.4 (22.0–27.3)	8.9 (7.5–10.5)	9.5 (8.2–11.0)	1.6 (1.2–2.0)	3.3 (2.4–3.8)	2.7 (2.1–3.1)
Nevis	4	23.3 (19.7–27.0)	8.8 (7.1–10.7)	9.0 (7.1–11.1)	1.6 (1.3–2.1)	3.3 (2.6–4.0)	2.5 (2.0–3.0)
Montserrat	11	20.3 (16.9–24.4)	7.5 (6.0– 7.7)	7.6 (6.4– 9.1)	1.4 (1.1–1.8)	2.9 (2.5–3.4)	2.1 (1.6–2.7)
Antigua	22	25.5 (21.4–29.7)	9.0 (7.8–10.6)	9.3 (8.0–11.0)	1.6 (1.3–1.8)	3.4 (2.8–4.0)	2.7 (2.1–3.5)
Barbuda	15	29.1 (27.0–32.3)	10.0 (9.2–11.6)	10.5 (9.5–12.2)	1.8 (1.6–2.1)	3.5 (3.1–3.8)	3.0 (2.4–3.6)
Martinique	27	24.1 (19.0–31.1)	8.6 (6.9–11.4)	8.9 (7.4–11.7)	1.6 (1.3–2.0)	3.2 (2.2–3.8)	2.5 (1.9–3.7)
St. Lucia	27	25.5 (21.5–34.8)	9.1 (7.8–12.4)	9.5 (7.5–13.8)	1.7 (1.4–2.3)	3.2 (2.8–4.2)	2.7 (2.0–3.8)
St. Vincent	13	25.6 (24.2–28.2)	9.0 (8.0–10.0)	9.6 (8.7–10.4)	1.6 (1.4–1.7)	3.4 (3.0–3.7)	2.6 (2.2–3.3)
Grenada	36	26.2 (19.4–31.6)	9.4 (7.2–12.1)	9.7 (7.2–12.0)	1.8 (1.4–2.7)	3.3 (2.2–4.1)	2.8 (2.2–3.5)
Barbados	20	24.1 (21.5–27.5)	8.6 (7.5– 9.9)	8.8 (7.8–10.0)	1.6 (1.3–1.8)	3.2 (2.8–3.6)	2.5 (2.1–3.1)

TABLE 1 (*continued*)

MALES	N	*Femur*	*Tibia*	*Fourth toe*	*T/SV*	*HW/SV*	*HW/T*
Saba	7		8.9 (8.6– 9.2)		42.8 (41.5–44.2)	35.1 (32.2–37.0)	82.1 (72.8–87.6)
St. Christopher	2	8.7 (8.1– 9.2)	8.9 (8.6– 9.2)	7.6 (7.4–7.8)	45.7 (43.5–47.8)	38.7 (37.2–40.2)	84.7 (83.7–85.6)
Nevis	4	7.6 (7.4– 8.0)	8.4 (8.0– 8.6)	7.2 (6.8–7.5)	44.1 (42.9–46.0)	38.2 (37.4–38.8)	86.7 (83.7–88.8)
Montserrat	11	7.1 (6.7– 7.5)	8.0 (7.5– 8.7)	6.7 (6.0–7.3)	43.8 (42.1–47.6)	37.7 (34.1–39.9)	86.2 (80.8–89.7)
Antigua	17	8.9 (7.3–10.1)	9.1 (9.2–10.2)	7.9 (7.2–8.9)	41.8 (38.2–47.1)	36.0 (33.0–38.7)	86.3 (77.3–96.7)
Barbuda	8	8.4 (6.9–9.0)	8.9 (8.3– 9.7)	7.4 (6.3–8.2)	43.8 (39.7–48.0)	36.4 (34.5–37.9)	84.0 (78.4–93.1)
Martinique	25	7.9 (6.7– 8.4)	9.2 (8.4–10.1)	7.9 (7.2–9.0)	43.2 (39.4–46.8)	36.3 (33.5–38.1)	84.3 (76.6–94.4)
St. Lucia	16	8.0 (7.1– 9.1)	9.0 (8.4– 9.7)	8.0 (7.4–8.7)	41.8 (38.3–45.5)	35.2 (32.0–38.8)	84.4 (77.3–90.7)
St. Vincent	10	8.9 (8.2– 9.5)	9.6 (8.9–10.1)	8.5 (7.9–9.0)	40.4 (36.8–42.2)	34.3 (32.7–36.6)	85.1 (81.4–92.3)
Grenada	25	8.5 (7.5– 9.4)	9.5 (8.5–10.6)	8.2 (7.2–9.0)	42.1 (38.5–48.4)	35.8 (32.9–38.8)	85.2 (78.9–93.2)
Barbados	16	7.7 (7.3–8.3)	8.4 (7.9– 9.2)	7.3 (6.5–7.8)	41.0 (38.4–44.3)	36.0 (34.0–38.9)	87.6 (81.4–96.6)
FEMALES	**N**	***Femur***	***Tibia***	***Fourth toe***	***T/SV***	***HW/SV***	***HW/T***
Saba	19		10.1 (8.3–11.6)		42.5 (39.1–46.8)	36.5 (32.6–42.6)	85.5 (71.4–100.0)
St. Christopher	26	9.9 (9.0–12.0)	10.9 (9.7–12.9)	9.3 (8.1–11.0)	44.6 (40.8–50.0)	38.7 (34.6–41.8)	86.4 (75.2– 98.1)
Nevis	4	9.0 (7.4–10.1)	10.6 (9.1–11.7)	8.8 (7.6– 9.9)	45.7 (41.5–47.6)	38.5 (36.0–41.1)	84.7 (78.0– 99.1)
Montserrat	11	8.1 (7.0–10.0)	9.1 (8.3–10.8)	7.5 (6.4– 9.0)	45.1 (39.9–48.2)	38.3 (37.0–40.8)	85.0 (78.8– 95.7)
Antigua	22	10.1 (8.5–11.6)	11.0 (9.4–12.7)	9.4 (7.4–10.8)	42.9 (37.7–48.4)	36.6 (34.2–38.5)	84.9 (77.9–101.0)
Barbuda	15	10.8 (9.4–12.6)	11.3 (10.5–12.9)	9.5 (8.5–11.1)	39.1 (36.4–42.7)	35.8 (34.0–38.3)	92.6 (88.5– 95.8)
Martinique	27	9.4 (7.8–12.1)	10.7 (8.9–13.0)	9.0 (7.7–11.2)	44.6 (39.0–49.5)	37.1 (34.1–39.5)	83.4 (76.5– 92.7)
St. Lucia	27	9.8 (8.0–13.4)	10.8 (9.2–14.3)	9.5 (8.1–12.4)	42.4 (37.8–46.9)	37.1 (34.2–42.4)	87.7 (79.8– 98.9)
St. Vincent	13	10.0 (8.6–11.0)	11.0 (10.2–11.9)	9.6 (8.8–10.5)	43.1 (37.9–48.2)	37.4 (35.8–39.1)	87.0 (79.1– 95.3)
Grenada	36	10.2 (8.3–11.8)	11.4 (8.5–13.5)	9.8 (8.1–11.4)	43.6 (38.3–47.7)	36.9 (33.3–39.9)	85.1 (79.3– 93.1)
Barbados	20	9.7 (8.2–11.8)	10.6 (9.4–12.8)	9.0 (7.4–10.7)	44.1 (40.0–49.6)	36.7 (33.0–39.7)	83.4 (73.4– 90.9)

bados) and 92.6 (Barbuda). Little can profitably be said about variation in these ratios except to note the variation itself (see, however, the comments on *E. barbudensis* below); there seem to be no general tendencies toward longer limbs or narrower head, for instance, in the north or south and there is no obvious pattern, correlated with geography, inherent to these data.

The coloration and pattern of *E. johnstonei* is somewhat variable. The dorsal coloration varies from some shade of brown to grayish-tan, with samples from various islands repeatedly noted in life as "tan to grayish-tan". Some few specimens are patternless above, but there is almost always one scapular chevron, usually followed by a second dorsal chevron, regardless of the presence of other pattern elements. Thus, if there is a median pale hairline, this line passes through the chevrons, breaking them into two separate parts, and if there are prominent pale dorsolateral stripes, these stripes neatly include the chevrons between them. A few specimens have a picket pattern, but this is not particularly common as a pattern variant. The most common condition is the one or two chevrons noted above, and these may be combined with either a dorsal hairline or a pair of dorsolateral stripes, or all three conditions may occur on the same frog. At times, the two chevrons may be much expanded, and additional dark pigment may occur on the back, giving a decidedly variegated dark-and-light pattern which I call the "dead leaf pattern"; this is merely an extension and modification of the two chevron pattern, but its obliterative and disruptive effect for ground-dwelling or partially ground-dwelling amphibians is obvious. The hindlimbs have but a single clear crossbar outlined by pale lines on the crus; on the thigh this crossbar is usually obsolescent. There may also be vague indications of two other crossbars, especially on the thigh (where they are far from prominent and lack integrity) and occasionally on the crura (where they are equally poorly delineated). There often is a dark postanal triangle, but its borders may be diffuse. The concealed surfaces are marbled, stippled, or blotched with dark brown on a tan to grayish-tan ground. The forelimbs usually have a single antebrachial bar, but this also may be diffuse or absent. The iris is gold above, and brownish below. The ventral

surface is creamy, often with some stippling on the throat. The vocal sac in males is strongly glandular, and in preserved specimens the sex can be determined by mere inspection of the throat without recourse to dissection. In life the vocal sac is relatively large when distended.

The structural features of *E. johnstonei* may be described as follows. Head slightly broader than distance from snout to posterior border of tympanum; snout decidedly truncate with nares prominent at anterior end of canthus rostralis; diameter of eye greater than distance from naris to anterior corner of eye; diameter of tympanum usually slightly more than one-half diameter of eye, distance from tympanum to eye equal to about one half diameter of tympanum; tympanum oval, the vertical diameter slightly greater than the horizontal. Interorbital distance about equal to or slightly less than diameter of eye. Digital discs present and well developed, those on fingers 3 and 4 distinctly larger than those on fingers 1 and 2, disc of finger 3 the largest and equal to about one third to one half the size of the tympanum. Fingers moderately long and slender, unwebbed, 3–4–2–1 in order of decreasing length; subarticular tubercles prominent, gray. Toes short, with vestigial webs, 4–3–5–2–1 in order of decreasing length; subarticular tubercles gray, prominent. Heels barely touch when femora held at right angles to body axis. Inguinal glands absent. Dorsum smooth or weakly tuberculate to fairly heavily and regularly studded with variously sized low rounded tubercles, especially behind the tympana and posteriorly; eyelids with many low rounded tubercles. Throat smooth, belly granular; abdominal disc moderately well developed, especially posteriorly. Dorsal surface of fore- and hindlimbs covered with variously sized low rounded tubercles, much more prominent on the hindlimbs. Posterior face of thighs with low, rounded, juxtaposed pavement-like granules. Tongue small, not or only slightly nicked, free behind, its greatest width equal to one-third to one-half that of floor of mouth. Vomerine teeth in two very small patch-like series, enclosed within the inner margins of the choanae and separated from the choanae by a distance equal to about twice the diameter of a choana, the two series separated from each other by a distance equal to about twice the diameter of a choana.

Choanae partially obscured when viewed from below. The small size of the choanae (especially relative to the size of these structures in *E. urichi*) is noteworthy; LYNN (1940: pl. 9) illustrated the buccal cavity of a Jamaican specimen of *E. johnstonei* (as *E. martinicensis*).

Comparisons: On the islands of Grenada and St. Vincent, *E. johnstonei* occurs with *E. urichi*. The two species are easily distinguished. The red limbs and groin of *urichi* differ from the irregularly patterned concealed surfaces of *johnstonei*. *Urichi* is much the larger of the two species, and the T/SV ratios (49.7 to 60.0 in *urichi*, 36.8 to 50.0 in *johnstonei*) will separate most adults of both sexes. In general aspect, *urichi* is a longer legged, brightly colored frog, often with multiple bands on the hindlimbs, whereas *johnstonei* is a short-legged, more drably colored frog with only a single hindlimb band. The patterned dorsa of some *urichi* contrast with the less elaborately patterned dorsa of *johnstonei*, although the latter species much more often has dorsolateral stripes, a feature which is known to occur only in *E. u. shrevei*. The species are so different that one should experience little difficulty in separating them where they occur together.

E. johnstonei occurs with *E. martinicensis* on Martinique and Antigua. Comparisons of these two species will be made in the discussion of the latter form.

Remarks: Throughout its range, *E. johnstonei* is a very common frog. It occurs from sea level to elevations of at least 2800 feet (854 meters) and presumably higher. The call is a weakly two-note call, rather like that of *E. urichi*, but with a distinctly more "whispery" quality. Males vocalize from above the ground surface, usually perched on leaves of shrubs or herbs, to about one meter above the ground. *E. johnstonei* is regularly encountered during the day – in piles of wet and decaying cacao husks, piles of coconut husks, under rocks, fallen walls of ruins, logs in forest, trash near human dwellings, in rock piles – in short, almost any terrestrial situation which offers concealment and some moisture. On Barbados, frogs were collected in the dead shells of the large snail *Strophocheilus oblongus*. Although I have collected them in fallen bromeliads, I have not taken *johnstonei* in bromeliads on trees (although no special effort has been made to search for this species in such situations and P. WAGENAAR HUMMELINCK has collected *johnstonei* in this situation on St. Martin), and I suspect that *johnstonei* is more terrestrial than its companion *urichi*. As far as habitat is concerned, it is by no means so confirmedly a forest dweller as is *urichi*. I have heard males calling from cut-over fields in Barbados, and there is a specimen from Point Saline on Grenada – a distinctly xeric region. On Martinique,

two were taken from among the dry breadfruit leaves bordering a dusty road through a large canefield – a particularly unappealing situation for most frogs. On St. Christopher, a small series was collected under rocks in a coastal *Terminalia* grove. *E. johnstonei* is much less restricted in its habitat requirements than are most other West Indian *Eleutherodactylus*.

E. johnstonei has been introduced in Jamaica and Bermuda. I have examined specimens from both islands and have collected the species in Jamaica. LYNN (1940: 51) noted that the species had been introduced in Jamaica at Kingston in 1890, but that it had not extended its range elsewhere. Since that date it has been reported (LYNN & DENT 1943, GOIN & COOPER 1950) from three additional parishes to the west (St. Catherine, Clarendon, St. Ann); I have heard the species in northern Manchester Parish in the vicinity of Christiana and have collected it in St. Ann Parish near Aenon Town. WINGATE (1965: 208–209) has recently traced the history of *E. johnstonei* (as *E. martinicensis*) on Bermuda; the frog is not only abundant on the mainland of Bermuda but is widespread there and has reached some of the smaller off-shore islets as well. I have not listed below the specimens I have examined from Jamaica and Bermuda.

The northern and southern population centers – Leeward Islands and Windward Islands – of *E. johnstonei* present the problem of the history of the species. Although a disjunct range is not unique in the Lesser Antilles, occurring also in *Constrictor constrictor* and in the genera *Ameiva* and *Leptodactylus*, and possibly *Clelia clelia* and *Chironius carinatus*, in no case is the gap so broad nor the distribution so extensive on either side of the gap. It is possible that *E. johnstonei* occurs on Dominica and Guadeloupe, but I consider this very unlikely, unless it is peculiarly restricted to some presently inaccessible area or some unsampled habitat. The fact that, north of Guadeloupe, *johnstonei* occurs on isolated Montserrat, on all the islands on the St. Christopher Bank, and on Saba – a total of five neighboring islands, if Redonda is excepted – suggests that the colonization of the Leeward Islands has been by natural means and at a time when at least the three St. Christopher Bank islands (St. Eustatius-St. Christopher-Nevis) were still united. Colonization of Saba may have been from St. Eustatius which lies immediately to the south. The occurrence of *E. johnstonei* only on St. Martin on the Anguilla Bank suggests that invasion of this bank took place after the separation of the various islands occurred. Another possibility is that *E. johnstonei* may have reached St. Martin fortuitously through the agency of man, from either Saba or St. Eustatius (or even from Martinique). Everything considered, the Leeward Islands distribution of *E. johnstonei* is about as compact as that of the same species in the Windward Islands.

The only real problem is the peculiar split distribution of the species. I have no suggestion for possible island of origin to the south of the Leeward Island populations; the small general size of *johnstonei* on the Leewards might suggest that the invasion might have come from that island to the south whose *johnstonei* are small, namely Grenada or St. Vincent, but the geographical remoteness of these two islands does not make them especially attractive. The absence of the species on Dominica and Guadeloupe I attribute only to the vagaries of transoceanic transport; since *E. martinicensis* occurs with *E. johnstonei* both on Martinique and Antigua, the two species can coexist without detriment to either. It thus is hardly likely that Dominica and Guadeloupe, which are inhabited by *E. martinicensis*, lack *E. johnstonei* because the smaller frog could not compete with the larger. Both Dominica and Guadeloupe are much larger islands than, for example, Antigua, where both

species also occur together. One other fact is suggestive; as will be shown later, on Martinique, *martinicensis* has a somewhat restricted distribution in the northern third of the island, whereas *johnstonei* is islandwide and in both uplands and lowlands. Such a distribution might indicate that here *martinicensis* is the late invader from the north, and has been unable to compete with the resident (and southern) *johnstonei* except in the mesic uplands where both species occur precisely together. Competition is so often invoked to explain peculiarities of distribution that I hesitate to make this suggestion here; the fact that both species occur apparently syntopically on the much smaller island of Antigua suggests that competition is not the sole explanation for the limited Martinique distribution of *martinicensis*.

Specimens examined:

GRENADA, *St. George Par.*, St. George's, 94 (MCZ 2759, 51754 – syntypes of *E. johnstonei*; MCZ 28077–78, 29323, 43139–66, 43185, 51778–82, PWH *587* (6 spec. in ZM)); 8 mi. (12.8 km) NE St. George's, 3 (ASFS 11125–27); 0.25 mi. (0.4 km) E Willis, 550 feet (168 m), 3 (ASFS X6859–61); Annandale Falls, 600 feet (183 m), 11 (ASFS X7034–43); 0.5 mi. (0.8 km) E Annandale Falls, 1 (ASFS 11121); Beauséjour, 8 (MCZ 51783–90); Point Saline, 1 (MCZ 31843); *St. Andrew Par.*, Grand Etang, 1700 feet (519 m), 45 (ASFS 11044–47, ASFS 11050, ASFS 11054–66, ASFS 11138–43, ASFS 11472, AMNH 72018–31, MCZ 31844–47, PWH *662*, PWH *590* in RMN); 0.75 mi. (1.2 km) NE Grand Etang, 1600 feet (488 m), 45 (ASFS X7079–124); Mt. Horn Cacao Station, Mt. Horn, 4 (MCZ 31556–59); *St. David Par.*, 3 mi. (4.8 km) E St. Pauls, 12 (ASFS 11075–86); Bailey Bacolet Stock Farm, 2 (ASFS X7156–57); north shore, Westerhall Bay, 3 (ASFS X7159–61); 1 mi. (1.6 km) SE Vincennes, 600 feet (183 m), 1 (ASFS X6871); *St. Patrick Par.*, Sauteurs, 38 (MCZ 2936–48, MCZ 2950–60, MCZ 42750, MCZ 42755–67); 0.8 mi. (1.3 km) S Sauteurs, 3 (ASFS X7200–02); *St. John Par.*, 1 mi. (1.6 km) SE Brothers Estate, 600 feet (183 m), 7 (ASFS X6935–41); 2 mi. (3.2 km) NW Castaigne, 1300 feet (397 m), 2 (ASFS X6948–49).

ST. VINCENT, *St. George Par.*, 8.5 mi. (13.6 km) SE Kingstown, 3 (AMNH 72034–35 + one untagged spec.); Young's Island, 2 (AMNH 74535 + one untagged spec.); *St. Andrew Par.*, 2.5 mi. (4.0 km) E Layou, 1 (ASFS 11224); Lowrt, 21 (ASFS 11225–42, ASFS 11273–75); *St. David Par.*, 2 mi. (3.2 km) NE Richmond Beach, 15 (ASFS 11297–311); *Charlotte Par.*, Owia Bay, 3 (AMNH 72032–33 + one untagged spec.); 0.8 mi. (1.3 km) N Tourama, 15 (AMNH 74530–34 + ten untagged spec.); parish indeterminate, Mt. Bentinck Estate, 1 (MCZ 19818).

ST. LUCIA, *Catries Qtr.*, Castries (Botanical Garden), 1 (ASFS X6701); Castries, 3 (MCZ 17612–14); 1 mi. (1.6 km) SW Castries, 300 feet (92 m), 2 (ASFS 18159–60); Cabiche, 1 (MCZ 33929); Piton Flor, 1400 feet (427 m), 72 (ASFS 18163–234, ASFS 18502); *Dauphin Qtr.*, 1 mi. (1.6 km) E Marquis, 5 (ASFS X6664–68); De Barra, 400 feet (122 m), 1 (ASFS X6763); *Praslin Qtr.*, 2.2 mi. (3.5 km) W Mamiku, 300 feet (92 m), 3 (ASFS X6677–79); *Laborie Qtr.*, 1.8 mi. (2.9 km) S Saltibus, 400 feet (122 m), 7 (ASFS X6733–38).

BARBADOS, *St. Michael Par.*, Barbados Museum grounds, 4 (MCZ 40883–86); St. Anne's Fort, 13 (MCZ 40870–82); *St. Philip Par.*, 2 mi. (3.2 km) from Seawell Airport on Rte. H, 5 (MCZ 51772–76); side road from Rte. H in

Warthing (not mapped), 1 (MCZ 51777); *St. Joseph Par.*, Bathsheba, 4 (MCZ 3510–13); nr. Mount Wilton, Bloomsbury, 1 (MCZ 51771); *St. Andrew Par.*, Lakes, 1 (ASFS X6828); *St. Peter Par.*, White Hall, 19 (MCZ 40887–905); *St. James Par.*, Porter's Gully, near Holetown, 3 (PWH *777* in ZM); *St. Thomas Par.*, Jack-in-the-box Gully, 59 ASFS 10946–11004); 6.2 mi. (9.9 km) NE Bridgetown, 1 (ASFS 11006); Reeds Hill, 16 (MCZ 40906–21); no other locality, 2 (MCZ 31569–70).

MARTINIQUE, Fort-de-France, 6 (MCZ 37142–47); L'Auberge d'Anse Mitan, 1 (MCZ 35556); La Pagerie, near Les Trois-Ilets, 2 (PWH *763* in RMN); Desloges, 4 (MCZ 37171–74); Habitation Dizac, 1.5 km W Le Diamant, 4 (ASFS X6531–34); 3 km W Ste.-Luce, 2 (ASFS X6367–68); 2 km NE Ste.-Anne, 2 (ASFS X6392–93); Pointe de la Batterie, Caravelle, 10 (PWH *762* in ZM); 3 km NE Tartane, 33 (ASFS 18633–60, ASFS X6444–48); 5 km NE Trinité, 3 (ASFS X6450–52); 5 km SE Basse-Pointe, 200 feet (61 m), 2 (ASFS X6476–77); 1 km W Macouba, 1 (ASFS X6514); 1 km N Le Prêcheur, 5 (ASFS X6603–04, ASFS X6606–08); 3 km NE St.-Pierre, 700 feet (212 m), 11 (ASFS X6342–52); southern slope, Montagne Pelée, 2200 feet (671 m), (not mapped), 1 (ASFS 18788); 4 km NE Le Morne Rouge, 1600 feet (488 m), 23 (ASFS 18797–819); 2 km N Le Morne Rouge, southeast slope, Montagne Pelée, 6 (ASFS X6353–58); 4 km N Le Morne Rouge, southeast slope, Montagne Pelée, 1 (ASFS X6359); 7 km SE Fond-St.-Denis, 2000 feet (610 m), 29 (ASFS 18538–39, ASFS X6332–39, ASFS X6341, ASFS X6401–18, ASFS X6428); Absalon, 16 (MCZ 37155–70).

ANTIGUA, *St. John Par.*, St. Johns, 26 (ASFS X7354–67, MCZ 28634–38, MCZ 43182–84, RT 477–80); Golden Grove, 2 (MCZ 30726–28); near All Saints, 1 (MCZ 28626); Friar's Hill (not mapped), 2 (PWH *594A*, in RNH); *St. Mary Par.*, near Crab Hill Village, 17 (MCZ 28629, MCZ 28631–33, MCZ 43167–70, MCZ 43172–79, MCZ 43181); *St. Paul Par.*, English Harbour, 1 (MCZ 51791); entrance to Nelson's Dockyard, 1 (MCZ 51792); *St. Philip Par.*, Gaynor's Mill, 3 (ASFS X7239–41); *St. George Par.*, Dutchman Bay, 5 (ASFS X7211–15); parish indeterminate, near Old Road Town, 1 (MCZ 28628); no other locality, 34 (MCZ 6751, MCZ 6753, MCZ 6755–56, MCZ 6758–60, MCZ 42985, MCZ 42987, MCZ 42989–3003, MCZ 43005–10, MCZ 43012–13, MCZ 43015–16).

BARBUDA, 3 mi. (4.8 km) E, 1.5 mi. (2.4 km) N Codrington, Darby's Cave, 6 (UF 11377); Bull Hole (not mapped), 24 (AMNH 70341–50 + 14 untagged spec.).

MONTSERRAT, *St. Peter's Par.*, 1 mi. (1.6 km) N Salem, 700 feet (214 m), 16 (ASFS 19369–84); Woodlands Spring, 2 (ASFS V6752–53); *St. Anthony's Par.*, Plymouth, 2 (MCZ 30718–19); ca. 0.5 mi. (0.8 km) SE Galway's Soufriere, ca. 1700 feet (519 m.), 6 (ASFS V6754–59); no other locality, 6 (MCZ 2981–85, MCZ 20908).

NEVIS, *St. George Gingerland Par.*, Golden Rock, 10 (ASFS 19553–62), *St. Thomas Lowland Par.*, Jones River, 2 (PWH *416*, in RNH).

ST. CHRISTOPHER, *St. John Capesterre Par.*, Bellevue Estate, 10 (ASFS 19804–13); no other locality, 119 (MCZ 2190, MCZ 2521, MCZ 2673, MCZ 42532–72, MCZ 42574–643, MCZ 42741–42, MCZ 42747–49); *St. Thomas Middle Island Par.*, Wingfield River, 5 (PWH *420*, *503*, in RNH).

ST. EUSTATIUS, in The Quill, 3 (PWH *427*, in RNH).

SABA, top of The Mountain, 7 (PWH *439*, *439A*, in RNH); Bottom, 2 (PWH

s.n. in RNH); no other locality, 38 (MCZ 2193, MCZ 42707–40, 3 spec. R. H. Cobben coll. in RNH).

ST. MARTIN, East of Philipsburg near Battery Hill, 62 (PWH *s.n.* in RNH); Old Battery Hill, 3 (PWH *299B* in RNH); Pointe Blanche hill top, 1 (PWH *458A* in RNH); Pointe Blanche, 1 (PWH *460* in RNH); Meschrine Hill east of Simson Bay, 2 (PWH *473, 540* in RNH); Colombier Valley, head of ravine on French part of the island, 27 (PWH *534, 466* in RNH).

Eleutherodactylus barbudensis (Auffenberg, 1959)

Hyla barbudensis AUFFENBERG, 1959, Journ. Florida Acad. Sci. *21*, no. 3, p. 251. Type locality – Cave I, Two Foot Bay, Barbuda.

Distribution: Known only from fossil remains of Late Pleistocene or Recent age.

Discussion: The inclusion of *"Hyla" barbudensis* in the present paper results from the fact that both WALTER AUFFENBERG and JOHN D. LYNCH (*in litt.*) are agreed that the type material on which the name *barbudensis* was based pertains properly to the genus *Eleutherodactylus* rather than *Hyla*. Thus some comment on the status of this fossil species is mandatory.

LYNCH (1966) has suggested that the name *barbudensis* may be applicable to the frog which presently inhabits Barbuda. I have examined 30 specimens of *Eleutherodactylus* from that island; these are UF 11377 and AMNH 70341–50. During a week's stay on Barbuda in the spring of 1962, KLINIKOWSKI and I did not encounter any frogs; KLINIKOWSKI in the summer of the same year found a single frog, which was not preserved, at Darby's Cave. It is apparent the living Barbudian *Eleutherodactylus* are not especially easily secured. WILLIAMS (1962: 461–65) in another context has discussed the situation at Darby's Cave (whence UF 11377 was secured), and has shown that this sink hole cave presents a very different mesophytic picture from the generally xerophytic aspect of much of the remainder of Barbuda. Presumably AMNH 70341–50 from Bull Hole are from a similar situation. Such mesic caves and sink holes offer a haven for amphibians on what is otherwise an extremely hostile island, and surely this accounts for the absence of specimens of *Eleutherodactylus* from collections made by others (myself and KLINIKOWSKI, for example) who did not make a special point of visiting the sink hole situation in search of amphibians.

The preserved specimens of *Eleutherodactylus* from Barbuda are, in pattern, to my eye in no way distinguishable from *E. johnstonei* from the Leeward Islands. The eight males agree in size, measurements, and ratios with males from the other Leeward Islands. The fifteen gravid females, on the other hand, are quite large, reaching a larger size (32.3 mm snout-vent) than all other Leeward Islands females (including females from Antigua on the same bank with Barbuda, with a maximum

snout-vent length of 29.7 mm), and being exceeded in size among Windward Island populations only by females from St. Lucia (34.8 mm). Mean ratios of the Barbuda females are very low (T/SV, 39.1, lowest mean for this ratio of all populations, with 42.4 the next highest – St. Lucia; HW/SV 35.8, lowest mean for this ratio of all populations, with 36.5 the next highest – Saba) or very high (HW/T, highest mean for this ratio of all populations, with 87.7 the next lowest – St. Lucia; see Table 1 for further data). Thus, although there seem to be some peculiar differences in size and proportions between females from Barbuda and those from the balance of both the Leeward and Windward Islands, females in pattern and males in size, pattern, and proportions are identical with the balance of *E. johnstonei*. Consequently, although recognizing the peculiarities of the Barbuda females, I have no hesitancy in regarding these Barbuda frogs as *E. johnstonei*.

I do not wish to pass upon the validity of *E. barbudensis* at this time, and I accept it as a valid but presumably extinct species. LYNCH (*in litt.*) has advised me that, judging from the fossil material, *E. barbudensis* reached a snout-vent length of about 30 mm; this size is included within the parameters of female *E. johnstonei* from Barbuda and even within the adult range of *E. martinicensis*, but I consider this of little consequence since the frog may have had an entirely different habitus, coloration, or pattern. It thus seems preferable to let the name *barbudensis* stand, at least temporarily.

The suggestion has been made that *E. barbudensis* was a species of frog restricted to Barbuda. I find this difficult to believe, for the following reasons. During the past few years, the fossil fauna of Barbuda has been intensively studied, and at the same time interesting Recent material has also been collected. In the former category, AUFFENBERG (1959: 253) reported finding two vertebrae of "*Pseudoboa*" cf. "*P.*" *cloelia* and ETHERIDGE (1964: 48) described the fossil *Leiocephalus cuneus*. AUFFENBERG (1959: 254) also reported living *Leptotyphlops* from Barbuda. WILLIAMS (1962: 463) described the living *Anolis alter* from Barbuda, but this species was also taken on Antigua.

The present native herpetofauna of Barbuda includes five lizards (*Sphaerodactylus elegantulus*, *Thecadactylus rapicauda*, *Anolis bimaculatus*, *Anolis wattsi*, *Ameiva griswoldi*), one snake (*Typhlops monastus*), and *Eleutherodactylus johnstonei*. Of these seven species, all occur on Antigua, which shares the Antigua Bank with Barbuda. The record of *Leptotyphlops* from Barbuda is erroneous (THOMAS 1965b: 6) and was based upon a specimen of *Typhlops*; although the former genus (*L. tenella*) has been reported from Antigua, the occurrence of this snake there is regarded as questionable (THOMAS 1965b). *Anolis alter* is presently considered a synonym of *Anolis forresti* Barbour (WILLIAMS *in. litt.*), which I regard as a subspecies of the Antiguan *Anolis wattsi* Boulenger. The supposed *Pseudoboa* vertebrae are in reality those of an *Alsophis* (PETER C. DRUMMOND, pers. com.), a genus which, prior to the introduction of the mongoose, occured on Antigua (*A. antillensis*) and occurs today on some of the Antigua satellite islands. *Sphaerodactylus elegantulus*, *Thecadactylus rapicauda*, *Anolis bimaculatus*, and *Ameiva griswoldi* occur today on both islands. *Iguana delicatissima* is known from Antigua, but apparently is absent from Barbuda. Thus the sole remaining unique Barbuda amphibian or reptile is *Leiocephalus cuneus*, which is now extinct there, but which may well have had a wider range than the present fossils indicate.

In summary, the present herpetofauna of Barbuda consists of a depauperate Antiguan fauna, as might be expected from the fact that both islands lie on the

same bank. If *E. barbudensis* is a valid species, surely it must have occurred at least on Antigua, and was very likely widespread on the Leeward Islands also.

The presence of *E. martinicensis* on Antigua and its absence from Barbuda may be explained by the postulated arrival of this frog (presumably from Guadeloupe) after the separation of Antigua and Barbuda. The situation with *E. martinicensis* on the Antigua Bank parallels that of *E. johnstonei* on the Anguilla Bank.

Eleutherodactylus martinicensis (Tschudi, 1838)

Hylodes martinicensis TSCHUDI, 1838, Mém. Soc. sci. nat. Neuchâtel *2*, p. 37. Type locality – "Martinique"; see discussion below.

Distribution: Martinique, Dominica, Guadeloupe (incl. La Désirade, Marie-Galante, Les Saintes, as well as some small satellite islets), and Antigua (Figs. 13–16).

Definition: An *Eleutherodactylus* of the *auriculatus* group characterized by a combination of large size (snout-vent length of males to 32 mm, of females to 47 mm), moderately long hindlimbs (tibia/snout-vent 38.2 to 53.6, both sexes combined), dorsal pattern variable but usually showing a dark narrow interocular bar, one or two dark dorsal chevrons, at times with a broad middorsal pale line or pale dorsolateral stripes, a single broad crural crossbar bordered

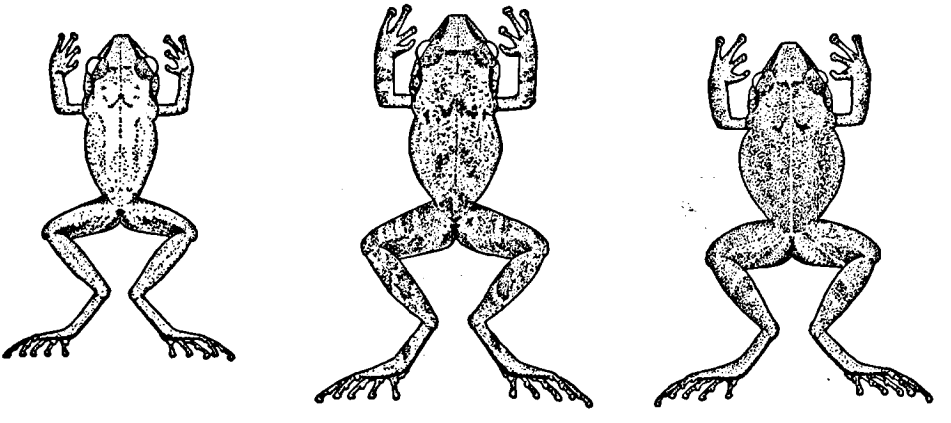

Fig. 4. *Eleutherodactylus martinicensis*; left, ASFS X6420, 7 km SE Fond-St.-Denis, 2000 feet, MARTINIQUE; center, ASFS X6315, 1 mi. NE Bells, St. Joseph Par., DOMINICA; right, ASFS X5697, Pointe du Vieux Fort, Vieux Fort, GUADELOUPE.

by paler (the bar may be completely absent or only vaguely indicated), often with red on the hindlimbs or in the groin, and lacking inguinal glands (Fig. 4).

Discussion: Perhaps no other West Indian *Eleutherodactylus* has occasioned so much confusion as *E. martinicensis*. The date of publication of *E. martinicensis* is usually given as 1838, from the title page of the Classification. However, The British Museum list and the list of the Royal Society both give 1839 and SHERBORN gives 1840. Previous workers have cited the name from 1838; STEJNEGER, who is known as having been extremely particular in such matters, gives 1838 (1904: 582) and without going into the matter further I have followed him.

TSCHUDI commented that he had examined eight specimens which he considered *H. martinicensis*; these specimens were in the Muséum National d'Histoire Naturelle in Paris. TSCHUDI's description, although adequate, is, after the fashion of diagnoses of that period, hardly diagnostic of any one Lesser Antillean species. Characters mentioned include that the fingers are not unusually long, the toes are free, the head rather broadened, the tongue small, elongate, free behind and rounded, and the teeth not very numerous and in two rows rather separated from one another.

DUMÉRIL & BIBRON (1841: 620) attributed the name *H. martinicensis* to TSCHUDI, and made it the generotype for their new genus *Eleutherodactylus*. Their description and plate are quite satisfactory and serve to affix the name with somewhat more certainty. Combining their measurements of head and trunk yields a "snout-vent" measurement of 41 mm – the first published mensural datum for *E. martinicensis*. Their plate (pl. 89 figs. 2a-b) shows a frog with a pair of dorsolateral stripes and a single crural crossbar outlined by broad pale borders. The figure of the buccal cavity shows two slightly bowed but patch-like series of vomerine teeth, separated from one another; the internal choanae are partially obscured by the margin of the upper jaw. Although there is no definite mention of the number of specimens at their disposal, they did state that "this species has been sent to us by M. Plée from Martinique".

JEAN GUIBÉ of the Muséum National d'Histoire Naturelle (*in litt.*, 17 Sep. 1965) feels strongly that the name *martinicensis* should not be attributed to TSCHUDI. In his opinion, the name *martinicensis* was seen by TSCHUDI on a manuscript ticket while he was in Paris at the time that DUMÉRIL & BIBRON were working on their Erpétologie générale. TSCHUDI's work purported to be only a general classification of the Batrachia, and therein TSCHUDI did not intend actually or formally to propose any new names. In rebuttal to this interpretation is the fact that DUMÉRIL & BIBRON themselves attributed the name *martinicensis* to TSCHUDI; they were thus well aware that the Martinique form had been named and considered that TSCHUDI had indeed at least named (if not "described") the species. I have no particular opinion in the matter (if an opinion is allowable under the present Rules), but there

is no doubt that the first detailed description and figure of *martinicensis* is that of DUMÉRIL & BIBRON in 1841.

We next turn to the provenance of the six syntypes. (In either event – whether the name *martinicensis* is to be attributed to TSCHUDI or DUMÉRIL & BIBRON – the six specimens in the Muséum National in Paris may correctly be regarded as the syntypes). These were collected by Monsieur PLÉE. As anyone with an interest in West Indian herpetology well knows, PLÉE's collections are notorious for incorrect data. STEJNEGER (1904: 557) noted that PLÉE visited Puerto Rico on his way between New York and Martinique sometime before 1835. There seems to be no better date for the PLÉE materials, since they were available to TSCHUDI by 1838. In any event, PLÉE stopped not only on Martinique, but also on Guadeloupe (where he collected the syntypes of *Sphaerodactylus fantasticus* Duméril & Bibron, KING 1962: 21 – and the holotype of *Anolis marmoratus* Duméril & Bibron, LAZELL 1964: 373) and on Puerto Rico and St. Thomas (where he collected the type material for *Diploglossus pleei* Duméril & Bibron, *Anolis cristatellus* Duméril & Bibron, and *Anolis pulchellus* Duméril & Bibron; STEJNEGER 1904). All the above species were originally described as having come from Martinique; this was due to the fact that PLÉE's specimens were presumably shipped to Paris from Martinique and were subsequently catalogued as having been taken on that island. There is thus the distinct possibility that the syntypes of *E. martinicensis* did not come from the island of Martinique, but may have originated on either Puerto Rico or Guadeloupe.

As noted in the discussion of *E. johnstonei*, two species of *Eleutherodactylus* occur on Martinique. One of these is *johnstonei*, and it would be only logical to assume that the other is *martinicensis*. Through the courtesy of JEAN GUIBÉ and ERNEST WILLIAMS, I have been able to examine the six syntypes of *martinicensis*. The series consists of one male and five gravid females (MNHN 4881–83 + 4883A-C). The single male (MNHN 4881) has a snout-vent length of 25.8 mm and an HW/SV ratio of 37.2; both tibiae are broken and thus the T/SV and HW/T ratios cannot be computed. In snout-vent length, this specimen falls within the known range of males from both Guadeloupe and Martinique, but the HW/SV ratio falls within the range of Guadeloupe frogs and not that of Martinique *martinicensis*.

The five females range in snout-vent length from 32.3 mm to 37.8 mm, and the ratios for the series are: T/SV, 42.9–46.4; HW/SV, 36.8–38.6; HW/T, 81.4–90.0. In size, the females fall within the known parameters of gravid females from both Martinique and the Basse-Terre portion of Guadeloupe, and all but one (the largest) fall within the range of snout-vent length of Grande-Terre females. Of the three ratios, HW/T in all cases agrees with Martinique, Basse-Terre and Grande-Terre material and is thus not decisive. In T/SV, all female syntypes fall within the parameters of Basse-Terre and Grande-Terre females, and all but two (43.7 and 42.9) all within the range of Martinique specimens. The most pertinent ratio is HW/SV, in which case the ratios of all female syntypes fall below the lower extreme of this ratio for Martinique and Basse-Terre specimens, but within the extremes of HW/SV for Grande-Terre females. Finally, in general aspect and pigmentation (the specimens are presently in excellent condition despite their prolonged sojourn in preservative, and at least pattern is well demonstrated on all of them) the syntypes in a general fashion agree quite well with fresh material from Guadeloupe, particularly the Grande-Terre portion. Possibly the large (for Grande-Terre) female noted above is merely of a size not taken in more recent collections. In any event, the available evidence from the syntypes of *E. martinicensis* indicates that they were collected by

PLÉE on Guadeloupe (and possibly even on the eastern Grande-Terre portion where the chief port, Pointe-à-Pitre, is situated) rather than on Martinique.

STEJNEGER (1904: 584) commented that *E. martinicensis* had been introduced from Guadeloupe to Martinique; I find neither prior nor further reference for this statement, nor reason to consider it necessarily credible. I doubt that there is presently unimpeachable evidence that such an introduction ever took place, and regard *E. martinicensis* as part of the indigenous fauna of Martinique.

One other fact should be taken into consideration in the matter of provenance of the syntypes. On Guadeloupe, *martinicensis* is widespread, occurring from sea level to high into the mountains. On Martinique, on the other hand, *martinicensis* is restricted to the northern third of the island, on the Pitons du Carbet and in the Montagne Pelée region, and is absent from the southern lower and less well forested regions. It would seem in some ways more likely that PLÉE would have encountered this frog more easily on Guadeloupe, especially if he stayed in Pointe-à-Pitre (or even the capital city, Basse-Terre), than if he spent his time on Martinique in either Fort-de-France or the then more populous and cosmopolitan city of St.-Pierre. While in residence at either of the latter localities, he would have presumably been outside the range of *E. martinicensis*. In rebuttal to this fact is the knowledge that picnics and excursions to Montagne Pelée from St.-Pierre were quite fashionable prior to the eruption of the volcano in 1902, and doubtless PLÉE would have made a point of visiting this unusual mountain while visiting Martinique. If so, he would have been within the range of *E. martinicensis*. All this is intriguing speculation.

When all facts in the situation are considered, it seems appropriate (despite the geographical trivial name of *martinicensis*) to restrict the type locality to the island of Guadeloupe.

E. martinicensis is known from three islands in the Windwards (Martinique, Dominica, Guadeloupe) plus one of the Leewards (Antigua), and from the major satellite islands (La Désirade, Marie-Galante, Les Saintes) of Guadeloupe. The bipartite nature of Guadeloupe (with its western mountainous volcanic inner-chain portion of Basse-Terre and its eastern lower limestone outer-chain portion of Grande-Terre) has already been noted; for the purposes of the present discussion frogs from these two parts of Guadeloupe will be commented on separately.

The largest male *E. martinicensis* are from Martinique, where males reach a snout-vent length of 32.3 mm. Males from other islands are somewhat smaller, with the following maximum sizes known: Basse-Terre, 27.8; Grande-Terre, 26.2; Dominica, 26.1; Antigua, 26.0; Les Saintes, 24.2; Marie-Galante, 23.8. Of these islands, only Martinique, Dominica, Basse-Terre, and Antigua are represented by adequate series of males. The largest females are

TABLE 2.

Means and extremes of nine measurements and three ratios of seven samples of *Eleutherodactylus martinicensis* from seven major islands or island groups.

(Non-gravid females from Les Saintes are included in the calculations for that sample.)

MALES	N	*Snout-vent length*	*Head length*	*Head width*	*Tympanum*	*Eye*	*Naris to eye*
Antigua	20	24.6 (23.3–26.0)	9.5 (8.9–10.3)	9.8 (9.9–10.7)	1.6 (1.3–2.0)	3.4 (3.0–3.8)	2.8 (2.5–3.2)
Grande-Terre	7	25.0 (23.0–26.2)	9.4 (8.7– 9.9)	9.8 (9.3–10.5)	1.6 (1.5–1.7)	3.4 (3.2–3.6)	2.9 (2.6–3.1)
Basse-Terre	22	25.3 (22.4–27.8)	10.0 (8.7–10.9)	10.3 (9.1–11.8)	1.8 (1.4–2.2)	3.7 (3.1–4.3)	3.0 (2.5–3.5)
Marie-Galante	2	23.8 (23.7–23.8)	9.3 (9.0– 9.5)	9.3 (9.0– 9.5)	1.7 (1.6–1.8)	3.2 (3.2)	2.8 (2.7–2.8)
Les Saintes	2	23.6 (23.0–24.2)	8.9 (8.6–9.2)	9.5 (9.3– 9.7)	1.7 (1.6–1.7)	3.2 (3.0–3.3)	2.7 (2.5–2.8)
Dominica	26	24.1 (21.9–26.1)	9.4 (8.5–11.1)	9.7 (8.8–11.1)	1.6 (1.3–2.0)	3.5 (3.1–4.0)	2.7 (2.1–3.0)
Martinique	25	28.5 (25.0–32.3)	11.2 (10.0–12.8)	11.6 (10.8–13.2)	2.0 (1.6–2.3)	4.2 (3.7–5.1)	3.2 (2.4–3.9)
FEMALES	N	*Snout-vent length*	*Head length*	*Head width*	*Tympanum*	*Eye*	*Naris to eye*
Antigua	63	30.7 (22.6–44.5)	11.8 (9.5–15.7)	12.3 (9.8–18.3)	2.0 (1.5–2.6)	4.0 (2.8–6.0)	3.6 (2.4–5.2)
Grande-Terre	14	32.3 (28.6–36.1)	12.5 (10.3–13.7)	13.1 (10.4–14.6)	2.2 (1.9–2.7)	4.2 (3.7–4.8)	4.0 (3.0–4.7)
Basse-Terre	30	36.0 (30.0–46.0)	14.1 (11.8–16.5)	14.9 (12.3–18.7)	2.4 (1.8–3.0)	4.8 (3.9–5.8)	4.5 (3.6–5.5)
Marie-Galante	11	35.0 (26.9–41.3)	13.2 (10.3–15.3)	13.8 (10.7–16.6)	2.3 (1.9–2.7)	4.2 (3.7–4.5)	4.1 (2.2–5.1)
Les Saintes	11	33.4 (29.8–38.4)	12.5 (11.3–14.3)	13.3 (11.8–15.0)	2.1 (1.8–2.4)	4.3 (4.0–5.0)	4.0 (3.5–4.6)
Dominica	88	31.9 (21.4–46.6)	12.6 (8.6–17.7)	13.5 (8.5–20.6)	2.0 (1.2–3.2)	4.3 (3.0–5.8)	3.9 (2.4–5.8)
Martinique	13	29.8 (23.8–40.3)	11.7 (9.3–15.7)	12.4 (9.5–17.2)	2.1 (1.7–2.4)	4.2 (3.7–5.8)	3.7 (2.7–5.6)

TABLE 2 (*continued*)

MALES	N	*Femur*	*Tibia*	*Fourth toe*	*T/SV*	*HW/SV*	*HW/T*
Antigua	20	10.0(9.1–11.2)	11.4(10.2–12.4)	9.5(8.3–10.3)	46.5(40.8–50.0)	39.8(37.3–42.3)	86.1(77.6– 98.1)
Grande-Terre	7	9.9(9.4–10.4)	11.3(10.5–12.0)	9.8(9.4–10.5)	45.2(40.8–50.0)	39.1(36.3–40.7)	86.8(78.3– 92.1)
Basse-Terre	22	10.6(9.7–11.6)	12.1(11.0–12.8)	10.1(9.0–10.9)	47.8(44.3–53.0)	40.7(36.5–44.7)	84.8(74.4– 96.4)
Marie-Galante	2	9.4(9.1– 9.6)	11.0(10.7–11.2)	8.9(8.8– 9.0)	45.5(43.7–47.3)	39.0(38.0–39.9)	84.6(80.4– 88.8)
Les Saintes	2	10.0(9.8–10.1)	11.3(11.3)	9.3(9.0– 9.5)	47.9(46.7–49.1)	40.3(40.1–40.4)	84.1(82.3– 85.8)
Dominica	26	10.1(9.0–11.3)	11.3(10.4–12.2)	9.8(9.0–11.2)	47.4(41.8–51.2)	40.4(36.0–43.8)	85.0(78.0– 92.0)
Martinique	25	11.3(9.4–12.8)	13.0(11.4–14.3)	11.3(9.2–14.5)	45.8(39.6–48.4)	40.9(38.1–45.2)	89.4(83.8–101.8)
FEMALES	**N**	***Femur***	***Tibia***	***Fourth toe***	***T/SV***	***HW/SV***	***HW/T***
Antigua	63	12.8(9.6–18.8)	14.5(11.9–19.4)	12.1(9.6–16.6)	47.6(43.5–51.7)	40.3(36.6–43.8)	85.1(75.3– 94.3)
Grande-Terre	14	13.0(11.6–15.1)	14.6(12.8–17.0)	12.5(10.0–15.0)	45.0(42.8–48.5)	40.4(36.4–43.8)	90.0(81.3– 96.4)
Basse-Terre	30	15.1(11.8–19.2)	17.0(14.3–20.3)	14.4(11.8–18.1)	47.1(41.8–51.2)	41.3(38.8–44.0)	88.0(77.8– 96.0)
Marie-Galante	11	13.6(10.5–15.3)	15.6(12.0–18.6)	13.5(10.2–16.0)	46.0(43.8–49.2)	40.6(39.0–43.0)	88.6(80.0– 93.1)
Les Saintes	11	13.8(11.6–15.3)	14.0(11.9–15.3)	13.2(11.2–14.4)	46.7(43.0–48.7)	40.1(37.3–42.6)	86.1(78.8– 95.3)
Dominica	88	13.7(9.4–20.4)	15.6(10.9–22.6)	13.5(8.7–20.0)	48.7(42.9–53.6)	42.1(36.0–46.4)	86.6(75.2–100.5)
Martinique	13	13.0(9.9–18.0)	14.4(11.2–20.1)	12.7(9.3–16.8)	49.1(44.1–51.7)	41.6(39.9–43.7)	85.1(81.3– 95.6)

from Dominica (snout-vent length 46.6 mm), with the largest females from the other islands ranked as follows: Basse-Terre, 46.0; Antigua, 44.5; Marie-Galante, 41.3; Martinique, 40.3; Les Saintes, 38.4; Grande-Terre, 36.1. The smallest gravid females (21.4 mm) are from Dominica; the largest minimal size for gravid females is 30.0 mm (Basse-Terre). Minimally sized gravid females from the other islands lie between these two extremes.

The largest mean of snout-vent length in males is 28.5 (Martinique), the smallest 23.6 (Les Saintes, only two males studied); the largest mean of snout-vent length in females is 36.0 (Basse-Terre), the smallest is 29.8 (Martinique). Data for females are based upon series varying between 11 frogs (Marie-Galante, Les Saintes) to 88 frogs (Dominica) and I consider the samples adequate in all cases.

Table 2 shows the variation in both sexes of seven populations of *E. martinicensis*. Males from Martinique have the highest means in all measurements, but females from Martinique on the other hand have generally low means of all measurements, although not always the lowest. The ratios of T/SV in males vary from a low of 45.2 (Grande-Terre) to 47.9 (Les Saintes), and in females from 45.0 (Grande-Terre) to 49.1 (Martinique). In HW/SV, males from Marie-Galante have the lowest mean (39.0) and males from Martinique the highest (40.9); the lowest HW/SV mean in females is 40.1 (Les Saintes) and the highest 42.1 (Dominica). The lowest male HW/T mean is 84.1 (Les Saintes) and the highest 89.4 (Martinique); means of this ratio in females vary from 85.1 (Martinique and Antigua) to 90.0 (Grande-Terre). Just as in the case of *E. johnstonei*, there are certain mean differences between populations of *E. martinicensis*, but there are no obvious nameworthy entities on the various islands. The best case might be made for the nomenclatorial recognition of the frogs from Martinique as a separate subspecies, but the peculiarity of large males and small females makes even this population difficult to diagnose with any logic.

E. martinicensis is perhaps one of the most variable of West Indian *Eleutherodactylus* as far as size of gravid females from a single population is concerned. During my first collecting on Dominica, I was convinced that there were two species involved in

the collection, on the basis of size of gravid females. The very large females (to almost 50 mm snout-vent length) with eggs stand in strong contrast to the much smaller gravid females with snout-vent lengths of less than 25 mm. The large frogs seem longer legged, broader headed and of course are considerably bulkier. However, study of the material has shown that there is only one species which is highly variable in adult size. Although the Dominica females might be divided into two groups on the basis of size at maturity, there is not a corresponding dichotomy in size of males. When the size of gravid Dominica females is plotted graphically, there is no distinct bimodality as would be expected if there were two species, but rather there is a continuum of measurements from the low to the high extreme. Additionally, when both large and small specimens were collected syntopically on Dominica, only one call was heard. All these facts indicate that Dominica is inhabited by only a single and highly variable species. The same situation exists in Guadeloupe and Antigua frogs also.

The dorsal ground color varies from reddish- or yellowish-tan, gray, to dark brown (often with a tendency toward the reddish shades); a few specimens were rather bright orange-tan dorsally. In contrast to the more sombre tones of *E. johnstonei*, *E. martinicensis* is often more brightly colored dorsally. There is regularly a narrow interocular dark brown to black line which does not set off a paler or darker snout. The dorsal pattern is extremely variable. A scapular dark chevron, often followed by a dorsal dark chevron, is a fairly regular feature, but these one or two chevrons may be completely absent, so that the dorsum is without pattern whatsoever. Some individuals have the dorsum overlaid with dark brown blotches, and at times these blotches outline a pair of pale dorsolateral stripes. There may be a fine or broad middorsal line. There is a dark canthal-supratympanic line. A short black or brown dash at the outer ends of the scapular chevron (or in this position if the chevron itself is absent) is quite a regular feature of the dorsal pattern. As in *johnstonei*, the middorsal line may be combined with one or two dorsal chevrons. The iris was noted as being silvery-gray to bronzy (Martinique), bronzy-gray to gold (Dominica), or gold to golden-brown (Guadeloupe) above. The venter varies from pale

yellow to white, and is often heavily stippled with dark brown. The throat may have dark discrete spots on the paler ground. Large adults often have a vivid red on the hindlimbs, in the groin, and even on the feet. There is a postanal dark triangle, but this is more prominent in young and subadult specimens than in adults, where it becomes diffuse. The crura have one crossbar, outlined by broad pale lines, with a matching crossbar on the thighs. However, in those frogs which are patternless dorsally, these hindlimb bars are absent also. The concealed surfaces are mottled gray to black. The vocal sac in males is strongly glandular, the glands arranged into two lateral masses separated medially by a distinct non- or less glandular line; in preserved specimens the presence of glands on the throat makes sexual determination relatively simple. The vocal sac in life is rather large when distended.

The structural features of *E. martinicensis* may be described as follows. Head distinctly broader than distance from snout to posterior border of tympanum; snout decidedly truncate with nares conspicuous at anterior end of canthus rostralis; diameter of eye equal to or slightly greater than distance from naris to anterior corner of eye; diameter of tympanum equal to about half or slightly more than half diameter of eye; distance from tympanum to eye equal to or slightly more than diameter of tympanum; tympanum oval, the vertical diameter slightly greater than the horizontal. Interorbital distance usually much greater than diameter of eye, or in some specimens at least as great as eye diameter. Digital discs present and well developed, those on fingers 3 and 4 distinctly larger than those on fingers 1 and 2, disc of finger 3 the largest and equal to about two-thirds the size of the tympanum, to equal to the tympanum in size. Fingers moderately long and slender, unwebbed, 3–4–2–1 in order of decreasing length; subarticular tubercles gray, prominent. Toes long, with vestigial webs, 4–3–5–2–1 in order of decreasing length; subarticular tubercles gray, prominent. Heels overlap strongly when femora held at right angles to body axis. Inguinal glands absent. Dorsum smooth to weakly granular, with a few low rounded tubercles at the angle of the jaw; upper eyelids with many low rounded tubercles. Throat smooth, belly strongly granular; abdominal disc moderately well developed, especially

laterally and posteriorly. Dorsal surface of fore- and hindlimbs smooth to very faintly granular. Posterior face of thighs with low rounded, juxtaposed pavement-like granules. Tongue large, weakly nicked, free behind, its greatest width equal to one-half that of floor of mouth. Vomerine teeth in two slightly diagonal but short and patch-like series, not quite enclosed within the inner margins of the choanae and separated from the choanae by a distance equal to about twice the diameter of a choana, the two series separated from each other by a distance equal to about twice the diameter of a choana. Outer margin of choanae obscured when viewed from below.

Comparisons: *E. martinicensis* occurs with *E. johnstonei* on Martinique and Antigua. The two species are somewhat similar in dorsal pattern, but the dorsal coloration is (in Martinique specimens of both species) regularly more sombre in *johnstonei* than in the brighter (tending towards yellow- or reddish-tans) *martinicensis*. Of the two species, *martinicensis* is much the larger; Martinique *martinicensis* males reach a snout-vent length of 32 mm and Martinique *johnstonei* males a snout-vent length of 24 mm, whereas Martinique *martinicensis* females reach a snout-vent length of 40 mm and Martinique *johnstonei* females reach a snout-vent length of 31 mm. On Martinique, the three ratios average higher for both sexes of *martinicensis*; HW/SV is diagnostic, the extremes for this ratio being 33.5–38.1 in male *johnstonei*, 38.1–45.2 in male *martinicensis*, 34.1–39.5 in female *johnstonei*, and 39.9–43.7 in female *martinicensis*. In general, *martinicensis* is a large, broad-headed, long-legged frog whereas *johnstonei* is a small, narrow-headed, and short-legged frog. *E. martinicensis* occurs with *E. barlagnei* and another diminutive species on Guadeloupe; comparison with these two forms will be made at appropriate places beyond.

Antigua *johnstonei* and *martinicensis* differ in the same manner as do these two species on Martinique. Antigua *martinicensis* males reach a snout-vent length of 26 mm and Antigua *johnstonei* males reach a length of 24 mm, whereas Antigua *martinicensis* females reach a snout-vent length of 46 mm and Antigua *johnstonei* females reach a snout-vent length of 30 mm. The three ratios average higher

in both sexes of *martinicensis* except HW/T in males, which has a slightly higher mean in *johnstonei*. The clear-cut differences between the means of HW/SV which occur between these two species on Martinique are not so diagrammatic on Antigua, but most specimens can be separated on the basis of this ratio, since the overlap is less than two units; the lower ratios are those of *johnstonei*, the higher those of *martinicensis*. The quickest method for separating the two species before one has become familiar with their color variation and general habitus is by the amount of overlap of the hindlimbs. In *martinicensis* the heels overlap distinctly, whereas in *johnstonei* they do not.

E. martinicensis and *E. urichi* are not sympatric, but the two are easily differentiable. Although *martinicensis* may have red on the thighs and in the groin, just as *urichi* may have these same areas red, orange, or orange-brown, *urichi* is a smaller frog than *martinicensis* and is less robust and more spindly-legged. Two ratios are suggestive; T/SV in *urichi* males varies between 50.0 and 59.9 whereas this ratio in all male *martinicensis* varies between 39.6 and 53.0. T/SV in *urichi* females ranges from 49.7 to 60.0 and in all *martinicensis* females between 41.8 and 53.6. The lower ratios in both sexes of *martinicensis* are apparent. HW/T shows the same situation, although the amount of overlap is slightly greater.

Remarks: *E. martinicensis* is generally widespread on those islands which it inhabits. Specimens have been taken at sea level (at times in coastal situations) to elevations of 2000 feet (610 m) on Martinique, 2200 feet (671 m) on Guadeloupe, and 2500 feet (763 m) on Dominica. Strangely, on Martinique, *martinicensis* is restricted to the more northern third of the island and even there is far commoner in the forested uplands than along the coast or at lower or intermediate elevations; *johnstonei* is the commoner of the two species in the lowlands and occupies the southern two-thirds of Martinique to the exclusion of *martinicensis*. All frogs which I and associates have recently collected on Antigua are referrable to *E. johnstonei*, so that I cannot comment upon the interaction of *johnstonei* and *martinicensis* on that island. However, judging only from the localities, the two species are sympatric at several localities; only *E. johnstonei* has been taken in St. Johns itself. Perhaps the whole picture of these two species on Antigua will never be known, since so much of that island is presently devoted to sugar cane. Richard Thomas encountered, but did not collect, *E. martinicensis* at Sweets Village, St. Paul Parish, in piles of coconut trash; this niche is not unlike situations where *E. johnstonei* has also been encountered at Gaynor's Mill. The two species may be syntopic on Antigua.

Choruses of *martinicensis* in the virgin rain forest of Dominica may be quite loud, especially along stream courses. Although *martinicensis* seems to have a predilection

for moist or wet habitats, it is not restricted to these, since specimens were collected along the coast under rocks in dry woods (Gosier, Guadeloupe) and in a rock pile in a *Coccoloba* stand (La Désirade). A small series was collected on Marie-Galante, under a rock near the airport in dry scrub. The single individual from Ilet à Cochons was secured as it sought to escape down a crab hole in mud adjacent to the ocean. On Terre-de-Haut, RICHARD THOMAS took seven of about twelve frogs which had sought refuge under a piece of tin in an otherwise very xeric area, and on Terre-de-Bas, the frogs were collected only from under rocks in a pasture adjacent to a freshwater pond.

However, *E. martinicensis* is much more commonly and regularly encountered in forested situations; it habituates both *Theobroma* and *Musa* groves as well as rain forest itself. In such situations it is at times found abroad during the day, especially if there has been a shower, hopping about on the ground among the leaves. Diurnal retreats are the petiole bases of banana leaves, in bromeliads (up to 35 feet – 11 meters) above the ground in forest, under loggers' chips, palm trash, cacao husk piles, among the fallen bricks and rocks of ruins – in short any niche which provides protection and moisture. I have the impression that *martinicensis* resorts to diurnal retreats above the ground (for example, arboreal bromeliads) far more regularly than does *johnstonei*. On Dominica, one frog was observed to retreat at night into a hole in a moss- and liverwort-covered cutbank along a roadside, so that some individuals must use completely terrestrial retreats. On Dominica also it was not uncommon to encounter these frogs at night on large rocks and boulders in montane streams.

The voice of *E. martinicensis* consists of a short single rising note which occasionally alternates with a 5-note rapid telegraphic call, much like the sound made by striking two stones against each other. In some areas, the 5-note call seems to predominate over the single rising note. The two types of calls of *martinicensis* are much like the two calls of *E. antillensis* in Puerto Rico and the Virgin Islands, although *antillensis* has a two-note call alternating with 5 or 6 telegraphic clicks. Calling sites are variable; males perch on herbs, moss, wet earth, mud, shrubs, arums, cacao trunks, banana trunks and low leaves, *Heliconia*, and ferns. None was encountered calling more than 5 feet (1.5 meters) above the ground, and usually the site is within 2 feet (0.6 meters) of the ground surface. The calls of *johnstonei* and *martinicensis* are quite different, the weakly two-note and reedy or "breathy" quality of *johnstonei* contrasting with the single rising note and telegraphic clicking of *martinicensis*.

Specimens examined:

ANTIGUA, *St. John Par.*, Golden Grove, 1 (MCZ 30728); near All Saints, 1 (MCZ 28625); *St. Mary Par.*, near Crab Hill Village, 3 (MCZ 28630, MCZ 43171, MCZ 43180); parish indeterminate, nr. Bishopstown, 1 (MCZ 28627); no locality except Antigua, 247 (MCZ 3637–61, MCZ 4081–84, MCZ 6752, MCZ 6754, MCZ 6757 + 116 untagged specimens, MCZ 42986, MCZ 42988, MCZ 43004, MCZ 43011, MCZ 43014, MCZ 43017–110).

GUADELOUPE, Matouba, 28 (MCZ 35303–08, MCZ 35310–20, MCZ 35330–33, MCZ 32322–28); 2 km N Matouba, 2200 feet (671 m), 15 (ASFS X5563–77); St. Claude, 236 (MCZ 3662–81, MCZ 42768–970, MCZ 42972–84); Pointe du Vieux Fort, Vieux Fort, 1 (ASFS X5697); 3 km E Vieux Fort, 1 (ASFS X5369); Le Grande Anse, between Trois-Rivières and Vieux Fort, 1 (ASFS X5696); Le

Faubourg, nr. Trois-Rivières, (not mapped), 4 (MCZ 31945–47, MCZ 31949); Plage de Roseau, 1 km SE Ste. Marie, 1 (ASFS X5247); 3 km W Grand Café, 600 feet (183 m), 36 (ASFS X5223–27, ASFS X5268–96, RT 177–78); 1 km S Prise d'Eau, 650 feet (198 m), 3 (ASFS X5065–67); 2 km W Prise d'Eau, 1000 feet (305 m), 7 (ASFS X5075–79, RT 162–63); 3 km W Prise d'Eau, 1100 feet (336 m), 1 (ASFS X5081); Sofaïa, 1200 feet (366 m), 21 (ASFS X5083–97, RT 164–68, RT 172); Caféière, 600 feet (183 m), 3 (ASFS X5327–29); 1 km NE Gommier, 1200 feet (366 m), 12 (ASFS X5585–92, RT 187–88); 2 km W Les Plaines, 4 (ASFS X5611–14); 4 km SE Pointe-Noire, 3 (ASFS X5608–10); 1 km E Mahaut, 6 (ASFS X5601–06); 3 km N Malendure, 1 (ASFS X5619); Bois Malher, 3 km NE Pigeon, 600 feet (183 m), 25 (ASFS X5479–82, ASFS X5511–25, ASFS X5620–24, RT 185); 2 km E Vieux-Habitants, 300 feet (92 m), 31 (ASFS X5424–54); Gosier, 10 (ASFS X4979–87, RT 161); 2 km SW Port-Blanc, 3 (ASFS X4989–91); 9 km W Ste.-Anne, 8 (ASFS X4993–98, RT 157–58); 5 km W Ste.-Anne, 10 (ASFS X5000–09); 1 km NW Ste.-Anne, 6 (ASFS X5010–15); 2.5 km W Moule, Baie du Nord-Ouest, 1 (ASFS X5948); Gardel, 2 (PWH *726* in RNH); Ravine de Boisvin, 8 (PWH *724* in ZM); 0.5 km N Château-Gaillard, 3 (ASFS X5046–48); 3 km SE Ste. Marguérite, 2 (ASFS X5214–15); Anse de la Savane Brûlée, 1 (ASFS X5213); Anse Labord, 4 (ASFS X5131–34); Anse du Souffleur, N of Port-Louis, 2 (ASFS X5882–83); 2 km NE Petit-Canal, 2 (ASFS X5135–36); 6 km SE Petit-Canal, 10 (ASFS X5861–69); *Ilet à Kahouanne*, 1 (MCZ 35329); *Ilet à Cochons*, 1 (ASFS X5376); no locality other than Guadeloupe, 3 (MCZ 2672, MCZ 42745–46); "Martinique", 6 (MNHN 488183, syntypes).

La Désirade, Anse d'Echelle, 1 (ASFS X6179); Grande-Anse, 2 (MCZ 32740, PWH *731* in RNH); Grande-Anse, 30 m (PWH *732* in RNH); Grande-Anse, 150 m, 6 (PWH *733* in ZM); Le Calvert, 200 m, (not mapped), 5 (PWH *734* in ZM).

Marie-Galante, 5 km SE Grand-Bourg, 8 (ASFS X6011–15, ASFS X6134–36); Grelin, 2 (PWH *746* in ZM); 3 km NW Grelin, 10 (ASFS X6118–27); Pirogue, 3 (ASFS X5990–92); Trou à Diable, 7 km NW Capesterre, 4 (ASFS X6130–33); Falaise des Sources, 2 (PWH *748* in RNH).

Les Saintes, *Terre-de-bas*, 10 (ASFS X5757–66); *Terre-de-haut*, 12 (ASFS X5742–54); Mare Basse, (not mapped), 7 (PWH *759* in ZM); *Ilet à Cabrits*, 3 (ASFS X5713–15).

Dominica, *St. George Par.*, Jack's Walk above Roseau, 6 (MCZ 30720–25); 0.5 mi. (0.8 km) E Loubière, 1 (ASFS 11479); Laudat, 12 (MCZ 2192, MCZ 42696–706); Fresh Water Lake, 2500 feet (763 m), 14 (ASFS 19116–29); nr. Fresh Water Lake, ca. 2000 feet (610 m,)1 (MCZ 31579); *St. David Par.*, 6 mi. (9.7 km) NE Pont Casse, 2 (ASFS X6245–46); 6 mi. (9.7 km) SW Castle Bruce, 1200 feet (364 m), 69 (ASFS 19040–106, ASFS 19049a, ASFS 19091a); *St. Andrew Par.*, Moore Park, 7 (MCZ 30852–58); 8 mi. (12.9 km) NE Pont Casse, 1 (ASFS 11529); *St. Joseph Par.*, Clarke Hall Estate, 24 (ASFS X6197–98, ASFS X6248–51, ASFS X6258–72, ASFS X6303–05); 6 mi. (9.7 km) NE Pont Casse, 1050 feet (320 m), 23 (ASFS 18947–69); Bells, 1 (ASFS X6311); 1 mi. (1.6 km) NE Bells, 8 (ASFS X6313–20); *St. Paul Par.*, 6 mi. (9.7 km) NE Roseau, 1100 feet (336 m), 27 (ASFS 11377–98, ASFS 11645–46, ASFS 18970–71, ASFS 18986); 8 mi. (12.9 km) NE Roseau, 2 (ASFS X6301–02); 8.5 mi. (13.7 km) NE Roseau, 1900 feet (580 m), 42 (ASFS 11401–05, ASFS 11530–64,

ASFS 19107–08); 10 mi. (16.1 km) NE Roseau, 37 (ASFS 11406–42); 1.5 mi. (2.4 km) S Pont Casse, 2000 feet (610 m), 20 (RT 239–58).

Martinique, Le Morne Rouge, 72 (MCZ 2189, MCZ 2191, MCZ 10498, MCZ 10632–48, MCZ 42644–95); 4 km NE Le Morne Rouge, 1600 feet (488 m), 8 (ASFS 18789–96); 7 km SE Fond-St.-Denis, 2000 feet (610 m), 44 (ASFS 18523–37, ASFS X6328–31, ASFS X6340, ASFS X6419–27, ASFS X6429–40, RT 322–23); 5 km SE Basse-Pointe, 200 feet (61 m), 1 (ASFS X6475); 1 km N Le Prêcheur, 1 (ASFS X6605).

Eleutherodactylus pinchoni, new species

Holotype: MCZ 43231, an adult female, from 3 km W. Grand Café, 600 feet (183 m), GUADELOUPE, French West Indies, one of a series collected by Albert Schwartz and Richard Thomas on 31 Jan. 1963. Original number X5297.

Paratypes (all from Guadeloupe): ASFS X5298–304, same data as holotype; AMNH 74545–47, same locality as holotype, 30 Jan. 1963, A. Schwartz; MCZ 43232, MCZ 43237–39, 1 km S Prise d'Eau, 650 feet (198 m), 24 Jan. 1963, R. Thomas; MCZ 43240, 3 km W Prise d'Eau, 1100 feet (336 m), 24 Jan. 1963, R. Thomas; ASFS X5105–06, Sofaïa, 1200 feet (366 m), 26 Jan. 1963, A. Schwartz, R. Thomas; UIMNH 61647–50, KU 93342–47, UF 21502–03, DRP 2617, RT 184, Bois Malher, 3 km E Pigeon, 600 feet (183 m), 7 Feb. 1963, A. Schwartz, R. Thomas; USNM 157890–94, Bois Malher, 3 km E Pigeon, 600 feet (183 m), 6 Feb. 1963, R. Thomas; ASFS X5374–75, Pointe Montagne, nr. Bananier, 900 feet (275 m), 3 Feb. 1963, R. Thomas; CM 40584, 2 km N Matouba, 2200 feet (671 m), 8 Feb. 1963, A. Schwartz; CM 40585, 2 km NE Gommier, 1800 feet (549 m), 9 Feb. 1963, R. Thomas; ASFS X5674, 2 km NE Gommier, 1800 feet (549 m), 13 Feb. 1963, R. Thomas.

Distribution: The western or Basse-Terre portion of the island of Guadeloupe, at elevations between 600 and 2200 feet (183–671 m) (Fig. 15).

Diagnosis: An *Eleutherodactylus* of the *auriculatus* group characterized by a combination of very small size (snout-vent length of males to 16 mm, of females to 20 mm), relatively short hindlimbs (tibia/snout-vent 40.0 to 50.3, both sexes combined), dorsal pattern variable, with one or two broad dorsal chevrons, a pair of dorsolateral lines or a vaguely trilineate dorsal pattern, usually with a diagonal dark flank bar from the ends of the second chevron to the groin, a single crural crossbar outlined by pale, venter orange, usually heavily overlaid with dark brown, groin and concealed surfaces bright orange-red, and lacking inguinal glands (Fig. 5).

Description of holotype: An adult female with the following measurements and ratios: snout-vent length 18.3; head length 6.6; head width 6.3; diameter of tympanum 1.1; diameter of eye 2.5; naris to anterior corner of eye 1.6; femur 7.3; tibia 8.0; fourth toe 6.7; T/SV 43.7; HW/SV 34.4; HW/T 78.8. Head slightly narrower than distance from snout to posterior border of tympanum; snout acuminate, nares inconspicuous; diameter of eye greater than distance from naris to anterior corner of eye; diameter of tympanum slightly less than one half diameter of eye, distance from tympanum to eye equal to about two-thirds diameter of tympanum; tympanum almost circular. Interorbital distance 1.8, less than diameter of eye. Digital discs present and moderately well developed, those on fingers 3 and 4 larger than those on fingers 1 and 2, discs of finger 4 the largest and equal to about one quarter the size of tympanum. Fingers long and slender, unwebbed, 3–4–2–1 in order of decreasing length; subarticular tubercles prominent but concolor with the dark brown palmar surfaces. Toes moderate, with vestigial webs, 4–3–5–2–1 in order of decreasing length; subarticular tubercles prominent but concolor with the dark brown plantar surfaces. Heels barely touch when femora held at right angles to body axis.

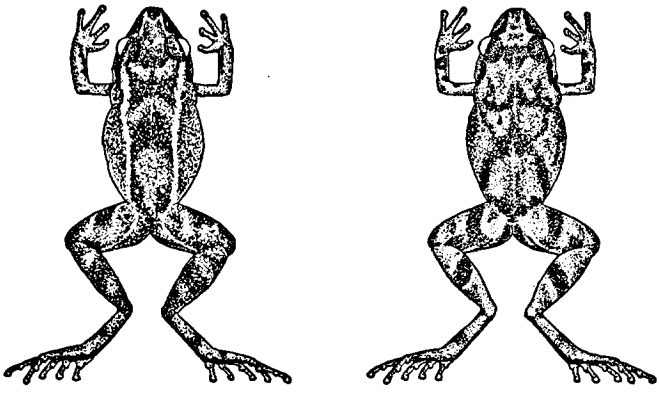

Fig. 5. *Eleutherodactylus pinchoni*, new species; left, MCZ 43231, holotype from GUADELOUPE; snout-vent length 18.3 mm; right, USNM 157890, paratype from GUADELOUPE; snout-vent length 18.9 mm.

Inguinal glands absent. Dorsum very finely granular; upper eyelids finely granular like dorsum and with one or two large low rounded tubercles. Throat smooth, belly coarsely granular; abdominal disc poorly developed. Dorsal surface of fore- and hindlimbs finely and fairly uniformly granular except that the thighs are randomly studded with scattered large rounded tubercles in addition to the fine granulation. Posterior face of thighs with low, rounded, juxtaposed, pavement-like granules. Tongue small, entire, free behind, its greatest width equal to about half that of floor of mouth. Vomerine teeth in two small patches, enclosed well within the inner margins of the choanae and separated from the choanae by a distance equal to about twice the diameter of a choana, the two series separated from each other by a distance equal to one and one-half times the diameter of a choana. Choana almost completely obscured when viewed from below.

Coloration of holotype: Dorsum in life rich dark wood brown with a pair of reddish-brown dorsolateral stripes enclosing between themselves a pair of darker brown and very broad chevrons; a dark brown interocular bar, convex posteriorly, and separating off the slightly paler brown snout which has a pale V and a pair of small pale dots just anterior to the interocular bar; sides brown with a bright orange-red area in the groin; a dark supratympanic line and a dark scapular dash below the dorsolateral line on each side. Hindlimbs brown dorsally, with a single crural crossbar with a slightly paler broad border on each side; a matching but less obvious crossbar on the thighs and feet; concealed surfaces bright orange-red, heavily overlaid with dark brown in a rather random pattern which leaves some orange-red popliteal spottings and marbling and a transverse orange-red hairline over the posterior face of the thigh. Brachia orange, antebrachia dark brown with some vague darker brown stippling on their preaxial surfaces. Venter orange, heavily overlaid with dark brown, giving an orange-and-brown mottled effect on the belly and throat; underside of hindlimbs dark brown. Iris golden.

Variation: There are 42 paratypes; the smallest gravid female has a snout-vent length of 16.6 mm, but all females have been used

in the following computations. Twenty eight adult females (including the holotype) have the following measurements and ratios: snout-vent length 15.2–20.2 (17.4); head length 5.5–7.0 (6.2); head width 5.5–6.8 (6.2); tympanum 1.0–1.5 (1.2); eye 1.9–2.8 (2.3); naris to eye 1.4–2.0 (1.7); femur 6.2–7.8 (7.1); tibia 6.7–8.5 (7.7); fourth toe 5.7–7.5 (6.6); T/SV 40.0–50.3 (44.2); HW/SV 33.3–38.4 (36.0); HW/T 73.8–88.6 (81.6). Data for eight males are: snout-vent length 14.4–16.0 (15.3); head length 5.2–5.9 (5.6); head width 5.2–5.7 (5.5); tympanum 0.9–1.3 (1.1); eye 2.0–2.2 (2.0); naris to eye 1.2–1.6 (1.4); femur 5.8–6.7 (6.3); tibia 6.5–7.2 (6.8); fourth toe 5.5–6.2 (6.0); T/SV 41.9–47.6 (44.6); HW/SV 34.4–39.0 (36.1); HW/T 75.0–85.3 (81.1). The series of paratypes includes five tiny juveniles with snout-vent lengths between 9.3 and 13.4 mm.

The dorsal pattern is variable but shows four basic types. The commonest pattern is a rich dark brown with a pair of rather broad dorsal chevrons and a diagonal flank bar from each end of the second chevron into the groin (although this mark may be missing); twenty five specimens have this general pattern. The chevrons may be much reduced, or very broad and practically longitudinally confluent; at times there is a very fine and inconspicuous median dorsal hairline. The crural and thigh crossbars are usually very prominent and rather boldly outlined by pale (tan) broad borders, setting the bars off from the balance of the limb color. A fairly regular feature is the presence (in preserved specimens) of a large unpigmented spot in the groin; in life this spot is orange-red. One frog (AMNH 74545) has a peculiar dark and pale dorsal asymmetrical blotching, very similar to the condition found in some specimens of the Hispaniolan species *E. audanti* Cochran and *E. abbotti* Cochran; in this irregularly blotched *pinchoni*, the blotching involves the upper surfaces of the fore- and hindlimbs as well as the back itself. A few specimens lack any sort of dorsal pattern whatsoever and are very dark wood brown. The orange brachia are conspicuous in all specimens in life.

A second pattern configuration, obviously derived from the pattern noted above, consists of a pair of chevrons, the posteriormost of which cuts off a middorsal patch of reddish-brown pigment in the sacral area. There are eight specimens with this pattern. The

effect here is as if the dorsum behind the last chevron did not receive its complete complement of dark pigment, and a reddish-brown and contrasting blotch results.

The third pattern is like that described for the holotype – a pair of reddish-brown dorsolateral stripes; including the holotype, five specimens show this pattern feature. One of the five (MCZ 43232) has a large posterior pale dorsal blotch, as described above for the second pattern, enclosed between the dorsolateral lines.

The fourth pattern, possessed by four frogs, consists of a pair of dorsolateral lines with an additional and irregular pale median dorsal stripe, thus giving the frogs a palely trilineate dorsal pattern. The dorsal stripe is not a hair-line and regularly has scalloped margins. The median stripe may be continuous with the pale snout color or it may be interrupted by the dark interocular bar. Two frogs with this trilineate pattern have the pale posterior dorsal blotch described above.

The venter in life is orange; this bright color may be almost completely obscured by overlying dark brown pigment, which may be mottled, blotched, or stippled over the entire ventral surface. Often the throat, even in females, has a median pale line separating two lateral dark areas. The vocal sac in males is not distinctly glandular, is heavily stippled with dark brown, and is not especially large, even considering the small size of the males. The pale (orange-red) groin spot is a prominent feature in most specimens. The dark interocular bar may be preceded by a very fine pale interocular line, or there may be a generally pale area on the snout just anterior to the dark interocular bar. The structural features of the holotype are matched by frogs in the paratypic series.

Comparisons: *E. pinchoni* occurs syntopically with *E. martinicensis* on Guadeloupe, and sympatrically with *E. barlagnei* on the same island. Comparisons with the latter species will be made in the discussion of *barlagnei*. Comparisons between *pinchoni* and *martinicensis* are practically unnecessary. The huge size of the latter compared to the tiny size of the former, the differences in coloration and pattern, and the voices of the two make separation a simple matter. Even tiny specimens of *martinicensis* are easily

separated from *pinchoni*; the short-legged and stocky appearance of *pinchoni* is quite different from (even in juveniles) the long-legged appearance of *martinicensis*. The amount of overlap of the heels is an additional means of distinguishing the two species – the heels of *pinchoni* barely touch, those of *martinicensis* overlap.

Although *E. pinchoni* is not sympatric with either *E. urichi* or *E. johnstonei*, it may be readily distinguished from *urichi* by its much smaller size, different pattern, coloration, and voice. From *johnstonei*, *pinchoni* differs in the same way as it does from *urichi* and *martinicensis*, except that the heels of both *pinchoni* and *johnstonei* barely touch when the femora are held at right angles to the body. Vocally, *pinchoni* and *johnstonei* are very different, and the much richer colors and smaller size of the former contrast with the drab colors and larger size of the latter. It is of interest that Montserrat *johnstonei* are only slightly larger than *E. pinchoni*.

Remarks: Like many of the tiny West Indian *Eleutherodactylus*, *E. pinchoni* is limited in its activities to the ground or low grasses and herbs. Specimens were collected in leaf litter in rain forest, piles of wet cacao husks, under very wet banana trash, under palm husks and fronds at the edge of a forest clearing, and under logs and rocks in the deep shade of the forest. Often they were encountered before noon in the rain forest or in *Theobroma* groves, hopping about on the leaf litter. Calling males vocalize from the ground or from herbs only 6 inches (15 cm) above the ground surface. The call is a series of "tick" 's followed by a single rising "wheep"; this call is much like that uttered by the Hispaniolan species *Eleutherodactylus audanti* Cochran (which also is a member of the *auriculatus* group). The call differs strikingly from that of *E. martinicensis* and *E. barlagnei*, that of the former a single rising note and of the latter a 4- or more unit trill, falling at the end of the series. The call of *pinchoni*, because of the small size of the calling male, is very insectlike and not at all loud; however, the call of the first males we encountered (at Sofaïa) was readily identified as issuing from a frog rather than an insect. Since males call from the ground, they are often difficult to locate in the leaf litter; one was secured with some difficulty as it called from the dead leaves within a raspberry thicket. At the type locality, two of the series of seven specimens secured with the type were collected from a large hole (about 1 meter in diameter) which had been recently dug in a vegetable patch adjacent to forest; these frogs plus some *martinicensis* had fallen into the hole during the evening and as yet had been unable to escape. At the Matouba locality, several males were heard calling at 10.00 hours. Here the frogs were calling from deep grass (less than one meter high) about some abandoned farm houses; no calling males were secured.

In general, *E. pinchoni* is associated with mesic and forested situations from elevations of 600 to 2200 feet. At night it may leave the sanctuary of the forests and sally forth to forage in adjacent and artificially cleared areas. I assume that the unusual occurrence of the frog in exposed grassy areas at Matouba is due to the

large amount of trash and debris about the abandoned buildings – objects which offer a suitable diurnal sanctuary for a frog which distinctly prefers shady and mesic situations.

Comments on the relationships of *E. pinchoni* will be made later in the present paper.

Eleutherodactylus barlagnei Lynch, 1965

Eleutherodactylus barlagnei LYNCH, 1965, Breviora *220* : 2. Type locality – Matouba, ca. 700 meters, Guadeloupe.

Distribution: The western or Basse-Terre portion of the island of Guadeloupe (Fig. 15).

Definition: An *Eleutherodactylus* of the *auriculatus* group characterized by a combination of small size (snout-vent length of males to 23 mm, of females to 32 mm), relatively short hindlimbs (tibia/snout-vent length 39.6 to 50.2, both sexes combined), dorsum black to brownish-black, somewhat speckled with tan outlining a pair of dorsal chevrons, a tan interocular bar followed by a black truncated triangle, its apex pointed posteriorly, a single very broad black crural crossbar not conspicuously outlined by pale, no red on the hindlimbs, groin, or venter, toes webbed and with lateral dermal flanges extending to the discs, and without inguinal glands (Fig. 6).

Discussion: Certainly the most striking and distinctive of the Lesser Antillean *Eleutherodactylus* is the recently described *E. barlagnei*. The species is based upon a very small series of five specimens collected at the type locality by JAMES D. LAZELL, Jr.;

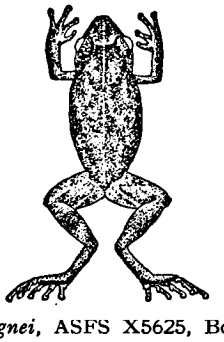

Fig. 6. *Eleutherodactylus barlagnei*, ASFS X5625, Bois Malher, 3 km E Pigeon, 600 feet, GUADELOUPE.

one of the paratypes is presently a skeleton and the holotype and remaining paratypes are hardly more than skeletons since they are presently extremely dessicated. Their condition at the time of the description of *barlagnei* doubtless prevented the describer from fully appreciating the very distinctive characters of the species.

E. barlagnei is a small frog, about equalling *E. johnstonei* in size. Measurements and ratios of thirty eight females are: snout-vent length 22.9–31.7 (25.2); head length 8.1–10.7 (8.8); head width 8.1–10.8 (8.8); tympanum 1.1–1.6 (1.3); eye 3.1–4.1 (3.4); naris to eye 2.1–3.9 (2.7); femur 9.3–13.3 (10.7); tibia 10.2–13.3 (11.1); fourth toe 8.8–12.2 (10.3); T/SV 39.6–47.8 (44.2); HW/SV 32.5–37.4 (35.0); HW/T 74.2–85.3 (79.3). The smallest gravid female has a snout-vent length of 22.9 mm. Measurements and ratios for twenty seven males are: snout-vent length 19.6–22.8 (21.2); head length 6.9–8.0 (7.4); head width 6.9–8.2 (7.6); tympanum 1.0–1.4 (1.2); eye 2.6–3.4 (3.0); naris to eye 1.9–2.6 (2.3); femur 8.4–10.2 (9.4); tibia 9.2–10.5 (9.9); fourth toe 8.4–9.8 (9.1); T/SV 43.2–50.2 (46.7); HW/SV 34.2–38.2 (35.8); HW/T 69.5–82.3 (76.9). Although the snout-vent length of the holotype, a gravid female, was given (Lynch, *op. cit.*: 5) as 33 mm, presently the specimen measures only 31.7 mm but is still the largest *barlagnei* known. LYNCH's (1965: 5) HW/SV ratios (for both sexes and including one juvenile) are consistently lower (27.0 to 32.0) than mine; this is surely due to the extremely poor condition of the type material. Nonetheless, comparison of HW/SV ratios of *barlagnei* and Basse-Terre *martinicensis* shows that the former does indeed have lower values for this ratio in both sexes, although the upper extremes of *barlagnei* overlap the lower extremes of *martinicensis* in all cases.

The coloration and pattern of *E. barlagnei* are relatively constant. The dorsum is generally black or rusty brown, at times with a brownish suffusion, and with a pair of broad dorsal chevrons set off from the dark ground color by irregular tan stippling or mottling. Some specimens have a very fine middorsal pale hairline, whereas in others there is no dorsal pattern whatsoever, the entire back being solid black. There is a tan interocular bar, followed by a more or less distinct truncated black triangle with its apex pointed posteriorly. On some specimens there is a pair of more or less distinct tan

blotches in the region of the dorsolateral line above the sacrum, but these may be very reduced or absent entirely. There is a single very broad crural band, with a matching thigh and foot band, outlined by an inconspicuous tan band on either side, but these elements are seldom distinct and may be absent. The venter is dark gray and has some white spots on the throat. At times the belly is paler gray centrally, thus giving a broad paler band down the center of the belly, with dark brown to black sides. The rather small vocal sac is usually darkly pigmented and with white spots, but it may be without heavy dark pigment and only lightly stippled with brown. The iris is dull grayish-brown above and dark brown or black below. The dorsal surface of the finger discs is often tan and in contrast to the black fingers.

The structural features of *E. barlagnei* may be described as follows. Head usually slightly broader than distance from snout to posterior border of tympanum; snout acuminate with nares rather conspicuous at anterior end of canthus rostralis, diameter of eye greater than distance from naris to anterior corner of eye; diameter of tympanum less than one half diameter of eye, distance from tympanum to eye equal to or slightly greater than diameter of tympanum; tympanum practically circular. Interorbital distance about equal to diameter of eye. Digital discs present and well developed, those on fingers 2, 3 and 4 larger than that on finger 1, disc of finger 3 the largest and equal to about the size of the tympanum. Fingers moderately long, with vestigial webs and with a narrow lateral fleshy flange extending from their bases to the discs, 3–4–2–1 in order of decreasing length; subarticular tubercles prominent, gray. Toes moderately long, webbed and with a distinct lateral fleshy flange extending from the end of the webs to the discs, 4–3–5–2–1 in order of decreasing length; subarticular tubercles prominent, gray. Heels widely separated when femora held at right angles to body axis. Inguinal glands absent. Dorsum smooth, upper eyelid smooth. Throat smooth, belly granular; abdominal disc poorly delineated except posteriorly. Dorsal surface of fore- and hindlimbs smooth. Posterior face of thighs with low, rounded, juxtaposed pavement-like granules. Tongue large, only slightly nicked, free behind, its greatest width equal to almost that of the

floor of mouth. Vomerine teeth in two very small patch-like series, enclosed well within the inner margins of the choanae and separated from the choanae by a distance equal to about one and one half the diameter of a choana, the two series separated from each other by a distance equal to about two and one-half times the diameter of a choana. Choanae small and completely visible when viewed from below. The roof of the buccal cavity is illustrated by LYNCH (1965: 2), although in fresh and fleshy material the two vomerine series seem regularly more widely separated than in the drawing.

Comparisons: *E. barlagnei* is so distinctive that comparisons with any of the Lesser Antillean species is hardly necessary. The webbed feet and dermal flanges on the hands and feet are themselves diagnostic of *barlagnei*, and the very dark dorsal coloration and lack of reds or oranges anywhere on the frog will distinguish it chromatically from all other Lesser Antillean species. In size, *barlagnei* is larger than *pinchoni*, equal to *johnstonei*, and smaller than *martinicensis* and *urichi*. Vocally, *barlagnei* is also distinctive, as noted below.

Remarks: As might be guessed from the webbed feet and flanged digits, *E. barlagnei* is aquatic. We encountered these frogs in rushing mountain torrents at Sofaïa and Bois Malher, at elevations of 1200 and 600 feet (366 and 183 m), and the type series came from Matouba at an elevation of about 700 meters. Specimens were collected both during the day and at night, but by night they were much easier to secure. By day at Sofaïa a few specimens were found by turning rocks inbedded in coarse sand on small bars in the stream. At night in this same area, many specimens were secured while they were perched on boulders in the stream. The frogs occupied only those reaches of the stream which were boulder strewn, and here they showed a distinct predilection for wet vertical surfaces. At Bois Malher the frogs showed the same preference, and here often occupied boulders which had a moss covering. The boulders on which *barlagnei* was found varied in diameter from 6 feet (1.8 m) to 1 or 2 feet (0.3 to 0.6 m). As many as six specimens were taken from a single boulder at Bois Malher. The frogs are generally lethargic but when hard pressed escape by leaping into the water. Progression was by short, *Bufo*-like hops, rather than long *Rana*-like jumps. No specimens were taken from the banks of the streams at either locality. Calling males vocalize from rocks in the slack water along the edges of the stream, not on the rocks or boulders in the rushing stream course, nor from the bank or rocks on the bank. The call is a series of four (or at times more) trilled notes, the entire series descending at the end. LYNCH's (1965: 3) statement that the voice of *barlagnei*, described by LAZELL as "teeen", appears to be incorrect, but it is possible that this is a variant call of the species. Although careful search was made along the more placid stretches of streams at Sofaïa and Bois Malher, no *barlagnei* were encountered along the banks; such stretches also lacked boulders or rocks. At Bois

Malher Thomas saw only a very few specimens in a rushing but narrow tributary of the river, which at this locality is about 20 feet (6.1 m) wide; the Rivière Salée at Sofaïa is a narrower but more torrential stream, with a maximum width at Sofaïa of about 12 feet (3.7 m). Apparently there is a minimum width to streams which *E. barlagnei* inhabits.

Although many species of West Indian *Eleutherodactylus* may occur adjacent to water, *E. barlagnei* is one of a select few which are truly aquatic and inhabitants of mountain streams. *E. karlschmidti* Grant of Puerto Rico, *E. orcutti* Dunn of Jamaica, *E. turquinensis* Barbour & Shreve of Cuba, and *E. schmidti* of Hispaniola are confirmedly aquatic and are more or less restricted to upland streams. SHREVE & WILLIAMS (1963: 326–27) mentioned the webbed feet of *E. semipalmatus* Shreve and almost certainly this species is also aquatic. These authors erected a group – the *orcutti* group – to include the above species (with the exception of *schmidti*), along with *E. sierramaestrae* Schmidt and *E. cuneatus* Cope from Cuba. Although it is somewhat outside of the province of the present paper to become involved with a discussion of this group of aquatic frogs, since *barlagnei* is aquatic and might be considered as the sole Lesser Antillean member of the *orcutti* group, some comments must be made at this time.

Of the three Cuban species of the *orcutti* group (*sierramaestrae, turquinensis, cuneatus*) only *turquinensis* is known to be restricted to mountain streams. *Sierramaestrae*, despite its name, occurs throughout much of eastern Oriente at both high and low elevations, and, although stream associated, is not confined to upland or mountainous situations. *E. cuneatus* is distinctly not an inhabitant of rushing mountain streams, and occupies lowland lentic situations such as streams of low gradient and the borders of swamps and marshes. The Puerto Rican *karlschmidti* is normally (and always, in my experience) a mountain torrent dweller, but the species has been reported (RIVERO *et al.* 1963: 26) from Patillas and Aguas Buenas at rather low elevations, and Richard Thomas heard the species calling from a meandering creek through the dry bed of the Embalse de Cidra. Possibly these latter rather unusual records are due to stream transport of what is orthodoxly an upland frog into less normal situations.

There are no data available on the habits nor habitats of *E. semipalmatus* from Hispaniola, but as noted above, surely SHREVE & WILLIAMS' contention that it is aquatic is correct. The other Hispaniolan member of this complex, *E. schmidti*, is associated with mountain streams at least in the Cordillera Central and Cordillera Septentrional in the República Dominicana, and also presumably so in Haïti (LYNN 1958: 157), although the elevation at the latter locality is in no way comparable in elevation to the Dominican stations for *schmidti*. In any event, *schmidti* is stream associated, but it is not typically a torrent frog and is most regularly encountered along the banks of slow flowing streams and rivers, or even on stones and small sandbars in, or immediately adjacent to, the water. In some areas it occurs in roadside seeps or drainage ditches. Thus *schmidti*, although often found adjacent to streams, is aquatic only in the broadest sense.

The sole Jamaican member of the assemblage, *E. orcutti*, occurs only in upland situations and is associated with torrents, streams, seepages, trickling water, or even small placid standing water pools.

In size, the above frogs vary from small (*semipalmatus*) to very large (*karlschmidti*). All are vocal (there are no data for *semipalmatus* or *turquinensis*), but the calls are variable, and include the loud rachet-like call of *karlschmidti* to the irregular

and insect-like calls of *sierramaestrae, cuneatus,* and *schmidti.* All have smooth venters (*barlagnei* has the venter granular), most lack a vocal sac (except *barlagnei,* and *karlschmidti* which has a double vocal sac), and all have dermal flanges on the toes, this latter feature being best demonstrated by *semipalmatus, turquinensis* and *orcutti.* All have some webbing on the feet, with *karlschmidti* having the most extensively webbed feet and *sierramaestrae, cuneatus* and *schmidti* having the smallest webs. The discs are very large in *karlschmidti,* and small in *sierramaestrae, cuneatus,* and *schmidti,* with the remaining forms having the discs rather moderate in size. The tongue is entire or only slightly nicked in all species. The vomerine teeth are small and patch-like in *orcutti, semipalmatus, karlschmidti, turquinensis* and *barlagnei,* and long and bowed and extending beyond the choanae in *sierramaestrae, cuneatus,* and *schmidti.*

In the light of the above brief discussion, it seems doubtful to me that these eight aquatic frogs show much similarity *intra se,* and I doubt strongly that they should be placed together in any schema which suggests that they represent a pan-Greater Antillean group of aquatic frogs (with one Lesser Antillean representative) with a common ancestry, and a broad distribution. Certainly they do not suggest the compact picture that members of the *auriculatus* group present through the Antilles (see SCHWARTZ, MS), either in habitus, size, or voice.

A preferable interpretation of these frogs is that they are local aquatic representatives of other widespread groups. The aquatic habitat in the Antilles is, except for the above species, all of which are restricted in distribution on their particular islands, unoccupied except for *Hyla heilprini* Noble (and occasionally *H. vasta* Cope and *H. pulchrilineata* Cope) on Hispaniola. It thus seems logical to suggest that on each of several islands, there has been an effort on the part of the local stock to evolve convergently at least one aquatic frog with webs, toe flanges, and blotchy dark-and-pale cryptic coloration, to occupy this vacant aquatic niche. Thus, the Cuban *cuneatus, sierramaestrae,* and *turquinensis* and the Hispaniolan *schmidti* do not violate my concept of the *ricordi* group and are merely aquatic members of that widespread Greater Antillean complex. Similarly, *barlagnei* is an *auriculatus* member on Guadeloupe.

The remaining members (*orcutti, karlschmidti,* and *semipalmatus*) are somewhat more divergent from parent stocks and consequently difficult to place. *E. karlschmidti* stands alone in West Indian *Eleutherodactylus* by virtue of its double vocal sac. *E. orcutti* differs from both Jamaican *ricordi* and *gossei* (*sensu* GOIN 1954) members in its short tooth row, although it is not distinctive vocally from at least the *ricordi* group. So little is known about the habits of *semipalmatus* that it cannot be placed with any certainty, but it may well be a highly specialized *ricordi* group relative or fringe member. With increasing knowledge and familiarity with the West Indian *Eleutherodactylus,* doubtless the position of these three species can be made with more decision. *Intra se,* at least there is nothing to suggest that they form any more close assemblage than do they and the other members of the "*orcutti* group".

Specimens examined:

GUADELOUPE, Matouba, ca. 700 meters, 4 (MCZ 35334 – holotype, MCZ 35330, MCZ 35332–33 – paratypes); Sofaïa, Rivière Salée, 1200 feet (366 m), 40 (ASFS X5109–14, ASFS X5137–48, ASFS X5159–76, RT 170–71, DRP 2605–06); Bois Malher, 3 km E Pigeon, 600 feet (183 m), 27 (ASFS X5625–49, RT 189–90).

DISCUSSION

The Lesser Antilles are inhabited by five species of *Eleutherodactylus*, all of which are members of one assemblage of forms, the *auriculatus* group, which is widespread throughout the Antilles and occurs as well on the South American (and presumably Central American) mainland. Of the five species, *E. urichi* is obviously a South American species which has invaded the southernmost islands of Grenada and St. Vincent. It has been long enough in residence on these two islands to have differentiated two subspecies, which are similar to one another in size, but different from *urichi* from Trinidad.

Of the remaining four species, *pinchoni* and *barlagnei* are restricted to the island of Guadeloupe, *martinicensis* has a compact distribution on the northern Windwards and Antigua, and *johnstonei* has a split distribution on the southern Windwards and most of the Leewards. The possible history of *johnstonei* has been discussed under that species and need not be repeated. The rather restricted distribution of *E. martinicensis* on Martinique and its presence on Antigua but absence on Barbuda suggests that it is a recent arrival to both Martinique and Antigua, and its site of origin may have been either Dominica or Guadeloupe; since the especially rich and mesic Dominica has no other small frog than *martinicensis*, perhaps it makes the best locality for the development of *martinicensis*.

The occurrence on Guadeloupe of two endemic species is striking. This can hardly be attributed to the bi-partite nature and resultant larger size of Guadeloupe, since both the Guadeloupe endemics are restricted to the inner chain mountainous Basse-Terre portion of the island. The eastern Grande-Terre section would not be satisfactory for *E. barlagnei* at least, and only doubtfully so for *E. pinchoni*. One can only postulate that both of these species arose locally in the mountains of Guadeloupe. Possibly *pinchoni* is the local derivative of the same stock which gave rise to *johnstonei*; at least Montserrat *johnstonei*, just to the north of Guadeloupe, are small and hardly larger than *pinchoni*. The radically different coloration, pattern, and voice of *pinchoni* clearly eliminate the possibility that it should better be regarded as a race of *johnstonei*,

although the two may have had a common ancestry. I have no ideas about the origin of *barlagnei*; it is so different from all other *auriculatus* group members that one is forced to acknowledge its long independent history and unknown ancestry.

Perhaps the most striking fact brought out by the present study is the extreme paucity of *Eleutherodactylus* species in the Lesser Antilles. Such rich and varied islands as the inner chain islands have surely not been able to achieve a small fraction of the frog fauna which they could easily support. Except for *barlagnei*, the mountain stream habitat remains empty of frogs. There are no strictly bromeliad dwellers, no grass inhabitants, no lentic water frogs. Even the forest niches are poorly filled: in less luxuriant highland forest in Cuba, for instance, as many as seven species occur together, and Hispaniola is equally as rich. The resounding and varied nocturnal choruses of the rain forest in the uplands of Puerto Rico, with eight species calling simultaneously (and seven of the eight are *auriculatus* group members) stand in striking contrast to the relatively feeble choruses of one or two species on a Lesser Antillean island. Choruses on Guadeloupe fare no better despite the occurrence there of *pinchoni* and *barlagnei*, since the call of the former is weak and that of the latter is drowned out by the cascading torrents where it calls! The nocturnal silence on St. Barthélemy is startling in its intensity.

The origin of the Lesser Antillean frogs remains shrouded in mystery, except for the South American *E. urichi*. Possibly the basic stock(s) of all Lesser Antillean frogs arrived from South America. The resemblance of *E. martinicensis* and *E. coqui* Thomas of Puerto Rico may offer a possible source for the ancestor of that Lesser Antillean species, or perhaps even for the ancestor of all of them. That, other than *urichi*, all the Lesser Antillean species may share a common ancestry is suggested by the basic community of pattern between them; all species have one or two dorsal chevrons as common pattern variants.

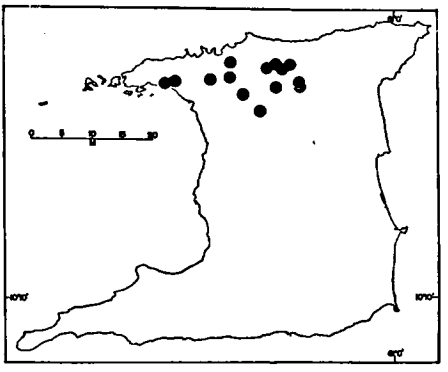

Fig. 7. TRINIDAD; solid circles indicate localities for *Eleutherodactylus urichi urichi*.

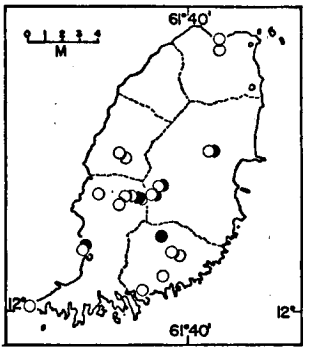

Fig. 9. GRENADA; solid circles indicate localities for *Eleutherodactylus urichi euphronides*; hollow circles, *E. johnstonei*.

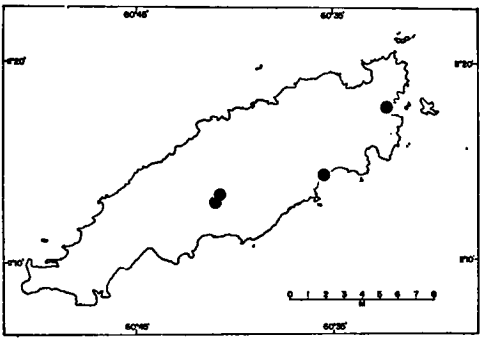

Fig. 8. TOBAGO; solid circles indicate localities for *Eleutherodactylus urichi urichi* × *euphronides*.

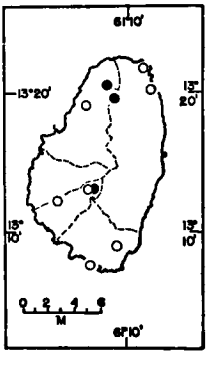

Fig. 10. ST. VINCENT; solid circles indicate localities for *Eleutherodactylus urichi shrevei*; hollow circles, *E. johnstonei*.

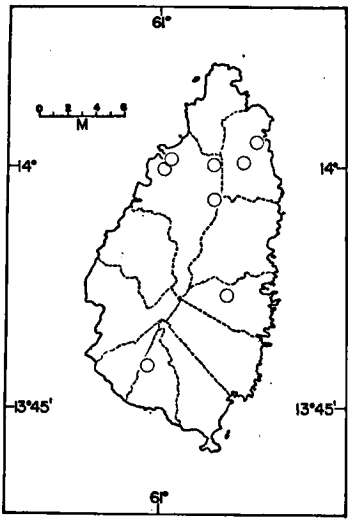

Fig. 11. ST. LUCIA; hollow circles indicate localities for *Eleutherodactylus johnstonei*.

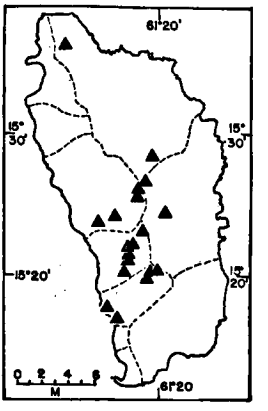

Fig. 14. DOMINICA; solid triangles indicate localities for *Eleutherodactylus martinicensis*.

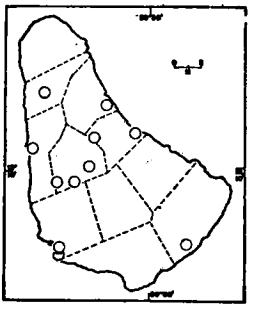

Fig. 12. BARBADOS; hollow circles indicate localities for *Eleutherodactylus johnstonei*.

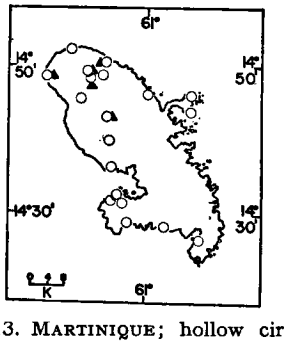

Fig. 13. MARTINIQUE; hollow circles indicate localities for *Eleutherodactylus johnstonei*; solid triangles, *E. martinicensis*.

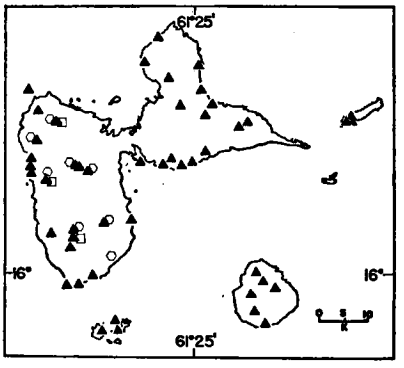

Fig. 15. GUADELOUPE with its satellite islands LA DÉSIRADE (E), MARIE-GALANTE (SE) and LES SAINTES (S); solid triangles indicate localities for *Eleutherodactylus martinicensis*; hollow hexagons, *E. pinchoni*; hollow squares, *E. barlagnei*.

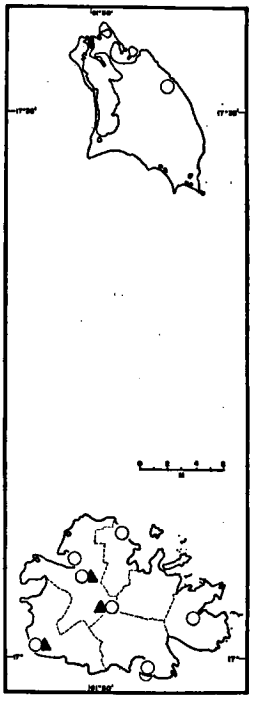

Fig. 16. ANTIGUA (S) and BARBUDA (N); solid triangles indicate localities for *Eleutherodactylus martinicensis*; hollow circles, *E. johnstonei*.

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