

## A New Marsh-dwelling Species of *Eleutherodactylus* from Haiti (Anura: Leptodactylidae)

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**ABSTRACT.**—A new species of leptodactylid frog (*Eleutherodactylus*) is described from a coastal mangrove marsh at the distal end of the Tiburon Peninsula in Haiti. It is a member of the *bakeri* series of the subgenus *Euhyas*, and is distinguished by its high-frequency call and unique reticulate skin texture.

Direct development and thus, the ability to lay eggs on land far from any water source, almost certainly played a large part in the enormous radiation of the leptodactylid frog genus *Eleutherodactylus* (approx. 500 spp.). The relatively few species that have reinvaded aquatic niches usually occur along small upland streams; none is known to regularly inhabit coastal swamps or marshes with standing water. Hence, we were surprised to encounter a new species of *Eleutherodactylus* in a coastal marsh dominated by red mangrove (*Rhizophora mangle*) at the distal (western) end of the Tiburon Peninsula of Haiti.

### MATERIALS AND METHODS

The following abbreviations are used: EL, eye length; EN eye-naris distance; FTW, fingertip (III) width; HL, head length; HW, head width; kHz, kilohertz; SHL, shank length; SVL, snout-vent length; THL, thigh length; and TYM, tympanum width. Museum abbreviations follow standardized usage (Copeia 1985:802–832). Measurements were taken with digital calipers (0.01 mm accuracy) and live weights were taken with a Pesola spring scale (0.01 g accuracy). Calls were recorded with a Sony TCM 5000 recorder and Electrovoice 635A microphone. Call analyses were made with a Digital Sona-Graph 7800 and Kay Sona-Graph 7900 printer. Terminology for call parameters follows Duellman and Trueb (1986).

*Eleutherodactylus caribe* sp. nov.

Fig. 1

**Holotype.**—USNM 314177, an adult male from 2.6 km SW Dame-Marie, Dépt. de la Grand'Anse, Haiti, 0 m, collected by S. Blair Hedges, Manuel Leal, Nicholas Plummer, and Richard Thomas on 30 May 1991.

**Paratypes** (15).—USNM 314178–79, KU 218686–88, paratopotypes (nine males, four females, two juveniles), all with same data as holotype.

**Diagnosis.**—A member of the subgenus *Euhyas*

(Hedges, 1989) by its possession of a liver with a long and pointed left lobe. Additionally, it can be placed in the *bakeri* series by its short vomerine odontophores (a derived trait within *Euhyas* but convergent with members of the subgenus *Eleutherodactylus*), paired vocal sacs, possession of a single, wide shank bar, and the sharply rising aspect of the call (see below). It can be distinguished from all other species in that series (*E. amadeus*, *E. bakeri*, *E. eunaster*, *E. glanduliferoides*, *E. glaphycompus*, *E. heminota*, *E. semipalmatus*, *E. thorectes*, and two species being described elsewhere; Hedges and Thomas, 1992) by its reticulate skin texture (Fig. 2) and high-frequency (6 kHz) call. In addition, its combination of small size (SVL 15.7–18.1 mm males, 17.2–20.1 mm females), dark dorsal and ventral coloration, and pointed digital tips further distinguishes it from other members of the *bakeri* series.

**Description.**—Head as wide as body, width less than length; snout subacuminate in dorsal view, subacuminate in lateral view, overhanging lower jaw; nostrils moderately protuberant, directed laterally; canthus rostralis rounded, slightly concave in dorsal view; loreal region flat, sloping abruptly; lips not flared; upper eyelid not tuberculate; interorbital space without tubercles; supratympanic fold weakly defined, concealing upper edge of tympanic annulus; tympanum of moderate size, round, separated from eye by a distance less than its own diameter; several postrictal tubercles, small, subconical; choanae of moderate size, round, not concealed by palatal shelf of maxillary arch when roof of mouth is viewed from below; vomerine odontophores posterior to choanae, each larger than a choana, slightly curved and angled posteromedially, separated narrowly at midline; tongue longer than wide, posterior edge without notch, posterior two-thirds not adherent to floor of mouth; males with vocal slits; males with vocal sacs paired, subgular and externally visible.

Skin of dorsum reticulate (Fig. 2), without dorsolateral folds; skin of flanks similar to dor-

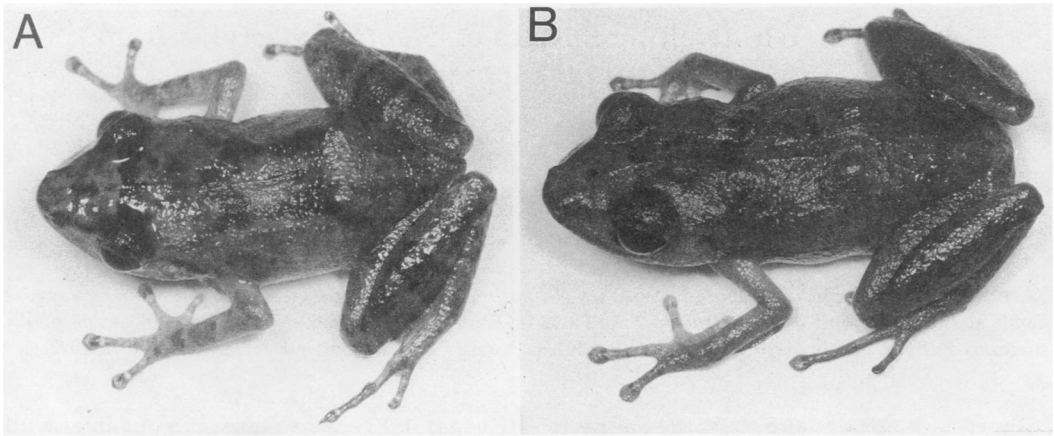


FIG. 1. *Eleutherodactylus caribe*, (A) middorsal blotch morph, (B) unicolor morph.

sum; skin of venter weakly reticulate, without discoidal folds; anal opening not extended in sheath; no glandular areas present; ulnar tubercles absent; palmar tubercle single or bifid, larger than thenar, thenar tubercle oval, low; several moderate-sized low, supernumerary tubercles; subarticular tubercles of fingers round and subconical; weak lateral ridge on finger; all fingers with expanded tips; fingertips pointed, circular pad on ventral surface of fingertip; circumferential groove bordering distal two-thirds of finger pad; width of largest pad (III) one-half to three-fourths tympanum; first finger shorter than second when adpressed; heel tubercles absent; no tubercles along outer edge of tarsus; metatarsal tubercles low, inner (oval) twice size of outer (subconical); several small, low, supernumerary plantar tubercles; subarticular tubercles of toes oval and rounded; toes with slight basal webbing; weak lateral ridge on toe; all toes with expanded tips; toetips rounded or pointed; circular pad on ventral surface of toetip; circumferential groove bordering distal two-thirds of toe pad; heels just touch when flexed legs are held at right angles to sagittal plane.

In preservative, dorsal ground color gray, grayish-brown, or dark brown; dark brown scapular W or chevron and usually a weakly-defined middorsal blotch or chevron; single, wide, dark-brown shank and antibrachial bars, each bordered by narrow light bars; distinctive white bands on dorsal surface of digits near tip; entire ventral surface uniform gray or dark gray; testicular peritoneum black.

In life, dorsal ground color dark brown (light brown or tan at night); dorsal pattern variable: unicolor, narrow middorsal stripe (pale), middorsal blotch, or more commonly, scapular "W" (see Fig. 2 in Hedges et al., 1987); wide shank

bar darker brown; ventral surface heavily pigmented with dark brown (black in some) but lighter at night; iris golden tan above, medium brown below, with darker brown bar passing horizontally through middle of eye; snout dark brown, or with light canthal bar and/or light interocular bar; wide bands on forearms dark brown; fingertips with white pigment at intercalary junction; concealed regions of things dark brown (no flash markings); some with yellowish groin (e.g., KU 218686).

*Measurements.*—The range and mean ( $\pm 2$  SE) of ten adult males (including holotype), four adult females, and the holotype (separately) are: snout-vent length, 15.7–18.1 ( $17.1 \pm 0.53$ ), 17.2–20.1 ( $18.2 \pm 1.32$ ), 18.1; head length, 6.18–7.10 ( $6.73 \pm 0.19$ ), 7.24–7.56 ( $7.40 \pm 0.13$ ), 7.10; head width, 5.76–6.80 ( $6.19 \pm 0.20$ ), 6.70–7.59 ( $6.98 \pm 0.41$ ), 6.80; tympanum length, 0.94–1.20 ( $1.08 \pm 0.06$ ), 1.11–1.28 ( $1.19 \pm 0.08$ ), 1.15; eye length, 2.15–2.74 ( $2.45 \pm 0.13$ ), 2.60–2.63 ( $2.61 \pm 0.02$ ), 2.40; eye-naris distance, 1.60–2.00 ( $1.77 \pm 0.08$ ), 1.97–2.21 ( $2.06 \pm 0.10$ ), 2.00; thigh length, 6.56–7.94 ( $7.19 \pm 0.29$ ), 7.94–8.69 ( $8.23 \pm 0.33$ ), 7.94; shank length, 7.62–8.20 ( $7.96 \pm 0.14$ ), 8.78–9.71 ( $9.20 \pm 0.40$ ), 8.20; fingertip (III) width, 0.50–0.80 ( $0.67 \pm 0.07$ ), 0.62–0.80 ( $0.72 \pm 0.09$ ), 0.54; toetip (IV) width, 0.50–0.73 ( $0.61 \pm 0.04$ ), 0.62–0.66 ( $0.64 \pm 0.02$ ), 0.54; live weight, 0.32–0.48 ( $0.40 \pm 0.04$ ) g, 0.49–0.72 ( $0.57 \pm 0.10$ ) g, 0.42 g.

*Etymology.*—A noun in apposition, from the Spanish word for "Caribbean"; referring to the unusual coastal distribution of this species, in a mangrove swamp adjacent to the Caribbean Sea.

*Natural history.*—The type-locality is at the north end of a causeway separating the Caribbean (to the west) from a relatively large mangrove swamp (to the east), on the road con-

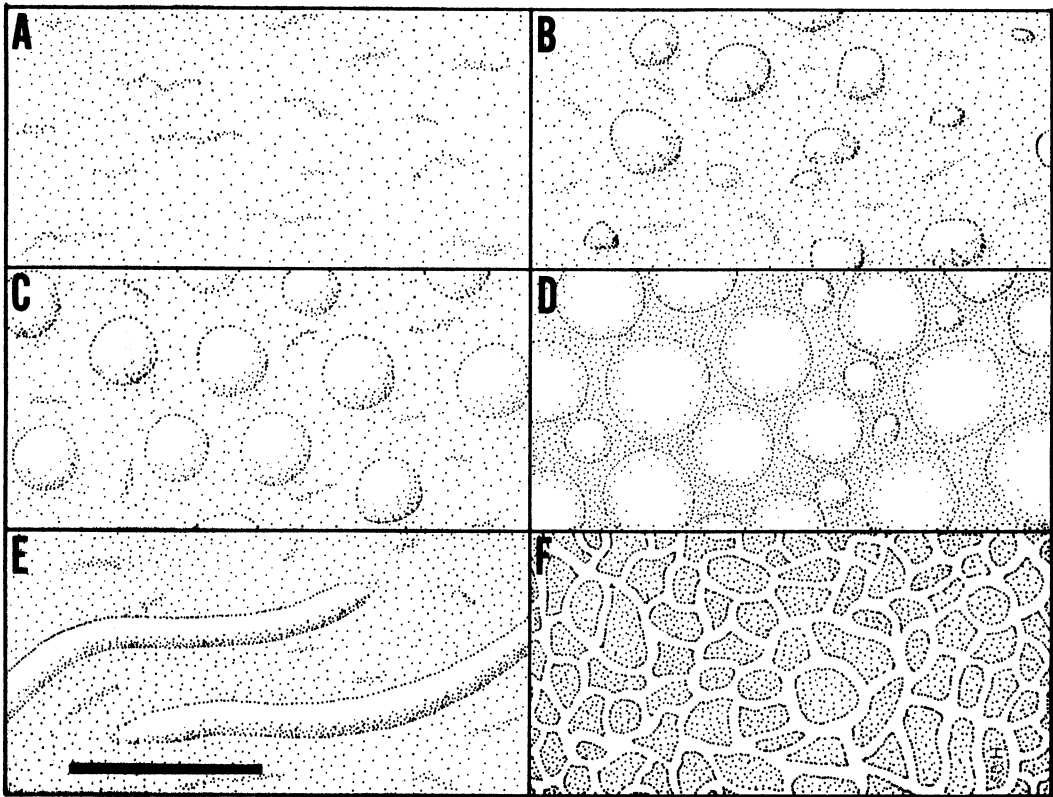


FIG. 2. Examples of different types of skin texture in frogs of the genus *Eleutherodactylus* (bar = 1 mm): (A) smooth (*E. heminota*); (B) tuberculate (*E. lamprotes*); (C) shagreened (*E. counouspeus*); (D) areolate venter (*E. lamprotes*); (E) rugose (*E. sulcatus*); and (F) reticulate (*E. caribe*).

necting Dame-Marie with Anse D'Hainault. The road is less than a meter above sea level and about two meters from the shoreline. The road is bordered to the east by a strip of tall grass (5 m wide) beyond which lies the mangrove swamp with standing water to a depth of at least 1 m. Although the mangrove species present (*Rhizophora mangle*) is the most salt tolerant, it can occur in nearly freshwater conditions, and the presence of the hylid frog species *Hyla pulchilineata* suggested that the water was either brackish or fresh. All collecting and observations were made at night (0200–0300 h) and therefore we were unable to determine the total extent of the swamp. The 1:100,000 scale topographic map of the region ("Jeremie") shows the marsh covering an area of about 25 hectares (Fig. 3).

The high-frequency call of *Eleutherodactylus caribe* first alerted us to its presence as we were searching for another species, *E. pictissimus*, that was calling in the grass clumps next to the road. *Osteopilus dominicensis* and *E. inoptatus* were taken in bushes next to the road, but *E. caribe* was

found only in the mangrove swamp with standing water, along with *H. pulchilineata*. Males of *E. caribe* were found calling from 1–2 cm above the water line up to 2 m high on mangrove leaves, but most frequently about 1 m above the water. None of the trees appeared to have epiphytes or other sites that might be used to deposit eggs, and thus the reproductive ecology of this species remains a mystery. None of the females have oviducal eggs and only one, USNM 314181 (the largest), has convoluted oviducts.

Several coastal and inland localities to the south (as far as Les Irois) and to the north (between Dame-Marie and Jérémie) were checked for anuran activity that same night, but *E. caribe* was neither seen nor heard. However, none of those other localities were within mangrove swamp habitat, which appears to be the preferred habitat of *E. caribe*.

*Vocalization.*—The call of *E. caribe* is a single, high-frequency whistle given in irregular, closely-spaced intervals (Fig. 4). Of seven calls from one individual analyzed, the number of notes per call was one (no variation); the mean

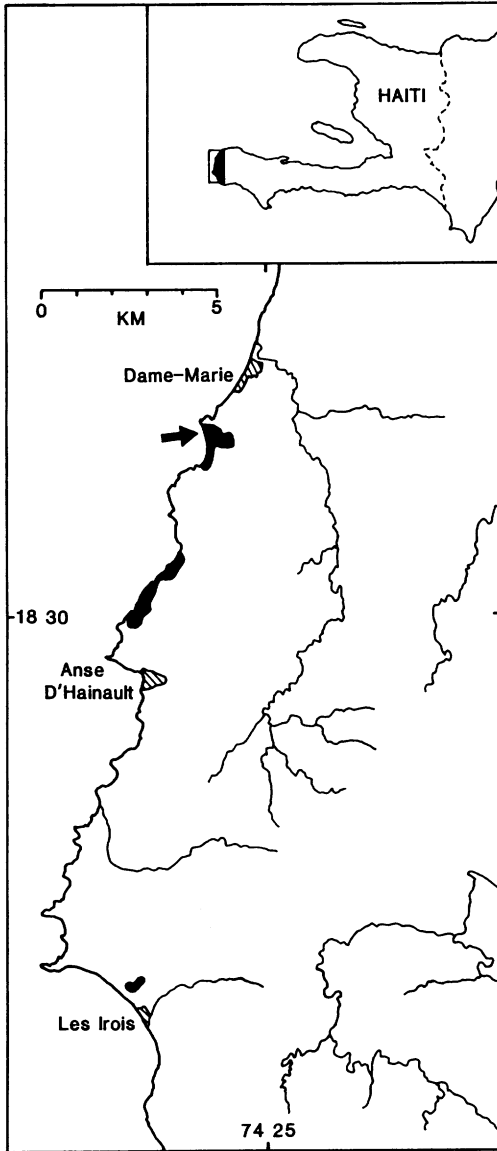


FIG. 3. Distribution of coastal marshes on the western end of the Tiburon Peninsula of Haiti (shaded) and the type-locality for *Eleutherodactylus caribe* (arrow).

dominant frequency was 5.98 (5.85–6.09) kHz; the call duration was 107.4 (99.6–125.1) msec; and the call rate was 19.5 (16.1–22.1) calls per minute. The dominant frequency (6 kHz) of this species is unusually high, exceeded only by *E. gryllus* of Puerto Rico (Drewry and Rand, 1983) among West Indian species that have been analyzed (S. B. Hedges, unpubl. data). The initial sharply-rising aspect of the call resembles calls

of the other species in the *bakeri* series, especially *E. amadeus* (Hedges et al., 1987).

*Distribution.*—Known only from the type-locality (Fig. 3). It may occur in other marshy areas along the western coast of the Tiburon Peninsula, although such habitat is uncommon and it is possible that this species is extremely restricted in range.

#### DISCUSSION

Only one species of frog, *Rana cancrivora*, is known to be adapted to salt water during all stages of the life cycle (Dunson, 1977), but many other species are associated with salt water habitat (Neill, 1958). Some species of *Eleutherodactylus*, such as *E. antillensis*, *E. pictissimus*, and *E. planirostris*, often are found under objects in tidal areas. However, no species is known to inhabit flooded, mangrove swamp habitat. In this respect, *E. caribe* appears to be unique among species in the genus.

It is possible that the small body size and reticulate skin texture of *E. caribe* are adaptations for its dry, arboreal environment. Because the ground was covered with standing water, it is likely that these frogs remain in the trees during the day. This would represent a much drier arboreal environment than encountered by most arboreal species of *Eleutherodactylus*, especially if bromeliads are not available (none were seen).

Small body size was found to be correlated with a more rapid rate of rehydration in two species of *Eleutherodactylus* on Puerto Rico (van Berkum et al., 1982), and epidermal sculpturing has been shown to play a functional role in bufonids by helping to move water up over the skin (Lillywhite and Licht, 1974). This is believed to impede dehydration of the underlying epidermis, which is important for frogs occurring in dry areas. A similar argument has been made for elephant skin, which is sculptured much the same way (Lillywhite and Stein, 1987). The reticulate skin texture of *E. caribe*, a form of epidermal sculpturing, may serve the same function.

Drewes et al. (1977) examined the physiological and anatomical adaptations of *Chiromantis petersi*, an African rhacophorid treefrog that occurs in arid conditions. They found that the dermal chromatophore units in the skin of this species were unusual in that they contained multiple, rather than single, irridophores. They postulated that these additional irridophores somehow played a role in the low rate of evaporative water loss observed in this species, although no mechanism was proposed. To examine whether these multiple irridophores were present in *E. caribe*, skin samples from a preserved specimen of that species and a presumed

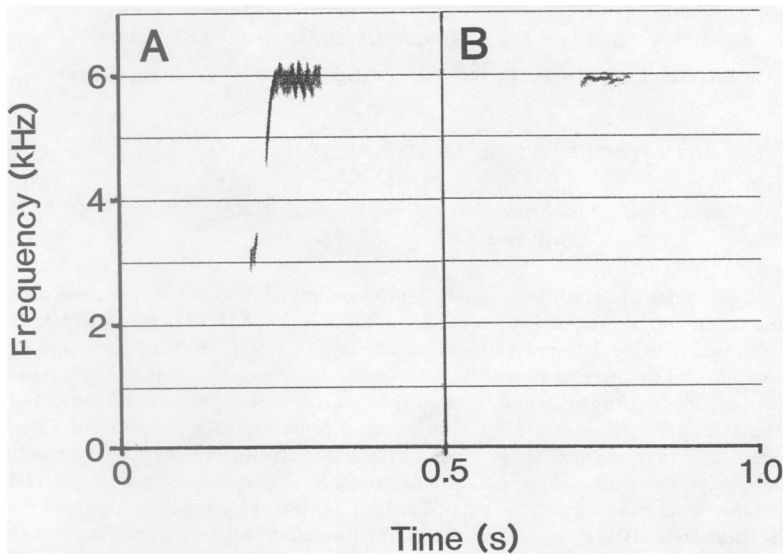


FIG. 4. Audiospectrogram of the call of *Eleutherodactylus caribe*; 300 Hz filter (A) and 45 Hz filter (B).

close relative, *E. amadeus* (which inhabits humid areas) were sectioned. We did not observe multiple irridophores, or any marked differences between the two species in chromatophore structure.

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