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Author(s): Juan M. Guayasamin, Diego Almeida-Reinoso, Fernando Nogales-Sornosa
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TWO NEW SPECIES OF FROGS (LEPTODACTYLIDAE: *ELEUTHERODACTYLUS*) FROM THE HIGH ANDES OF NORTHERN ECUADOR

JUAN M. GUAYASAMIN[1,4], DIEGO ALMEIDA-REINOSO[2], AND FERNANDO NOGALES-SORNOSA[3]

[1]*Natural History Museum & Biodiversity Research Center, Department of Ecology and Evolutionary Biology, The University of Kansas, Lawrence, KS 66045-7561, USA*
[2]*Universidad Central del Ecuador, Facultad de Filosofía, Letras y Ciencias de la Educación, Escuela de Biología y Química, Av. América, Quito, Ecuador*
[3]*Fundación Ecológica Arcoiris, Segundo Cueva Celi 03-15 y Clodoveo Carrión, Ciudadela Zamora, Loja, Ecuador*

ABSTRACT: We describe two new species of *Eleutherodactylus* that are hypothesized to belong to the *E. orcesi* Group. Both species are found in Andean habitats of northern Ecuador at elevations above 3000 m. The presence of an anteriorly exposed frontoparietal fontanelle distinguishes the two new species from most other members of the genus, in which the frontoparietal fontanelle is covered by frontoparietal bones. Additionally, both species have fingers and toes with fleshy lateral fringes, and vomerine teeth reduced or absent. The new species differ from one another mostly by tuberculation and coloration patterns.

Key words: Andes; Ecuador; *Eleutherodactylus orcesi*; Leptodactylidae; New species.

THE *ELEUTHERODACTYLUS ORCESI* GROUP was recognized by Lynch (1981) for an assemblage of species distributed in the high Andes (>3000 m) of Colombia and Ecuador. The only diagnostic feature cited for the group was the presence of an anteriorly exposed frontoparietal fontanelle (Lynch et al., 1996). Currently, the *Eleutherodactylus orcesi* Group contains six species: *E. obmutescens* Lynch 1980, *E. orcesi* Lynch 1972, *E. racemus* Lynch 1980, *E. simoteriscus* Lynch et al. 1996, *E. simoterus* Lynch 1980, and *E. thymelensis* Lynch 1972. All of these species live in paramos at elevations of 3000–4150 m and replace one another along the geographic axis of the Andes of Colombia and Ecuador (Lynch, 1981; Lynch et al., 1997). If the group is monophyletic, its pattern of distribution is congruent with an allopatric mode of speciation (Lynch et al., 1997).

It is not surprising that fieldwork in poorly collected Andean localities results in the discovery of undescribed species. Herpetological expeditions by Oxford University of UK in cooperation with the Pontificia Universidad Católica del Ecuador and the Universidad Central del Ecuador to localities in montane forests and paramo in the Andes of northern Ecuador have revealed two more species of the *Eleutherodactylus orcesi* Group. Herein, we describe these newly discovered species.

MATERIALS AND METHODS

Specimens were euthanized in the field by immersion in chloretone, fixed in 10% formalin, and preserved in 70% ethanol, as suggested by Simmons (2002). We examined alcohol-preserved specimens of frogs from the herpetological collections at Museo de Zoología of the Universidad Católica del Ecuador (QCAZ), Natural History Museum of The University of Kansas (KU), and Instituto de Ciencias Naturales of the Universidad Nacional de Colombia (ICN). In addition to the type series of the two new species, specimens examined are listed in Appendix I. Morphological measurements were taken as described in Guayasamin (2004) and are: (1) snout–vent length (SVL); (2) tibia length; (3) foot length; (4) head length; (5) head width; (6) interorbital distance; (7) upper eyelid width; (8) internarial distance; (9) eye-to-nostril distance; (10) snout-to-eye distance; (11) eye diameter; (12) tympanum diameter; (13) eye-to-tympanum distance; (14) radioulna length; (15) hand length; (16) Finger-I length. Sexual maturity was determined by the presence of eggs or convoluted oviducts in females and by the presence of vocal slits in males. For ease of comparison,

[4] CORRESPONDENCE: e-mail, juanm@ku.edu

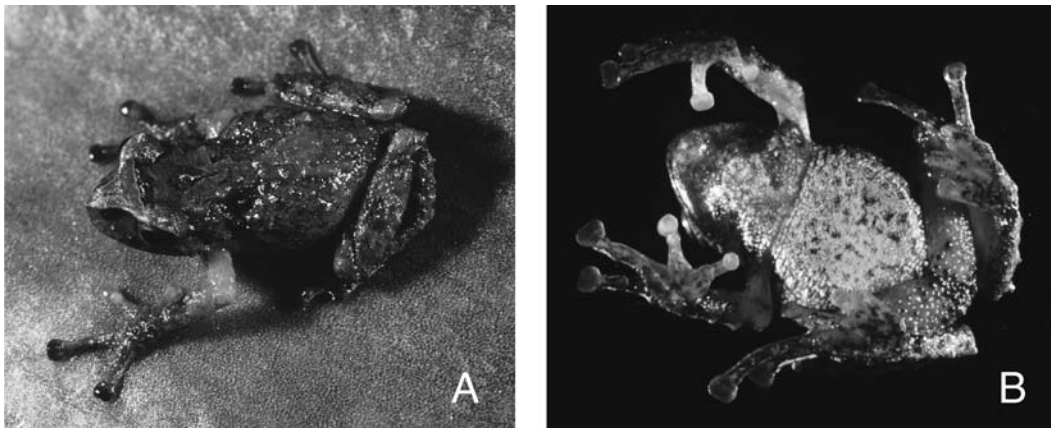

FIG. 1.—Dorsal (A) and ventral (B) views of paratype of *Eleutherodactylus huicundo*, QCAZ 15394, SVL = 19.8 mm, male.

the diagnosis and description of the new species follow those of Lynch and Duellman (1997). Terminology for digital disc features is that described by Savage (1987, 1997).

SYSTEMATICS

Eleutherodactylus ***huicundo*** sp. nov.

Figs. 1–4, 8

Holotype.—QCAZ 14753, an adult female, collected by Diego Almeida near El Playón de San Francisco (approx. 77°40′ W, 00°38′ N; elevation 3400 m), Provincia Sucumbíos, Ecuador, on 26 August 2000.

Paratypes.—All paratypes were collected near El Playón de San Francisco and have the same data as holotype, except as follows: QCAZ 14751, an adult male collected by Fernando Nogales at an elevation of 3600 m; QCAZ 14752, an adult female collected by Fernando Nogales; QCAZ 14745–46, adult females collected by Diego Almeida at an elevation of 3350 m; QCAZ 14747, an adult male collected by Fernando Nogales at an elevation of 3700 m; QCAZ 14754, an adult male collected by Nora Schultz; QCAZ 14768, an adult female collected by Diego Almeida; QCAZ 15391, an adult female collected by Juan M. Guayasamin, Elisa A. Bonaccorso, and Diego Almeida on 5 June 2001; QCAZ 15392, QCAZ 15394, adult males collected by Elisa A. Bonaccorso, Juan M. Guayasamin, and Diego Almeida at an elevation of 3400–3600 m on 5 June 2001; QCAZ 14748–50, juveniles collected by Nora Schultz at an elevation of 3229–3240 m on August 2000; and QCAZ 15395, juvenile collected by Diego Almeida, Juan M. Guayasamin, and Élisa A. Bonaccorso at an elevation of 3400–3600 m on 5 June 2001.

Diagnosis.—Eleutherodactylus huicundo, as other species in the *Eleutherodactylus* (*Eleutherodactylus*) *orcesi* Group, has an anteriorly exposed frontoparietal fontanelle. Additionally, *E. huicundo* is diagnosed by having: (1) skin of dorsum shagreen to warty, that of flanks with some flat warts, venter areolate, dorsolateral folds absent; (2) tympanic annulus evident, round, 36.4–48.0% of eye length ($\bar{x}$ = 42.8 ± 3.1, n = 11), tympanic membrane poorly defined; (3) eye-to-nostril distance 64.7–86.2% eye length ($\bar{x}$ = 74.5 ± 6.7, n = 11); snout rounded in dorsal view, angular in lateral view, usually with papilla at tip (Figs. 3, 8); (4) upper eyelid narrower than interorbital space, with some low tubercles and one enlarged, non-conical tubercle; cranial crests absent; (5) vomerine teeth absent or reduced and difficult to see; (6) males with vocal slits and median subgular vocal sac, nuptial pads absent; (7) Finger I shorter than Finger II, fingers with expanded discs (Fig. 4); (8) fingers with fleshy lateral fringes (Fig. 4); (9) ulnar tubercles small, two or three in number; (10) heel with one enlarged non-conical tubercle; tarsus with two or three tubercles along outer edge; (11) two metatarsal tubercles prominent, inner oval, two to three times size of subconical outer tubercle; supernumerary plantar tubercles numerous (Fig. 4); (12) toes with

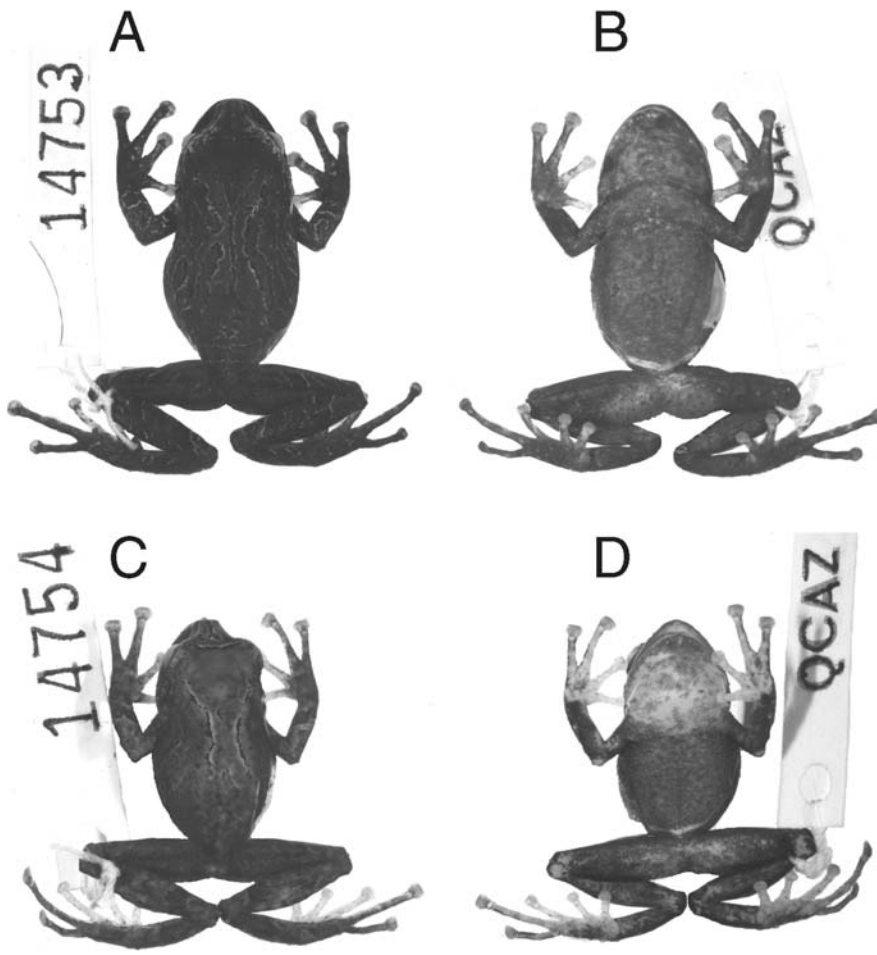

FIG. 2.—Dorsal and ventral views of holotype (A, B) of *Eleutherodactylus huicundo*, QCAZ 14753, SVL = 28.4 mm, female, and of paratype (C, D) QCAZ 15394, SVL = 19.8 mm, male.

fleshy lateral fringes (Fig. 4); (13) in ethanol, dorsum usually gray to dark gray with darker markings outlined with thin black and white lines; throat and venter gray to dark gray or dark brown with small darker spots; palmar and plantar surfaces dark gray with Fingers I and II being paler (Figs. 2, 4); and (14) adults small, males 19.8–21.3 mm SVL ($\bar{x}$ = 20.6 ± 0.6, n = 5), females 23.2–28.7 mm SVL ($\bar{x}$ = 25.7 ± 2.3, n = 6).

Comparison with similar species.—The presence of an anteriorly exposed frontoparietal fontanelle distinguishes the species of the *Eleutherodactylus orcesi* Group from most other members of the genus, in which the frontoparietal fontanelle is covered by frontoparietal bones (Lynch, 1971; Lynch et al., 1996). Differences among species in the *E. orcesi* Group are in Table 1. Additionally, *E. huicundo* is distinguished from *E. ortizi* sp. nov. by having tarsal tubercles (usually absent in *E. ortizi*); males of *E. huicundo* have shagreen to warty flanks (areolate in males and females of *E. ortizi*) and pronounced tubercles on the upper eyelid, forearm, heel, and tarsus (tubercles small or absent in males and females of *E. ortizi*). *Eleutherodactylus huicundo* differs from *E. orcesi*, *E. simoteriscus* and *E. simoterus* by having tubercles on upper eyelid, forearm, and tarsus (absent in *E. orcesi*, *E. simoteriscus* and *E. simoterus*; Lynch, 1980, Lynch et al., 1996); from *E. racemus* by the presence of canthal and supratympanic stripes (absent in *E. racemus*);

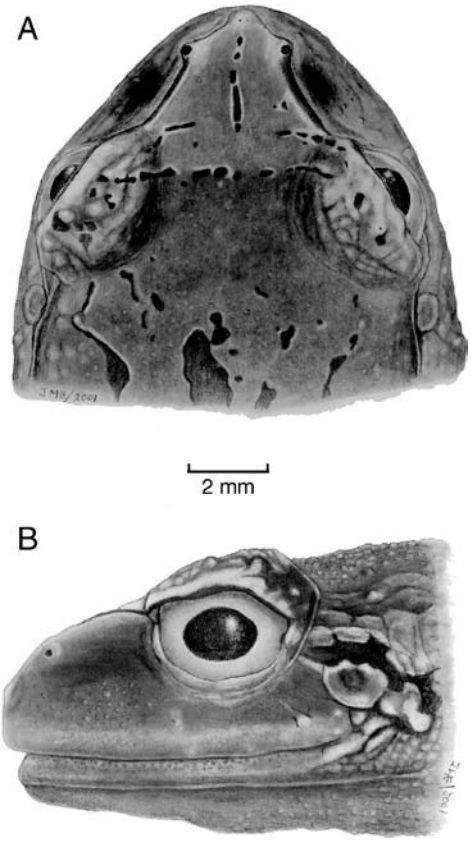

FIG. 3.—Dorsal (A) and lateral (B) views of head of holotype of *Eleutherodactylus huicundo*, QCAZ 14753, SVL = 28.4 mm, female.

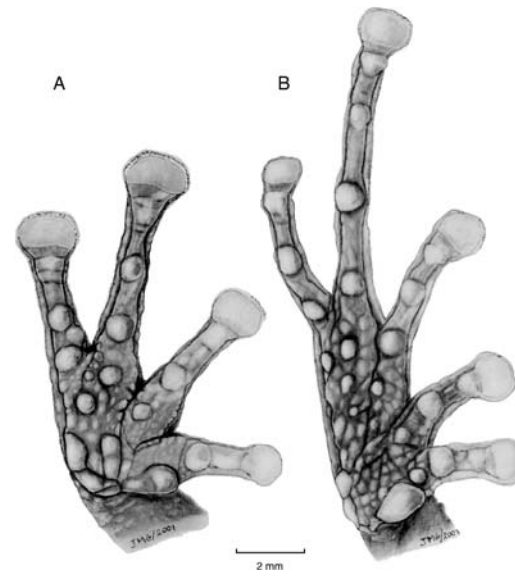

FIG. 4.—Ventral view of right hand (A) and foot (B) of holotype of *Eleutherodactylus huicundo*, QCAZ 14753, SVL = 28.4 mm, female.

and by having ulnar and tarsal tubercles (absent in *E. racemus*), and from *E. thymelensis* by lacking paravertebral ridges (present in *E. thymelensis*).

Description of holotype.—Adult female (QCAZ 14753) with head narrower than widest part of body; head wider than long (head length 88.1% head width); snout rounded in dorsal view and angular in lateral view, relatively short (snout-to-eye distance 16.1% SVL, <20% SVL), with small papilla at tip (Fig. 3); in lateral view, canthus rostralis distinct (Fig. 3); loreal region concave; nostrils slightly protuberant, directed laterally; interorbital area flat, broader than upper eyelid (upper eyelid width 71.9% interorbital distance); cranial crests absent; upper eyelid bearing one enlarged, nonconical tubercle; tympanic membrane ill-defined, paler than surrounding skin; tympanic annulus distinct, round; supratympanic fold obscuring upper and posterodorsal edges of annulus (Fig. 3); tympanum diameter 42.9% eye length; one enlarged, nonconical postrictal tubercle. Choanae small, nearly elliptical, not concealed by palatal shelf of maxillary; dentigerous process of the vomer oblique, widely separated, posteromedial to choanae, each bearing 0–3 small teeth; shortest distance between dentigerous processes 32.4% distance between choanae; tongue longer than wide, granular, with small notch in posterior border.

Skin of head shagreen with one small interorbital tubercle; dorsum shagreen, with small tubercles in scapular and sacral regions, and posterior to eye; dorsolateral folds absent; flanks with some large flat warts; venter areolate, with warty pelvic patch; discoidal fold not well-defined; anal sheath absent. Forearm slender; radio-ulna length 25.4% SVL; white flecks denote three low ulnar tubercles; ulnar fold absent; hand length longer than radio-ulna length (hand length 34.2% SVL); fingers with fleshy lateral fringes that join at base to form basal web; finger lengths I < II < IV < III; palmar tubercle bifid, thenar tubercle oval (Fig. 4); subarticular tubercles round, prominent; supernumerary

TABLE 1.—Comparison of coloration and morphological characters among species of the *Eleutherodactylus orcesi* Group. SVL in mm. Ventral coloration for specimens preserved in alcohol.

	SVL males	SVL females	Tympanic annulus	Vocal slits in males	Ventral coloration	Source
E. huicundo	19.8–21.3	23.2–28.7	Visible	Present	Gray to dark gray or dark brown	This work
E. obmutescens	21.4–26.6	28.5–38.4	Not visible	Absent	Cream with reticulation to gray	Lynch, 1980
E. orcesi	23.9–29.6	35.2–36.1	Visible	Present	Pale brown	Lynch, 1972, 1981
E. ortizi	18.1–24.7	24.3–29.2	Visible	Present	White with or without spots and/or reticulation	This work
E. racemus	25.2–30.2	29.9–37.9	Visible	Absent	White with brown spots and reticulation	Lynch, 1980
E. simoteriscus	23.1–25.1	25.7–31.4	Visible	Absent	Pale brown	Lynch et al., 1996
E. simoterus	25.9–32.7	31.4–39.0	Visible	Present	Reddish-brown to black	Lynch et al., 1996
E. thymelensis	21.4–25.2	28.0–33.5	Not visible	Present	Gray to brown, with black marks	Lynch, 1972, 1981

palmar tubercles numerous and conspicuous (Fig. 4); disc cover of Finger I slightly expanded; those of Fingers II–IV expanded (Fig. 4); outer discs of fingers larger than those of toes; all disc covers with elliptical ventral pads defined by grooves.

Hind limbs relatively slender; tibia length 50.0% SVL; foot length about same as tibia length; white flecks on three low tubercles on tarsus; heel with enlarged nonconical tubercle; toes with fleshy lateral fringes that join at base to form basal web (Fig. 4); subarticular tubercles round, prominent; inner metatarsal tubercle oval, two to three times size of subconical outer tubercle; supernumerary plantar tubercles prominent and numerous (Fig. 4); all disc covers expanded; toes with defined pads; disc pads nearly elliptical; toe lengths I < II < III < V < IV (Fig. 4); tip of Toe V reaching proximal border of distal subarticular tubercle of Toe IV; tip of Toe III reaching distal border of medial subarticular tubercle of Toe IV.

Color in ethanol of holotype (Figs. 2A, B, 3).—Dorsum and flanks dark gray with darker gray markings narrowly outlined with black inner and outer white lines. Interorbital, canthal, and supratympanic stripes black; anterior border of black interorbital stripe outlined by narrower white stripe. Outer edge of upper eyelid with white stripe that extends along canthus rostralis to tip of snout. Area limited by interorbital and canthal stripes paler than rest of dorsum. Two weakly defined, thin, grayish white labial bars below eye. Limbs with four transverse, dark gray bars outlined by narrow white lines. Groin dark brownish gray with minute white spots. Posterior surfaces of thighs dark gray with minute cream spots. Throat and venter grayish brown with small dark brown spots; pelvic patch gray. Palmar and plantar surfaces dark gray. Dorsal and ventral surfaces of Fingers I and II cream, and Fingers III and IV dark gray. Dorsal and ventral surfaces of Toes I–III cream, and Toes IV and V dark gray.

Measurements of holotype (mm).—SVL = 26.1; tibia length = 14.2; foot length = 14.4; head length = 8.9; head width = 10.1; upper eyelid width = 2.3; interorbital distance = 3.2; eye diameter = 2.9; eye-to-nostril distance = 2.5; snout-to-eye distance = 4.2; tympanum diameter = 1.2; eye-to-tympanum distance = 1.2; internarial distance = 2.1; radio-ulna length = 7.0; hand length = 9.4; and Finger-I length = 5.8.

Variation in external morphology.—Variation in measurements and proportions is given in Tables 1 and 2. Other variation is as follows: upper eyelid with subconical tubercle (2 males) or no tubercle (1 female); tympanic membrane not evident (1 female); vomerine teeth absent (3 females) or only one tooth visible (1 female, 1 male); tongue without notch in posterior border (1 female); dorsum without tubercles (1 female), or with some flat warts (1 male); flanks shagreen, without warts (2 males) or with small but pronounced warts (1 male); tubercles on tarsus, heel, and ulna enlarged (1 male); supernumerary tubercles on palms and soles less evident (1 female, 2 males). Usually, tubercles on eyelid, ulna, heel, and tarsus are more pronounced in males than in females.

TABLE 2.—Measurements of adult males and females of *Eleutherodactylus huicundo* (mean ± standard deviation, followed by range; in mm).

Character	Males (n = 5)	Females (n = 6)
SVL	20.6 ± 0.6	25.7 ± 2.3
	19.8–21.3	23.2–28.7
Tibia length	11.7 ± 0.6	13.7 ± 0.6
	11.0–12.5	12.8–14.2
Foot length	11.6 ± 1.0	13.5 ± 1.2
	10.5–12.8	11.5–14.6
Head length	7.6 ± 0.6	9.4 ± 0.6
	6.8–8.2	8.9–10.4
Head width	8.3 ± 0.3	9.8 ± 0.6
	7.8–8.7	8.9–10.7
Upper-eyelid width	2.1 ± 0.2	2.4 ± 0.1
	1.9–2.3	2.2–2.6
Interorbital distance	2.7 ± 0.2	3.1 ± 0.2
	2.5–3.0	2.9–3.4
Eye length	2.7 ± 0.2	3.3 ± 0.3
	2.4–2.9	2.9–3.7
Eye-to-nostril distance	2.0 ± 0.2	2.5 ± 0.1
	1.7–2.2	2.2–2.5
Snout-to-eye distance	3.3 ± 0.3	4.1 ± 0.3
	3.0–3.8	3.5–4.4
Tympanum diameter	1.2 ± 0.1	1.4 ± 0.2
	1.1–1.3	1.2–1.6
Eye-to-tympanum distance	0.9 ± 0.1	1.2 ± 0.2
	0.7–1.0	0.9–1.4
Internarial distance	1.8 ± 0.1	2.1 ± 0.2
	1.6–2.0	2.0–2.4
Radio-ulna length	5.9 ± 0.3	6.8 ± 0.5
	5.5–6.2	6.2–7.4
Hand length	7.4 ± 0.7	8.9 ± 0.6
	6.7–8.2	8.0–9.7
Finger-I length	4.5 ± 0.4	5.6 ± 0.4
	4.0–5.1	4.9–6.0

Color variation (in ethanol).—Based on five adult males and six adult females (paratypes). Labial bars clearly defined (1 male) or absent (1 male). Dorsum from brownish gray to brownish orange; marks on dorsum not outlined by black and white lines (1 female; 1 male); dorsum and flanks with pale yellowish-white warts (1 male). Throat and venter from grayish cream to dark brownish-gray with or without dark gray marks. Undersides of limbs cream (1 female) or cream with pale yellowish warts and minute dark gray spots (1 male). Groin and posterior surfaces of thighs brown with minute cream spots (1 female) or cream with minute black spots (3 males). Tarsal tubercles not pigmented with white (2 females). Palmar and plantar surfaces cream (1 male). Usually, females have a darker coloration than males.

Color in life.—Color in life for three individuals is as follows:

QCAZ 15391: Iris golden brown with fine black reticulation and dark brown horizontal streak; dorsum greenish brown with darker brown markings outlined with narrow black and pale brown lines; white stripe in outer edge of upper eyelid; interorbital, canthal, and supratympanic stripes dark brown; two narrow, white labial bars below eye; tympanum pale brown; bars in hind and forelimbs weakly defined; groin gray; posterior surfaces of thighs dark gray; throat and venter cream gray with small dark brown spots; palmar and planar surfaces dark gray; dorsal and ventral surfaces of Fingers I and II orange yellow, and Fingers III and IV brown; dorsal and ventral surfaces of Toes I–III orange-yellow, and Toes IV and V brown.

QCAZ 15394 (adult male): Same as QCAZ 15391, except dorsum uniformly orange-brown; flanks light green-gray; groin and anterior and posterior surfaces of thighs mustard-yellow; throat light yellow-gray; venter greenish yellow with light and dark brown marks.

QCAZ 15392 (adult male): Same as QCAZ 15391, except middorsal blotch green; flanks brown with small cream spots; interorbital, canthal, and supratympanic strip reddish brown; labial bars absent; no bars on limbs; groin and posterior surfaces of thighs yellow; throat gray (red when male was calling); venter cream with dark brown warts; palmar and planar surfaces dark orange-brown; dorsal and ventral surfaces of Fingers I and II orange, and Fingers III and IV orange-brown; dorsal and ventral surfaces of Toes I–III orange, and Toes IV–V orange-brown.

Natural history.—Eleutherodactylus huicundo occurs in Bosque Siempre Verde Montano Alto (High Montane Evergreen Forest) and Páramo de Frailejones (paramo dominated by the plant species *Espeletia pycnophylla* ssp. *angelensis*), as defined by Valencia et al. (1999). Individuals were found at night mostly on terrestrial and epiphytic bromeliads (7 of 11 individuals), branches, and leaves, 30–230 cm ($\bar{x}$ = 105.6 ± 71.8, n = 11) above the ground. At the time of collection (August, 2000; June 2001), three females (QCAZ 14746, 14752–53) had mature eggs, two males (QCAZ 15392, 15394) were heard

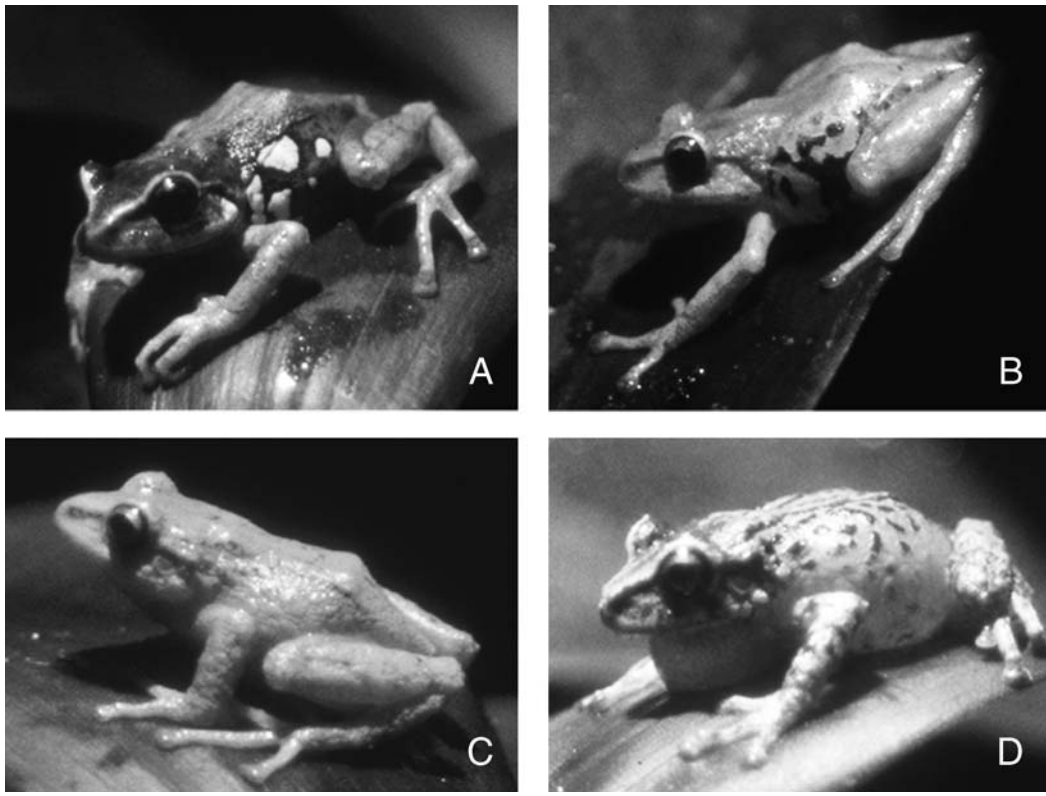

FIG. 5.—*Eleutherodactylus ortizi*. (A) QCAZ 14777, SVL = 24.3 mm, female. (B) Non-collected individual. (C) QCAZ 14789, SVL = 19.8 mm, male. (D) QCAZ 14783, SVL = 20.9 mm, male.

calling, and three juveniles (QCAZ 14748–50) were found.

Distribution.—Eleutherodactylus huicundo is known only from the montane forest and paramo in the vicinity of El Playón de San Francisco (approx. 77° 37′45″ W, 00° 37′50″ N) at elevations of 3229–3700 m, Provincia Sucumbíos, Cordillera Oriental of the Andes of northern Ecuador (Fig. 11). The proximity of El Playón de San Francisco to the Colombian border (<5 km) almost assures that *E. huicundo* also occurs in Colombia.

Etymology.—In the quichua language, *huicundo* refers to any plant that has the general form of a bromeliad. We use the specific name *huicundo* as a noun in apposition that indicates the preference of the species to bromeliads.

Eleutherodactylus ***ortizi*** sp. nov.

Figs. 5–10

Holotype.—QCAZ 16313, an adult female, collected by Diego Almeida near Nueva América (77° 58′54″ W, 00° 15′34″ N; elevation 3420 m), Provincia Imbabura, Ecuador, on July 2001.

Paratypes.—Same data as holotype, except: QCAZ 14777, 14780, 14790, adult females, collected by Fernando Nogales on 10–14 July 2000; QCAZ 14792, adult female, collected by Diego Almeida on 01 August 2000; QCAZ 14793, adult female, collected by Diego Almeida on 12 July 2000; QCAZ 14778, adult male, collected by Fernando Nogales on 14 July 2000; QCAZ 14782–4, adult male, collected by Fernando Nogales on 10–14 July 2000; QCAZ 14786, adult male, collected by Diego Almeida on 19 August 2000; QCAZ 14787, adult male, collected by Fernando Nogales on 2 August 2000; QCAZ 14788, adult male, collected by Diego Almeida on 3 August 2000; QCAZ 14789, adult male, collected by Diego Almeida on 11 July 2000; QCAZ 14805, adult male, collected by Fernando Nogales on 1 August 2000; QCAZ 16310–2, adult males, collected by Fernando Nogales on July 2001.

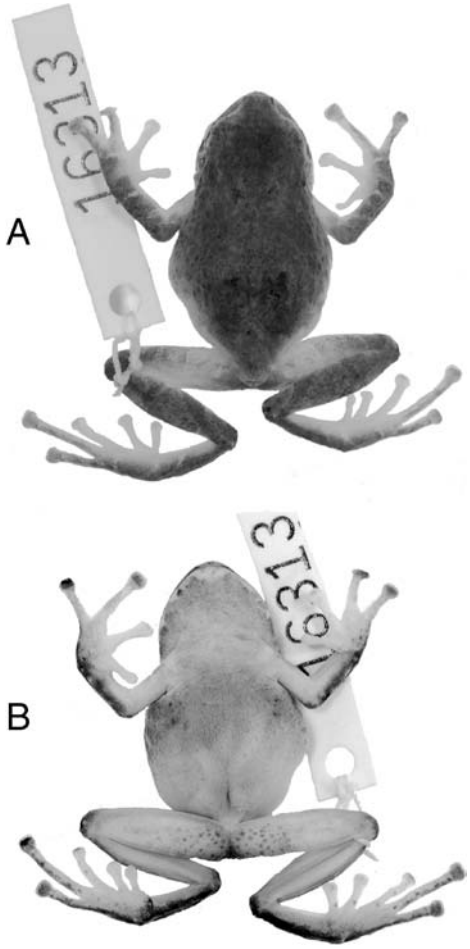

FIG. 6.—Dorsal (A) and ventral (B) views of holotype of *Eleutherodactylus ortizi*, QCAZ 16313, SVL = 29.2 mm, female.

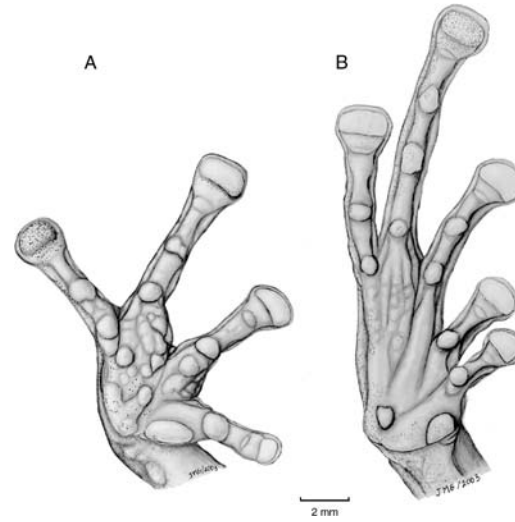

FIG. 7.—Ventral view of right hand (A) and foot (B) of holotype of *Eleutherodactylus ortizi*, QCAZ 16313, SVL = 29.2 mm, female.

QCAZ 14763, adult male, collected by Diego Almeida near El Chamizo (77° 46′03″ W, 00° 29′35″ N; elevation 3264 m), Provincia de Carchi, Ecuador, on 20 July 2001; QCAZ 14765–6, 14769, adult males, collected by Diego Almeida and Benjamin McCormick near El Chamizo on 17–19 July 2000; and QCAZ 14770–72, adult males, collected by Diego Almeida, Benjamin McCormick, and Fernando Nogales near El Chamizo on 6–7 August 2000.

Diagnosis.—Eleutherodactylus ortizi has an anteriorly exposed frontoparietal fontanelle. Additionally, *E. ortizi* is diagnosed by having (1) skin of dorsum shagreen; flanks in females with numerous flat warts, in males areolate; venter areolate, dorsolateral folds absent; (2) tympanic annulus evident, round, 23.1–46.4% of eye length ($\bar{x}$ = 36.6 ± 5.4, n = 26), tympanic membrane poorly-defined; (3) eye-to-nostril distance 59.4–81.5% eye length ($\bar{x}$ = 69.6 ± 5.5, n = 26); snout rounded in dorsal and lateral views, without papilla at tip (Fig. 5); (4) upper eyelid narrower than interorbital space, with or without one small tubercle; cranial crests absent; (5) vomerine teeth absent or reduced and difficult to see; (6) males with vocal slits and median subgular vocal sac; nuptial pads absent; (7) Finger I shorter than Finger II, fingers with expanded discs (Fig. 7); (8) fingers with fleshy lateral fringes (Fig. 7); (9) ulnar tubercles usually absent, if present small; (10) heel usually with one small tubercle; tarsus without tubercles on outer edge; (11) two prominent metatarsal tubercles, inner oval, two to three times size of subconical outer tubercles; supernumerary plantar tubercles usually low and difficult to see (Fig. 7); (12) toes with fleshy lateral fringes (Fig. 7); (13) in ethanol, dorsum usually uniform gray to brown; interorbital and canthal stripes gray to brown; white stripe in outer edge of eyelid and canthus rostralis; labial bars and bars on limbs usually absent; throat whitish cream; venter uniform whitish cream to cream with dark gray reticular pattern; groin and posterior surfaces of thighs

usually whitish cream; palmar and plantar surfaces whitish cream (Figs. 6, 7); (14) adults small, males 18.1–24.7 mm SVL ($\bar{x}$ = 21.6 ± 1.7, n = 19), females 24.3–29.2 mm SVL ($\bar{x}$ = 26.7 ± 1.8, n = 7).

Comparison with similar species.—Species of the *Eleutherodactylus orcesi* Group differ from most other *Eleutherodactylus* by having an anteriorly exposed frontoparietal fontanelle (Lynch et al., 1996). Characters that distinguish species of the *E. orcesi* Group are presented in Table 1. Additionally, *Eleutherodactylus ortizi* differs from *E. obmutescens* by having a gray to brown dorsum (dark brown in *E. obmutescens*); from *E. orcesi* by having a shagreen dorsum (areolate in *E. orcesi*); and from *E. racemus* by having a canthal stripe (absent in *E. racemus*). *Eleutherodactylus ortizi* differs from *E. simoteriscus* by having vocal slits (absent in *E. simoteriscus*; Lynch et al., 1996) and a mostly cream venter (venter pale brown in *E. simoteriscus*; Lynch et al., 1996); from *E. simoterus* by having relatively large discs on fingers (discs relatively small in *E. simoterus*; Lynch, 1980) and by lacking warts on dorsum (present in *E. simoterus*; Lynch, 1980); from *E. thymelensis* by lacking paravertebral ridges (present in *E. thymelensis*); and from *E. huicundo* sp. nov. by usually lacking tarsal tubercles (present in *E. huicundo*). Males of *E. ortizi* have areolate flanks (flanks shagreen to warty in *E. huicundo*) and small or non-evident tubercles on eyelid, ulna, and heel (tubercles pronounced in males of *E. huicundo*).

Description of holotype.—Adult female (QCAZ 16313) with head narrower than body; head wider than long (head length 94% head width); snout round in dorsal and lateral views, relatively short (snout-to-eye distance 16.1% SVL; <20% SVL), without papilla at tip; canthus rostralis distinct; loreal region concave; nostrils slightly protuberant, directed laterally; interorbital area flat, broader than upper eyelid (upper eyelid width 86.1% interorbital distance); cranial crests absent; upper eyelid bearing one small tubercle; tympanic membrane not visible; anteroventral half of tympanum distinct; supratympanic fold obscures dorsal and posterodorsal borders of tympanum; tympanum diameter 41.0% eye length; one postrictal tubercle enlarged, nonconical. Choanae small, nearly elliptical, not concealed by palatal shelf of maxillary; dentigerous process of vomer oblique, posteromedial to choanae, bearing 1–3 teeth each; shortest distance between dentigerous processes 36.3% distance between choanae; tongue longer than wide, granular; posterior border of tongue with small notch.

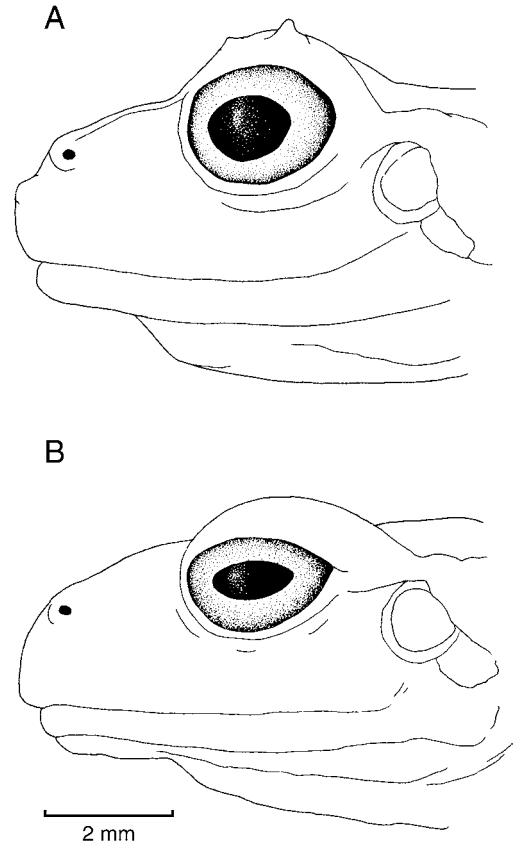

FIG. 8.—Lateral view of head of males of *Eleutherodactylus huicundo* (A) QCAZ 14754, SVL = 21.3 mm, and of *E. ortizi* (B) QCAZ 16310, SVL = 23.7 mm.

Skin of head and dorsum of body shagreen; dorsolateral folds absent; flanks with numerous large flat warts; venter areolate, with warty pelvic patch; discoidal fold not well defined; anal sheath absent. Forearm slender; radio-ulna length 26.0% SVL; antebrachial tubercle and tubercle on elbow small; ulnar tubercles small and barely distinguishable; ulnar fold absent; hand longer than radio-ulna length (hand length 36.4% SVL); fingers with fleshy lateral fringes joining at base to form basal web; fingers lengths I < II < IV < III; palmar tubercle bifid, thenar tubercle oval (Fig. 7);

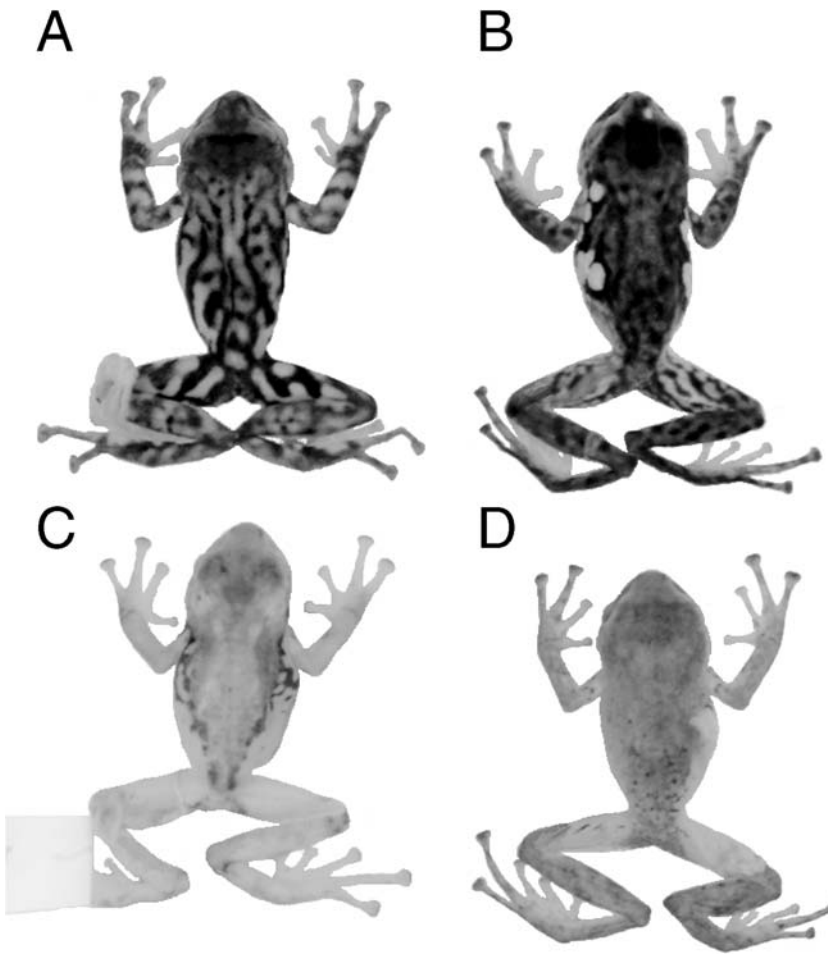

FIG. 9.—Color variation in adult males of *Eleutherodactylus ortizi*. Dorsal view of (A) QCAZ 14763, SVL = 23.6 mm; (B) QCAZ 14778, SVL = 23.1 mm; (C) QCAZ 14782, SVL = 23.1 mm; and (D) QCAZ 14787, SVL = 21.2 mm.

subarticular tubercles round, prominent; supernumerary palmar tubercles present (Fig. 7); disc cover on Finger I not well developed, those of Fingers II–IV expanded (Fig. 7); outer disc covers of fingers larger than those of toes; all disc covers with elliptical ventral disc pads defined by grooves (Fig. 7).

Hind limbs slender; tibia length 52.1% SVL; foot slightly shorter than tibia (foot length 96.1% tibia length); tarsal tubercles absent; heel with small tubercle; toes with fleshy lateral fringes joining at base to form basal web (Fig. 7); subarticular tubercles round, prominent; inner metatarsal tubercle oval, about twice the size of subconical outer tubercle; supernumerary plantar tubercles poorly defined (Fig. 7); all disc covers expanded; toes with defined pads; disc pads nearly elliptical; Toe lengths I < II < III < V < IV (Fig. 7); tip of Toe V reaching proximal border of distal subarticular tubercle of Toe IV; Toe III reaching distal border of medial subarticular tubercle of Toe IV.

Color in ethanol of holotype (Fig. 6).—Dorsum uniform gray; flanks paler than dorsum. Interorbital and canthal stripes faint, supratympanic stripe absent; two labial bars below eye poorly defined. White stripe on outer edge of upper eyelid continuous along canthus rostralis to tip of snout. Area limited by interorbital and canthal stripes paler than rest of dorsum. Limbs uniform gray, without bars. Groin, anterior and posterior surfaces of thighs, throat, venter, undersides of limbs, and

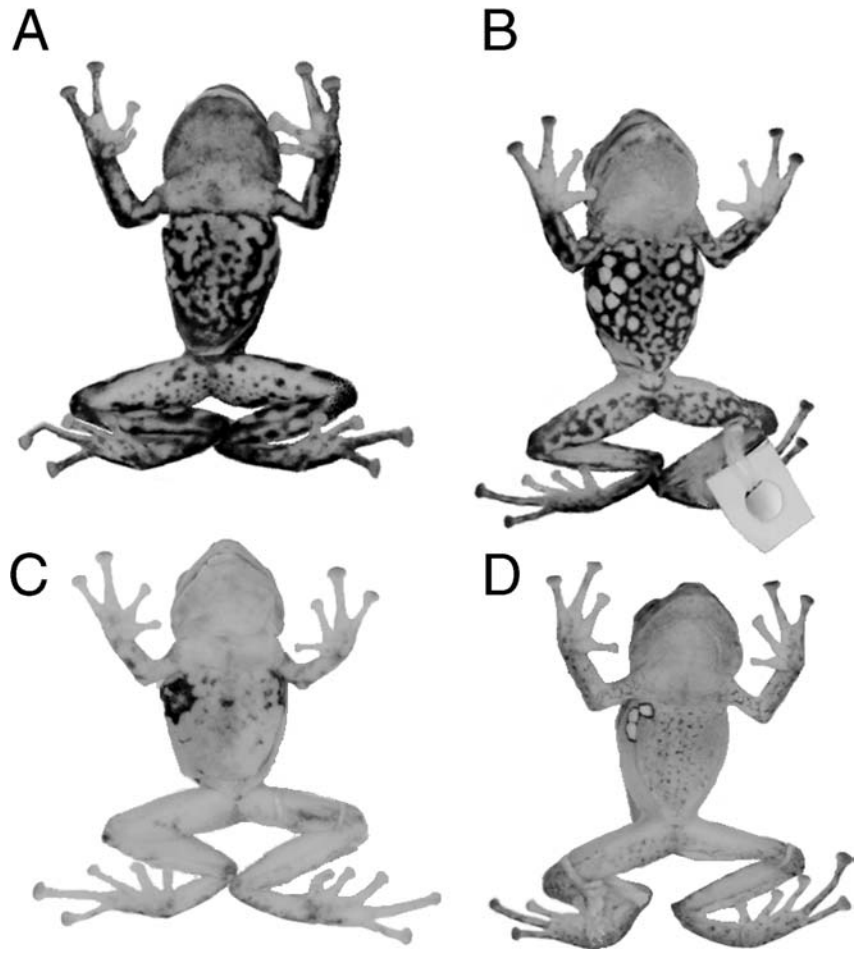

FIG. 10.—Color variation in adult males of *Eleutherodactylus ortizi*. Ventral view of (A) QCAZ 14763, SVL = 23.6 mm; (B) QCAZ 14778, SVL = 23.1 mm; (C) QCAZ 14782, SVL = 23.1 mm; and (D) QCAZ 14787, SVL = 21.2 mm.

palmar and plantar surfaces whitish cream; ventral surface of discs of Fingers I and II, and Toes IV and V dark gray (Fig. 6).

Measurements of holotype (mm).—SVL = 29.2; tibia length = 15.2; foot length = 14.6; head length = 11.0; head width = 11.7; upper eyelid width = 3.1; interorbital distance = 3.6; eye diameter = 3.9; eye-to-nostril distance = 2.6; snout-to-eye distance = 4.7; tympanum diameter = 1.6; eye-to-tympanum distance = 0.9; internarial distance = 2.6; radio-ulna length = 7.6; hand length = 10.6; and Finger-I length = 6.7.

Variation in external morphology.—Variation in morphological measurements and proportions is given in Tables 2 and 3. Based on 19 males and 7 females, other variation is as follows: flanks areolate (all males) or with flat warts (1 female); small papilla at tip of snout (1 male); no tubercle on upper eyelid (2 females; 10 males); one or two vomerine teeth visible (4 males); pronounced notch on posterior border of tongue (1 female, 2 males), or without notch (1 male); no ulnar tubercles (1 female, 6 males); no antebrachial tubercle and tubercle on elbow (2 females, 6 males); no tubercle on heel (1 female, 9 males), or three small tubercles on heel (1 female); small tarsal tubercles (3 males).

Color variation (in ethanol).—Eleutherodactylus ortizi is remarkably variable. Some of color patterns that differ from the holotype

TABLE 3.—Proportions (in percentages) of adult males and females of *Eleutherodactylus huicundo*.

Characters	Males (n = 5)	Females (n = 6)
Head width/SVL	38.6–41.4	34.8–41.6
Head length/SVL	34.3–39.6	34.5–39.7
Head width/Head length	97.5–120.6	96.7–113.5
Eye-to-nostril distance/Eye length	70.8–76.0	64.7–86.2
Eyelid width/Interorbital distance	73.3–88.5	70.6–83.9
Tympanum diameter/Eye length	41.4–48.0	36.4–44.8
Radio-ulna length/SVL	26.6–29.7	25.4–28.8
Hand length/SVL	33.2–38.7	31.0–38.7
Tibia length/SVL	55.6–58.7	48.1–58.4
Hand length/Radio-ulna length	111.7–136.7	120.3–140.6
Foot length/Tibia length	94.8–104.1	87.8–102.8
Foot length/SVL	53.0–60.1	46.7–59.3
Finger-I length/Hand length	57.3–62.3	61.3–66.3

TABLE 4.—Measurements of adult males and females of *Eleutherodactylus ortizi* (mean ± standard deviation, followed by range; in mm).

Character	Males (n = 19)	Females (n = 7)
SVL	21.6 ± 1.7	26.7 ± 1.8
	18.1–24.7	24.3–29.2
Tibia length	11.5 ± 0.8	14.1 ± 0.7
	9.5–12.8	13.3–15.2
Foot length	10.2 ± 0.8	13.2 ± 0.9
	8.4–11.5	12.4–14.6
Head length	8.0 ± 0.5	9.8 ± 0.7
	6.9–9.0	9.2–11.0
Head width	8.7 ± 0.5	10.5 ± 1.0
	7.9–9.9	9.3–11.9
Upper-eyelid width	2.0 ± 0.2	2.4 ± 0.4
	1.6–2.3	2.0–3.1
Interorbital distance	2.7 ± 0.2	3.2 ± 0.2
	2.2–2.9	3.0–3.6
Eye length	2.9 ± 0.3	3.5 ± 0.4
	2.5–3.4	3.1–4.0
Eye-to-nostril distance	2.0 ± 0.2	2.4 ± 0.2
	1.6–2.3	2.2–2.6
Snout-to-eye distance	3.7 ± 0.3	4.4 ± 0.3
	3.0–4.3	4.1–4.8
Tympanum diameter	1.0 ± 0.2	1.4 ± 0.2
	0.6–1.3	1.1–1.6
Eye-to-tympanum distance	0.9 ± 0.1	1.0 ± 0.2
	0.6–1.1	0.8–1.2
Internarial distance	1.8 ± 0.1	2.2 ± 0.2
	1.7–2.1	2.0–2.6
Radio-ulna length	5.7 ± 0.5	7.1 ± 0.5
	4.7–6.4	6.6–7.8
Hand length	7.3 ± 0.6	9.1 ± 0.8
	6.0–8.1	8.3–10.6
Hand width	4.5 ± 0.4	5.9 ± 0.7
	3.5–5.0	5.0–6.8

(Fig. 6) are as follow: (1) dorsum, flanks, venter, and groin whitish cream with dark gray reticulation; two dark gray labial bars; limbs and posterior surfaces of thighs whitish cream with dark gray bars (Figs. 9A, 10A); (2) dorsum gray with dark gray marks, flanks gray with white spots outlined by black; limbs gray with small dark gray spots; groin cream, posterior surfaces of thighs cream with elongated dark gray marks; venter cream with black reticulation and white spots outlined with black (Figs. 9B, 10B); (3) dorsum whitish cream, flanks whitish cream with black marks in the anterior half; limbs cream without bars; groin and posterior surfaces of thighs whitish cream; venter whitish cream with some dark gray flecks and black spots next to arm insertion; disc pads of Finger III and IV cream (Figs. 9C, 10C); and (4) dorsum pale gray with some small black spots on posterior half, flanks pale gray with few white spots outlined with black; limbs pale gray without bars; groin and posterior surfaces of thighs cream; venter cream with numerous dark gray flecks and some white spots outlined with black (Figs. 9D, 10D).

Detailed variation is noted below. Dorsum cream to brown (5 males), with small dark gray marks or spots (4 females, 7 males), or dark gray oblique stripes (1 male). Labial bars present (1 male). Supratympanic stripe brown (1 male, 1 female). Flanks cream to grayish brown with dark gray flecks (1 male), gray warts (1 male, 1 female), white spots outlined with black (1 female, 6 males), dark gray reticular pattern (2 males), or with dark gray oblique bars (2 males). Limbs with faint bars (1 female) or clearly defined bars (2 males). Forelimbs and shanks brown with small dark gray spots (1 female, 1 male). Concealed surfaces of limbs and groin cream with small dark gray marks (3 males), gray with minute cream spots (1 female, 1 male), brown with darker marks (1 male), or dark gray with white spots (1 male). Posterior surfaces of thighs dark brown with minute cream spots (1 female). Undersides of limbs pale brown (1 male). Throat grayish cream (1 female), or cream with dark gray reticular pattern (1 female). Venter whitish cream to creamy gray (1 male) with midventral pale brown stripe (1 female), small gray spots (2 females, 4 males),

TABLE 5.—Proportions (in percentages) of adult males and females of *Eleutherodactylus ortizi*.

Characters	Males (n = 19)	Females (n = 7)
Head width/SVL	37.7–44.8	36.3–41.5
Head length/SVL	34.3–40.4	35.9–37.9
Head width/Head length	98.8–121.9	101.1–114.4
Eye-to-nostril distance/Eye length	59.4–81.5	65.0–74.2
Eyelid width/Interorbital distance	61.5–87.5	62.5–86.1
Tympanum diameter/Eye length	23.1–46.4	34.4–45.2
Radio-ulna length/SVL	22.7–28.8	25.5–27.6
Hand length/SVL	31.8–36.0	32.5–36.3
Tibia length/SVL	48.2–56.2	50.7–54.7
Hand length/Radio-ulna length	116.1–142.9	123.2–139.5
Foot length/Tibia length	79.7–96.3	89.4–98.0
Foot length/SVL	43.9–51.1	46.5–51.9
Hand width/Hand length	57.7–67.6	58.8–80.0

faint gray reticular pattern (1 female, 2 males) to defined reticular pattern (3 males), or with white spots outlined with black (1 female; 5 males).

Color in life.—Color in life for four individuals is as follows:

QCAZ 14765: Iris brownish copper; dorsum pale brown with gold specks; hind and forelimbs brown with pale green bars; groin dark brown with bright green patches; throat greenish brown; venter white with dark brown specks (field notes of D. Almeida on 17 July 2000).

QCAZ 14777: Dorsum uniform brown; supraorbital and canthal stripes grayish white; flanks brown with white spots outlined with black (from color slide; Fig. 5A).

Uncollected individual: Dorsum uniform brown; flanks dark gray with greenish yellow spots (from color slide; Fig. 5B).

QCAZ 14789: Dorsum uniformly greenish yellow (from color slide; Fig. 5C).

QCAZ 14783: Dorsum yellow with dark brown marks; flanks yellow (from color slide; Fig. 5D).

Ecology.—Eleutherodactylus ortizi occurs in Evergreen High Montane Forest (Bosque Siempre Verde Montano Alto), *Espeletia* Paramo (Páramo de Frailejones; Paramo dominated by the plant species *Espeletia pycnophylla* ssp. *angelensis*), and Herbaceous Paramo (Páramo Herbáceo) as defined by Valencia et al. (1999). Individuals were observed at night in secondary montane forest (32 of 71 individuals), paramo (24 of 71 individuals), primary montane forest (8 of 71 individuals), and agricultural lands (7 of 71 individuals; Schultz et al., 2000). The frogs were in terrestrial bromeliads (39 of 61 individuals), other plants (27 of 61 individuals), or on the ground (5 of 61 individuals).

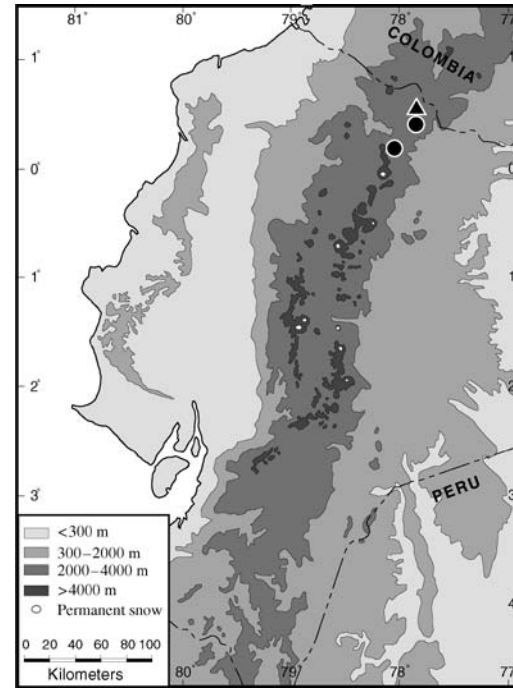

FIG. 11.—Distribution of *Eleutherodactylus huicundo* (triangle) and *E. ortizi* (circles) in Ecuador.

Distribution.—Eleutherodactylus ortizi is known only from the montane forest and paramo near El Chamizo (77° 46′03″ W, 00° 29′35″ N; 3264 m; Provincia Carchi, Ecuador) and Nueva América (77° 58′54″ W, 00° 15′34″ N; 3420 m; Provincia Imbabura, Ecuador). Both localities are in the Cordillera Oriental of the Andes of northern Ecuador (Fig. 11).

Etymology.—The specific name is a noun in the genitive case and is a patronym for Fernando Ortiz-Crespo, one of the most noted Ecuadorian ornithologists. Fernando Ortiz-Crespo was well known for his research in the Galapagos Islands and the Andes. He drowned while conducting fieldwork in the Laguna de la Mica in the high Andes of Ecuador on 13 September 2001.

Key to Species of the *Eleutherodactylus orcesi* Group

1. Tympanic annulus not externally visible under skin 2
   Tympanic annulus externally visible under skin 3
2. Dorsum usually having paravertebral folds; adult males with vocal slits .... *Eleutherodactylus thymelensis*
   Dorsum lacking paravertebral folds; adult males lacking vocal slits ..... *Eleutherodactylus obmutescens*
3. Skin of dorsum mostly areolate or with flat warts 4
   Skin of dorsum mostly shagreen 6
4. Skin of dorsum mostly areolate ..... *Eleutherodactylus orcesi*
   Skin of dorsum mostly with flat warts 5
5. In adult females, SVL 31.4–39.0 mm; in adult males, SVL 25.9–32.7 mm; adult males with vocal slits ..... *Eleutherodactylus simoterus*
   In adult females, SVL 25.7–31.4 mm; in adult males, SVL 23.1–25.1 mm; adult males without vocal slits ..... *Eleutherodactylus simoteriscus*
6. In adult females, SVL 29.9–37.9 mm; in adult males, SVL 25.2–30.2 mm; adult males lacking vocal slits; sinuous paravertebral folds sometimes present ..... *Eleutherodactylus racemus*
   In adult females, SVL < 29.5 mm; in adult males, SVL < 25.0 mm; adult males with vocal slits; paravertebral folds absent 7
7. Ulnar and tarsal tubercles present; background of venter gray to dark gray ..... *Eleutherodactylus huicundo*
   Ulnar and tarsal tubercles absent or minute; background of venter white ..... *Eleutherodactylus ortizi*

RESUMEN: Describimos dos especies nuevas de *Eleutherodactylus* e hipotetizamos que pertenen al grupo de especies reconocido como *E. orcesi*. Ambas especies habitan los Andes del norte del Ecuador a altitudes sobre los 3000 m. La presencia de una fontanela expuesta entre los frontoparietales distingue a las nuevas especies de la mayoría de especies del género *Eleutherodactylus*, en donde la fontanela frontoparietal está cubierta por los huesos frontoparietales. Adicionalmente, las nuevas especies se caracterizan por poseer dientes vomerinos reducidos o ausentes, y conspicuos pliegues laterales en los dedos de las manos y pies. Las nuevas especies pueden ser diferenciadas entre ellas por la presencia/ausencia de determinados tubérculos y por sus patrones de coloración.

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Appendix I

Specimens Examined

Eleutherodactylus obmutescens (KU 144086–89, 144091–106). *Eleutherodactylus orcesi* (KU 130314–16, 177815–16, 140001, 218021–23). *Eleutherodactylus racemus* (KU 168941–68). *Eleutherodactylus thymelensis* (KU 117719–21, 117724–70).