

A New Species of Frog from the Meseta de Cabo Cruz, Eastern Cuba (Leptodactylidae, *Eleutherodactylus*)

ALBERTO R. ESTRADA¹ AND S. BLAIR HEDGES²

¹Instituto de Investigaciones Forestales, Apartado Postal 5152, La Habana, 5 Cuba CP 10500

²Department of Biology, 208 Mueller Laboratory, Pennsylvania State University, University Park, PA 16802, USA

ABSTRACT.—A new species of *Eleutherodactylus* is described from several caves on a limestone plateau, the Meseta de Cabo Cruz, in eastern Cuba. It is a member of the subgenus *Euhyas* and is most similar to *E. planirostris*. However, it is larger in size, has strongly arched vomerine odontophores, a different call, and a different habitat preference. The two Cuban subspecies of *E. planirostris* are elevated to full species, *E. casparii* and *E. goini*.

INTRODUCTION

Our knowledge of the biodiversity of the West Indies is decidedly incomplete. In Cuba, the largest island in this region, an accurate knowledge of species diversity is lacking for the amphibians and reptiles. Since 1989, many new species have been discovered, largely as a result of joint U.S./Cuba herpetological expeditions. Among these taxa are at least 12 new species of frogs of the genus *Eleutherodactylus* (Estrada and Hedges, 1991; Hedges et al., 1992; Estrada and Alonso, 1997; Estrada and Hedges, 1996a,b). One of those new frogs, a cave-dwelling species from eastern Cuba, is described herein.

From 1985 to 1987, the senior author and some Cuban zoologists collected anurans at three cave localities on the Meseta de Cabo Cruz (Granma Province), to the west of the Sierra Maestra, Cuba. During a recent Penn State/Cuba herpetological expedition (June-July, 1994), we collected additional specimens and recorded calls at one of those localities. All of the specimens clearly represent a new species of *Eleutherodactylus*.

MATERIALS AND METHODS

The following abbreviations are used: SVL = snout-vent length; HL = head length (angle of jaw to tip of snout); HW = head width (at widest point), TYM = tympanum width; EL = eye length; EN = eye-naris distance; IOD = interorbital distance; THL = thigh length; SHL = shank length; and FTW = fingertip (III) width. Museum

abbreviations are as follows: CARE = private collection of Alberto R. Estrada, Havana, Cuba; CZACC = Zoological Collection from Instituto de Ecología y Sistemática, Havana, Cuba; MCZ = Museum of Comparative Zoology, Harvard University; MNHNCU = Museo Nacional de Historia Natural, Havana, Cuba; and USNM = United States National Museum of Natural History, Smithsonian Institution. Measurements were taken with calipers (0.01 mm accuracy) and an ocular micrometer. Calls were recorded with a Sony Walkman Professional cassette recorder and WM-D3 with electret condenser stereo microphone PC-62. The signal analyses were made with the use of Canary software (Cornell University). Terminology for call parameters follows Duellman and Trueb (1986).

Eleutherodactylus tonyi sp. nov.

Fig. 1

Holotype.—MNHNCU 683, an adult female from Cueva del Fustete, Meseta de Cabo Cruz, Municipio Niquero, Granma Province, Cuba, 50 m, collected by Alberto R. Estrada, S. Blair Hedges and Emilio Alfaro on 12 July 1994.

Paratypes.—MNHNCU (seven uncatalogued specimens), USNM 509053-54, paratopotypes, same collecting data as holotype; CARE 4-6, 563 and 566 (females); CARE 7, 564 and 565 (males); CARE 9-10 (juveniles), collected by Antonio Perera and Pedro Rosabal from type locality on 22-25 September 1985; CARE 10, USNM 509056



FIG. 1. *Eleutherodactylus tonyi*, from the type locality in Granma Province, Cuba.

from Cueva del Hueso, 6 km to the E of Monte Gordo, collected by Luís F. de Armas on 22 to 25 November 1985; CARE 556–561, from Cueva del Guafe (10–15 m elev.), collected by Alberto R. Estrada on 23 November 1987; USNM 509055, also from Cueva del Guafe, coll. by S. Blair Hedges on 10 July 1994; all from Municipio Niquero, Granma Prov., Cuba.

Diagnosis.—*Eleutherodactylus tonyi* is a member of the subgenus *Euhyas* (Hedges, 1989) in having a long, pointed left lobe of the liver, and in several morphological characters including smooth to weakly rugose venter, long vomerine odontophores, and digital tips not greatly enlarged. It most closely resembles *E. p. planirostris*, with which it shares a similar pattern polymorphism (mottled and dorsolateral stripes) and overall appearance. It differs from that taxon in having a larger body size (19.9–21.5 [mean = 20.5] mm SVL males; 22.8–33.7 [28.0] mm SVL females in *E. tonyi*; 12.4–18.2 [16.2] mm SVL males; 20.1–23.7 [22.1] mm SVL females in *E. p. planirostris*); a more robust body shape (flattened in *E. p. planirostris*); relatively longer legs; head length less than width (0.89–0.97 [mean = 0.93] mm HL/HW males; 0.87–1.05 [0.95] mm HL/HW females) in *E. tonyi* whereas

head length approximately equals width (0.94–1.08 [1.01] mm HL/HW males; 0.88–1.07 [0.98] mm HL/HW females) in *E. p. planirostris*; wide (extending beyond external margin of choana) and strongly arched vomerine odontophores (shorter, and more nearly straight in *E. planirostris*); ventrolateral skin texture moderately rugose (smooth in *E. p. planirostris*), a call with a lower dominant frequency (2.04–2.88 [mean = 2.29] kHz in *E. tonyi*; 2.22–3.66 [2.67] kHz in *E. p. planirostris*); longer note duration (26.3–52.7 [36.9] mS in *E. tonyi*; 10.8–25.2 [18.3] mS in *E. p. planirostris*); and longer note interval (539 mS–1.22 S [766] mS in *E. tonyi*; 25.6–51.1 [38.5] mS in *E. p. planirostris*).

Description.—Head as wide as body, width greater than length, snout rounded in lateral view, overhanging lower jaw; nostrils weakly protuberant, directed laterally; canthus rostralis rounded, straight in dorsal view; loreal region slightly convex, sloping abruptly; lips not flared; upper eyelid bearing tubercles; interorbital space without tubercles (occasionally one or two small and flat tubercles); supratympanic fold on upper edge of tympanic annulus; tympanum separated from eye by a distance less than its own diameter; choanae moderate-

sized, round, partially concealed by palatal shelf of maxillary arch when roof of mouth is viewed from below; vomerine odontophores posterior to choanae and strongly arched, each several times wider than a choana, separated narrowly at midline and extending outwards beyond external margin of each choana; tongue longer than wide, posterior edge without notch, posterior three-fourths not adherent to floor of mouth; males without external vocal sac.

Skin of dorsum moderately tuberculate, with dorsolateral folds; skin of flanks slightly more rugose; skin of venter smooth in central region and moderately rugose at edges, with discoidal folds; anal opening not extended in sheath; no glandular areas present; ulnar tubercles subconical; palmar tubercle single, smaller than thenar, thenar tubercle low; several supernumerary tubercles; subarticular tubercles of fingers round, subconical, and angled outward; weak lateral ridges on fingers; all fingers with expanded tips; fingertips rounded, oblong pad on ventral surface of fingertip; circumferential groove bordering distal one-half of finger pad; width of largest pad (III) one-fourth to one-half tympanum; first finger shorter than second when adpressed; heel tubercles small and subconical; no rows of tubercles along outer edge of tarsus; inner metatarsal tubercle (oval) same size as outer (subconical); several supernumerary plantar tubercles; subarticular tubercles of toes round and subconical; toes unwebbed; well-defined lateral ridges on toes; all toes with expanded tips; toetips rounded; circular pad on ventral surface of toetip; circumferential groove bordering distal one-half of toe pad; heels overlap when flexed legs are held at right angles to sagittal plane; fifth toe not as long as third when each is parallel to fourth toe.

In life, ground color brown to tan; dorsal pattern consists of a black interocular triangle or bar, and either two light brown dorsolateral stripes (extending from posterior corner of the eyelids to groin, delimited by a black discontinuous line) or dark brown mottling, with dorsal chevrons; dorsal tubercles tan and orange along the dorsolateral fold; snout light brown with a black stripe from snout to eye above the

canthals; loreals mottled with dark brown; lips mottled with black and white; iris bronze above, red-brown below; supratympanic fold black; concealed portions of thigh red-brown, anterior portions of thighs with brown markings, cross-banded in some specimens; venter uniformly dark brown with a few white flecks on chin. In preservative, ground color light brown to tan with dark brown markings; two light brown dorsolateral stripes, dorsal tubercles tan; snout light brown, black stripe over canthals; supratympanic fold black; concealed portions of thigh brown, anterior portions of thighs with brown markings; venter light brown or gray; chin light brown.

Measurements.—The mean (\pm 1SE) of 5 adult males and 10 adult females (the female holotype in parentheses) are: SVL 20.5 ± 0.155 mm males; 28.0 ± 2.70 (22.8) mm females; HL 7.2 ± 0.054 mm males; 10.1 ± 0.229 (9.4) mm females; HW 7.7 ± 0.072 mm males, 10.6 ± 0.229 (9.6) mm females; TYM 2.6 ± 0.138 mm males; 2.08 ± 0.01 mm (2.0) females; EYE 3.4 ± 0.076 mm males; 4.24 ± 0.02 mm (4.1) females; E-N 2.5 ± 0.13 mm males; 3.4 ± 0.02 mm (3.3) females; IOD 2.7 ± 0.02 mm males; 3.3 ± 0.01 mm (3.7) females; THL 9.5 mm males; 12.6 (11.3) mm females; SHL 9.8 ± 0.02 mm males; 12.8 ± 0.31 mm (11.7) females; FTW 0.7 ± 0.06 mm three males; 0.9 ± 0.03 (1.1) mm females; TTW 0.8 ± 0.01 females. The live masses of two adult males were 0.79 and 1.17g; two adult females weighed 1.18 and 2.21 g.

Etymology.—This new species is named in honor of our friend, and millipede specialist, Antonio Pérez Asso (Tony).

Natural History.—The Meseta de Cabo Cruz is a terraced limestone platform overlain by semideciduous hardwood forest and dry coastal forest. The average annual rainfall is below 1,200 mm. The type series was collected during the day on the ground and under limestone rocks up to 50 m inside the caves and near the entrances. Males called during the day from both exposed and concealed sites in the caves. Humidity inside the caves was high, and areas with frogs usually were moist.

The call of *E. tonyi* (Fig. 2A) consists of a

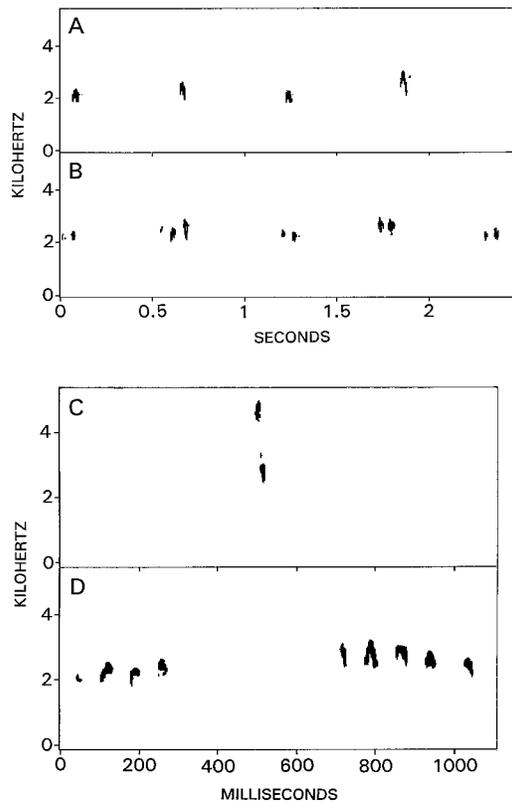


FIG. 2. Audiospectrograms (filter bandwidth 353 Hz) of Cuban *Eleutherodactylus*: (A) *E. tonyi* from the type locality, (B) *E. p. planirostris* from Ciudad de La Habana. (C) isolated double note of *E. tonyi*, (D) two trills of *E. p. planirostris*.

series of 2–4 (mean = 2.8 ± 0.12 ; $N = 19$) chirping notes similar to the call of *E. p. planirostris* (Fig. 2B). However, the mean dominant frequency of *E. tonyi* (mean = 2.29 ± 0.014 kHz; $N = 21$) is lower than that of *E. p. planirostris* (2.67 ± 0.03 kHz; $N = 18$); the note interval is larger (539.15 mS–1.122 S [mean = 766.24 mS], $N = 10$ in *E. tonyi* versus 25.6–51.1 [38.5] mS, $N = 9$, in *E. p. planirostris*), and the note duration is larger (26.3–52.7 [36.9] mS, $N = 21$, in *E. tonyi* versus 10.8–25.2 [18.3] mS, $N = 18$, in *E. p. planirostris*). The calls of *E. tonyi* were isolated chirps or groups of notes, although sometimes the males emitted a very isolated and brief call with two very closely spaced notes, the first higher in frequency (4–5 kHz) (Fig. 2C). Typical calls of *E. p. planirostris* are series of paired notes, with

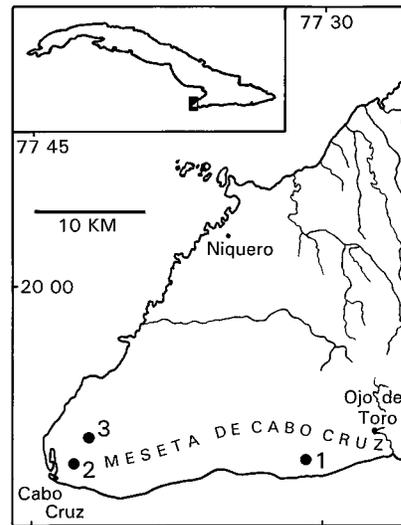


FIG. 3. Distribution of *Eleutherodactylus tonyi* in eastern Cuba (1) type locality, Cueva del Fustete, (2) Cueva del Guafe, (3) Cueva del Hueso (6 km E Monte Gordo).

occasional breaks into short trills with four or five notes each (Fig. 2D).

Distribution.—Known only from three caves on the limestone terraces of the Meseta de Cabo Cruz, at the extreme southwestern end of the Sierra Maestra in eastern (Oriente) Cuba (Fig. 3).

DISCUSSION

Two localities for *Eleutherodactylus p. planirostris*, Cabo Cruz (Schwartz and Henderson, 1991) and Ojo del Toro (see Appendix 1) are only a few km from known localities of *E. tonyi* (El Guafe, and Cueva del Fustete, respectively). Therefore, *E. tonyi* may be sympatric with *E. p. planirostris*, although it is unlikely that the two are syntopic. The former is known only from limestone cave habitats, whereas *E. p. planirostris* seems to prefer beach or lowland riparian situations (Schwartz, 1960; Schwartz and Henderson, 1991). The two species may occur together at caves along the south coast, adjacent to the beach.

There are two other subspecies of *E. planirostris* recognized from Cuba: *E. p. casparii* from the Sierra de Trinidad in central Cuba, and *E. p. goini* from upland areas in western Cuba (Schwartz and Henderson, 1991). We

have field experience with both of these taxa and believe that their status deserves re-evaluation.

Dunn (1926) described *E. casparii* as a full species and commented on its small size, long legs, and distinctive pattern compared with "*ricordii*" (= *planirostris*) from adjacent areas. Shreve (1945) associated the name *ricordi* with populations from Oriente, and noted "some evidence of hybridization" between *casparii* and *planirostris*, but did not identify specimens that exhibited intermediate characteristics. Subsequent workers (Schwartz, 1960; 1965; Schwartz and Henderson, 1991) did not find evidence of intergradation. In addition, *casparii* is unusual in its possession of green dorsal coloration (Schwartz, 1960). Schwartz (1965) commented "that *casparii* is a distinct form is unquestionable" and further suggested that its relationship to *planirostris* was "not so certain." Nonetheless, he chose to maintain *casparii* as a subspecies of *planirostris*, "*pro tem*." Because subsequent field work in the Sierra de Trinidad by us and others has failed to discover specimens intermediate between *casparii* and *planirostris*, and because of the close proximity of these taxa, we concur with Dunn's (1926) original assessment that *E. casparii* is a distinct species. It can be distinguished from *E. tonyi*, whose range is about 400 km to the east, by its smaller size, green dorsal coloration, and presence of groin markings.

Schwartz (1960) described *goini* as a subspecies of *ricordi* (= *planirostris*) from the Sierra del Rosario and Sierra de los Organos of western Cuba. It is considerably larger than *E. p. planirostris*, measuring up to 34 mm SVL (males) and 36 mm (females), compared with 19.9 mm and 26.9 mm, respectively, for Cuban *planirostris*. The difference is so great that there is essentially no overlap in the adult size ranges of the two taxa (Schwartz, 1960). Moreover, *planirostris* has the typical strong sexual dimorphism in body size characteristic of the genus (females are larger) whereas *goini* is only slightly dimorphic in body size. Such a lack of strong sexual dimorphism in body size is especially unusual in the subgenus *Euhyas* (Hedges, 1989). Additional traits noted by Schwartz (1960) are relatively lon-

ger legs and a much higher proportion (82%) of frogs with a striped dorsal pattern. Ecologically, *goini* is associated with rocky, montane areas, whereas *planirostris* typically occurs in lowland, riparian situations. The morphological differences apparently are not a simple reflection of elevation because *goini* also occurs in lowland areas adjacent to the mountains (e.g., San Diego de los Baños, 50 m).

Although Schwartz noted some slight geographic variation within *goini*, he could not identify intergrades between that taxon and *planirostris*. Likewise, subsequent collecting by us and others has failed to demonstrate intergradation. The distribution of *planirostris* surrounds that of *goini* on at least three sides, and localities of the two taxa are within 15 km of each other (Schwartz and Henderson, 1991). It is likely that sympatry occurs along the southern base of the cordillera (e.g., San Diego de los Baños). In light of the distinctiveness of *goini*, the close proximity of its range to that of *planirostris*, and lack of intergradation, we recognize the former taxon as a distinct species, *Eleutherodactylus goini*. It can be distinguished from *E. tonyi*, whose range is about 700 km to the east, by its larger body size, lack of strong sexual dimorphism in body size, and a relatively longer head (HL = HW versus HL < HW in *E. tonyi*).

With these taxonomic changes, the only remaining subspecies of *E. planirostris* is *E. p. rogersi* from the central Bahamas Bank (Goin, 1955; Schwartz and Henderson, 1991). It has been considered to be the least distinctive of the subspecies of *planirostris* (i.e., most similar to the nominate taxon; Schwartz, 1960, 1965), and it is not believed to be sympatric with *E. p. planirostris*. We have no additional information on the status of this taxon.

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APPENDIX 1

SPECIMENS EXAMINED

Eleutherodactylus p. planirostris.—Cuba: Ciudad de La Habana Prov., Fontanar, Boyeros (CARE 542-43), Víbora (CARE 012, 108, 248, 569-72, 574), Parque Forestal (CARE 149). Cienfuegos Prov.; Mina Carlota, Cumanayagua (MCZ 11201-08). Villa Clara Prov.; Buenos Aires, Santa Clara (MCZ 21926-27). Sancti Spíritus Prov.; Punta Judas Yaguajay (CARE 250). Ciego de Avila Prov.; Cayo Coco (CARE 691-692). Granma Prov., 2.4 km SE Ojo del Toro (USNM 509064), Santo Domingo (USNM 509060-61), 1.6 km N Camarón Grande (USNM 509062-63).