

- THORPE, R. S. 1975. Quantitative handling of characters useful in snake systematics with particular reference to intraspecific variation in the Ringed Snake *Natrix natrix* (L.). *Biological Journal of the Linnaean Society* 7:27–43.
- . 1984. Geographic variation in the Western Grass Snake (*Natrix natrix helvetica*) in relation to hypothesized phylogeny and conventional subspecies. *Journal of Zoology*, London 203:345–355.
- VELLEMAN, P. F., AND D. C. HOAGLIN. 1981. *Application, Basics, and Computing of Exploratory Data Analysis*. Duxbury Press, Boston, MA.
- VINCENT, S. E., A. HERREL, AND D. J. IRSCHICK. 2004. Ontogeny of intersexual head shape and prey selection in the pitviper *Agkistrodon piscivorus*. *Biological Journal of the Linnaean Society* 81:151–159.
- WEATHERHEAD, P. J., AND G. P. BROWN. 1996. Measurement versus estimation of condition in snakes. *Canadian Journal of Zoology* 74:1617–1621.
- WEATHERHEAD, P. J., F. E. BARRY, G. P. BROWN, AND M. R. L. FORBES. 1995. Sex ratios, mating behavior and sexual size dimorphism of the Northern Water Snake, *Nerodia sipedon*. *Behavioral Ecology and Sociobiology* 36:301–311.

Accepted: 20 February 2004.

Journal of Herpetology, Vol. 38, No. 2, pp. 240–244, 2004
Copyright 2004 Society for the Study of Amphibians and Reptiles

A New Species of *Eleutherodactylus* (Anura: Leptodactylidae) from the Darién Province, Panama

ROBERTO IBÁÑEZ D.^{1,2,3} AND ANDREW J. CRAWFORD

Smithsonian Tropical Research Institute, Apartado 2072, Balboa, Ancón, Panamá, Rep. de Panamá

ABSTRACT.—A new species of *Eleutherodactylus* is described from the Serranía de Pirre, Darién Province, Panama. This species is similar to *Eleutherodactylus altae* and *Eleutherodactylus pardalis*, but can be differentiated by the lack of red or white spots on groin and limbs.

RESUMEN.—Se describe una especie nueva de *Eleutherodactylus* de la Serranía de Pirre, Provincia de Darién, Panamá. Esta especie se asemeja a *Eleutherodactylus altae* y *Eleutherodactylus pardalis*, pero se diferencia de éstas por carecer manchas de color rojo o blanco en su ingle y extremidades.

The frog fauna of Panama includes over 145 species (Ibáñez et al., 2001), and this diversity may be in large part caused by Panama's unique position as a land bridge between Central and South America (Savage, 1982; Rand and Myers, 1990). The genus *Eleutherodactylus* exemplifies this mixing of faunas: about half of the Panamanian species belong to the Central American subgenus, *Craugastor*, and about half belong to the South American subgenus, *Eleutherodactylus*. Members of four different lineages within the latter subgenus arrived in Central America after the mid-Pliocene (Duellman, 2001:806–811). In this paper, we describe a new species of southern invader belonging to the *Eleutherodactylus uni-*

strigatus group of Lynch and Duellman (1997) and the *Eleutherodactylus cruentus* group of Savage (2002).

In September 2002, we visited the old Cana goldmining site, now an ecotourism destination managed by Ancon Expeditions of Panama, located 6 km north of the Colombian border in the Darién National Park. On two nonconsecutive nights, we were able to search for reptiles and amphibians on the crest of the Pirre mountain range, 1200–1600 m in elevation. On both nights, we found one or two *Eleutherodactylus* that had the distinctive morphology and locomotor habits similar to *Eleutherodactylus pardalis* (Barbour, 1928) and *Eleutherodactylus altae* (Dunn, 1942). However, none of the three frogs we found had any trace of the large white (*E. pardalis*) or coral-colored (*E. altae*) spots found on the groin and legs that are diagnostic of these two species. We then checked the descriptions of all *E. unistrigatus* species (Lynch and Duellman, 1997) recorded from the Chocó region of Colombia (Duellman,

¹ Corresponding Author. E-mail: ibanezr@tivoli.si.edu

² Círculo Herpetológico de Panamá, Apartado 10762, Estafeta Universitaria, Panamá, Rep. de Panamá.

³ Departamento de Zoología, Universidad de Panamá, Panamá, Rep. de Panamá.



FIG. 1. Holotype of *Eleutherodactylus pirrensis* (MVUP 1773) in life, dorsolateral view.



FIG. 2. Holotype of *Eleutherodactylus pirrensis* (MVUP 1773) in life, ventral view.

1999) and searched the literature and other databases for more recently described Colombian *Eleutherodactylus*. Finally convinced that these frogs were unknown from either Colombia or Panama, we proceeded with the following species description.

MATERIALS AND METHODS

Terminology for morphological descriptions follows mainly Savage (2002). All measurements of external morphology were taken on preserved specimens with a dial caliper to the nearest 0.1 mm. The sex of the specimens was determined by observing the gonads under a dissecting scope. Museum and collection abbreviations are as follows: CH, Círculo Herpetológico de Panamá; MVUP, Museo de Vertebrados de la Universidad de Panamá; UCR, Museo de Zoología de la Universidad de Costa Rica. Collector's tag AJC, Andrew J. Crawford.

Eleutherodactylus pirrensis sp. nov.

Figures 1–2

Holotype.—MVUP 1773, bearing tag CH 5567; female (with immature oocytes) collected along the headwaters of the Cana River, approximately 100 m below the Pirre Tent Camp run by Ancon Expeditions at Cana, Darién National Park, Darién Province, Panama, 1250 m elevation, 07°45'48.6"N, 77°43'19.8"W, on 27 September 2002 by R. Ibáñez D. and D. Reznick.

Paratypes.—Two females (both with immature oocytes), CH 5641, bearing collector's tag AJC 0594, and CH 5642, bearing collector's tag AJC 0602, collected along the Pirre ridge trail above the Pirre Tent Camp run by Ancon Expeditions at Cana, Darién National Park, Darién Province, Panama, 1550 m elevation, 07°46'16"N, 77°43'49"W, on 30 September 2002 by A. J. Crawford.

Diagnosis.—*Eleutherodactylus pirrensis* is more similar to *E. altae* and *E. pardalis* than to any other

congeners from lower Central America. *Eleutherodactylus pirrensis* can be easily differentiated from the latter two species because it completely lacks the bright coral red and/or silvery white spots on groin and limbs.

Description of Holotype.—Head wider than body, and only slightly longer than wide; snout short, in dorsal view nearly rounded to rounded, in lateral profile rounded to truncate; nostrils protruberant, directed laterally; internasal area concave; canthus rostralis well developed, concave; loreal region slightly concave; upper lip slightly flared; upper eyelid smooth to granulate without tubercles; narrow superciliary ridge extends from posterior third of eye, continuing as supratympanic ridge that extends to groin region, thinner above tympanum; tympanum visible through thin skin, round, separated from eye by slightly less than tympanum diameter; two rather small but distinct postrictal tubercles on each side, plus six even smaller ones on left side; choanae moderate sized, not concealed by palatal shelf of maxillary arch when roof of mouth is viewed directly from below; vomerine odontophores oblique, medial and posterior to choanae, smaller than choanae; odontophores separated by a distance of about one choana; tongue longer than wide, its posterior edge irregularly scalloped, posterior half not adherent to floor of mouth.

Skin of head, dorsum, and flanks smooth to granulate, except for the aforementioned narrow ridge extending from above eye to groin; skin of throat smooth; skin of venter granular; a transverse fold anterior to cloacal opening, formed by tip of coccyx dorsally; cloacal opening not extended in sheath; pericloacal area rugose; skin on upper surfaces of limbs smooth; heel smooth; no inner tarsal fold.

TABLE 1. Selected measurements (in millimeters) of the holotype and paratypes of *Eleutherodactylus pirrensis* sp. nov.

	MVUP 1773 (Holotype)	CH 5641	CH 5642
Snout-vent length	30.0	25.8	26.1
Shank	14.2	12.4	13.3
Head width	12.3	11.1	11.7
Head length	13.7	11.8	11.8
Upper eyelid width	3.6	3.6	3.0
Interorbital distance	3.5	2.9	3.5
Eye length	3.4	4.0	5.0
Tympanum length	1.8	—	1.5
Eye to nostril distance	5.3	4.8	5.1

Palmar tubercle bifid; thenar tubercle oval, on outer margin of base of thumb, as large as palmar tubercle; left hand has four accessory palmar tubercles; subarticular tubercles round in outline, globular in profile; no supernumerary tubercles on fingers; first finger shorter than second; no lateral fringes or webbing on fingers; fingers bearing discs and pads, both broader than long; finger disc covers expanded, even, palmate, some with fine points; disc pads even, broadened; disc cover of fingers III–IV slightly larger than tympanum.

Thigh areolate on proximal posteroventral margin, smooth elsewhere; knee smooth to granular; shank smooth; one oval and flattened inner metatarsal tubercle; one weakly developed outer metatarsal tubercle; no tarsal fold; plantar surface with a few small and faint supernumerary tubercles; tip of toe III extends to proximal margin of pad on toe V; subarticular tubercles round in outline, globular in profile; no supernumerary tubercles on toes; no lateral fringes or webbing on toes; toes bearing discs and pads, both broader than long; toe disc covers expanded, even, palmate; disc pads even, broadened; heels overlap when hind limbs are flexed at right angles to sagittal plane; heel of adpressed hind limb reaches the posterior portion of eye.

Measurements.—See Table 1.

Variation.—Supratympanic ridge weakly indicated, not extending beyond tympanum in either paratype; upper eyelid faintly tuberculate in CH 5641; tympanum not visible through skin in CH 5641; one small but distinct postrictal tubercle on each side in CH 5641; vomerine odontophores small and poorly developed in CH 5641, not detectable in CH 5642; posterior edge of tongue weakly asymmetrically bifid in both paratypes; fold above cloaca is replaced by a simple depression in CH 5642; pericloacal area not rugose in CH 5642; heel with several small tubercles in both paratypes; one to three supernumerary palmar tubercles on each hand in paratypes; finger disc covers without fine points in CH 5641; knee

granular to weakly tuberculate in both paratypes; a few small and scattered tubercles along outer edge of tarsus visible under magnification in CH 5642; tip of toe III not reaching proximal margin of pad on toe V, but does extend past distal subarticular tubercle of toe V.

Color in Life.—Holotype with overall uniform coloration without stripes or spots, middorsally very dark purplish brown, fading rapidly along flanks into a translucent off-white on ventral surfaces; dorsal surfaces of head, body, lower arm, fingers I–II, hind limbs, and toes IV–V dark brown with a purplish tint; flanks, groin, fingers I–II, anterior and posterior surfaces of thigh are purplish white; throat and ventral surface of arm white with grayish suffusion; chest and abdomen translucent white; outline of heart, liver and intestines noticeable; iris dark brown with a purplish tint. CH 5641 same as holotype during daytime, slightly lighter with less purple coloration at night. CH 5642 differs from holotype as follows: dorsal surfaces of head, body, lower arm, and hind limbs densely mottled with brick red; throat, chest and abdomen clearer, tongue and viscera more noticeable; iris brown.

Color in Preservation.—Holotype and paratypes dorsally dark brown, ventrally pale gray. CH 5642 differs in that the brick red mottling is brownish orange.

Etymology.—The species name refers to the Serranía de Pirre, where the types were found, with Latin suffix *-ensis*.

Natural History.—All three individuals were collected on vegetation at night, between 1930 and 2200 h. The holotype was found on the upper surface of a leaf on a tree about 3 m off the ground. CH 5641 was found on vegetation about 1 m above the ground. CH 5642 was observed at a height of 1.8 m while climbing up the 2–3 cm diameter trunk of a small tree.

Habitat.—The types were found around the transition between premontane rain forest and montane rain forest of Holdridge's life zones system (Departamento de Cartografía del Catastro Rural, Reforma Agraria, Mapa Ecológico de

Panama, Rome, Italy, 1970). Myers (1969) stated that cloud forest predominates on the crest of the Serranía de Pirre above 900 m in elevation. Based on our observations, the holotype was collected in premontane rain forest habitat, whereas the paratypes were found in cloud forest.

Distribution.—Only known from type locality in the Serranía de Pirre, Darién Province, Panama.

DISCUSSION

We believe that *E. pirrensis* likely forms a natural group with *E. pardalis* and *E. altae* (Appendix 1). These three species share in common the wide head, short legs and short toes, relative to other members of the *Eleutherodactylus cruentus* group. The former trait is unmistakable among Panamanian *Eleutherodactylus*, whereas the shortness of legs and especially the toes is reminiscent of *Eleutherodactylus diastema* group animals. *Eleutherodactylus pirrensis* and its two presumed closest relatives are also distinctive from the rest of the *E. cruentus* group in that they tend to move slowly, walk rather than hop, and when handled excessively, they exude a sticky substance from their skin.

Eleutherodactylus pirrensis is not found in sympatry with *E. altae* or *E. pardalis*. Records of *E. altae* are restricted to Costa Rica and extreme northwestern Panama (Savage, 2002). *Eleutherodactylus pardalis* ranges from the Pacific slope of southern Costa Rica to the Serranía de San Blas in Panama (Savage, 2002; pers. obs.).

Acknowledgments.—We would like to express our appreciation to ANAM for allowing us to collect specimens. We thank D. Windsor and ANCON Expeditions of Panama for getting us to Cana, and to Emilio "Chichile" Cuñapa for his help in the field. We thank D. Reznick for helping us collect the holotype specimen and C. Jaramillo for the photographs. RID would like to thank STRI for its financial support in getting to Cana. AJC was supported by a National Science Foundation International Programs Postdoctoral Fellowship. Also, thanks to J. D. Lynch, J. R. McCranie, and E. R. Wild for reviewing the manuscript.

LITERATURE CITED

BARBOUR, T. 1928. New Central American frogs. *Proceedings of the New England Zoological Club* 10:25–31.

DUCELLMAN, W. E. 1999. Distribution patterns of amphibians in South America. *In* W. E. Duellman (ed.), *Patterns of Distribution of Amphibians*, pp. 255–328. Johns Hopkins Univ. Press, Baltimore, MD.

———. 2001. Hylid frogs of Middle America. *SSAR Contributions to Herpetology* 18:1–1180.

DUNN, E. R. 1942. A new species of frog (*Eleutherodactylus*) from Costa Rica. *Notulae Naturae of the Academy of Natural Sciences of Philadelphia* 104:1–2.

IBÁÑEZ D. R., F. A. SOLÍS, C. A. JARAMILLO, AND A. S. RAND. 2001. An overview of the herpetology of Panama. *In* J. D. Johnson, R. G. Webb, and O. Flores-Villela (eds.), *Mesoamerican Herpetology: Systematics, Zoogeography, and Conservation*, pp. 159–170. Univ. of Texas at El Paso, El Paso.

LYNCH, J. D., AND W. E. DUCELLMAN. 1997. Frogs of the genus *Eleutherodactylus* in western Ecuador. *Univ. of Kansas Natural History Museum Special Publication* 23:1–236.

MYERS, C. W. 1969. The ecological geography of cloud forest in Panama. *American Museum Novitates* 2396:1–52.

RAND, A. S., AND C. W. MYERS. 1990. The herpetofauna of Barro Colorado Island, Panama: an ecological summary. *In* A. H. Gentry (ed.), *Four Neotropical Rainforests*, pp. 386–409. Yale Univ. Press, New Haven, CT.

SAVAGE, J. M. 1982. The enigma of the Central American herpetofauna: dispersals or vicariance? *Annals of the Missouri Botanical Garden* 69:464–547.

———. 2002. *The Amphibians and Reptiles of Costa Rica*. Univ. of Chicago Press, Chicago.

Accepted: 20 February 2004.

APPENDIX 1

Comparative Material

Eleutherodactylus altae.—Costa Rica: Provincia de Alajuela: UCR 16472, Cantón La Paz, Estación La Paz, about 16 km by road northwest of San Ramón, 1230 m.

Eleutherodactylus pardalis.—Panama: Comarca de San Blas (Kuna Yala): CH 3412. Provincia de Coclé: CH 0222, approximately 4.5 northwest of El Copé, 1200 m. Provincia de Panamá: CH 3816, Cerro Jefe, 800 m; CH 4549, camino a Cerro Brewster, approximately 700–760 m; CH 5332, Quebrada de El Cántaro, Río Indio Nacimiento, Río Indio Arriba, approximately 700 m; CH 5343, El Cántaro, Río Indio Nacimiento, Río Indio Arriba, 735 m.