Zootaxa 1278: 49–56 (2006)
www.mapress.com/zootaxa/

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

1278

Distribution and morphological variation of *Eleutherodactylus mercedesae* Lynch & McDiarmid, 1987 (Amphibia, Anura, Leptodactylidae) with first record for Peru

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Abstract

We report new distributional information for *Eleutherodactylus mercedesae* in Bolivia, and provide the first record for Peru based on an adult female. This species, previously endemic to Bolivia, now ranges across about 1000 km in cloud forests on the Amazonian slopes of the Andes from southern Peru to central Bolivia. We provide the first morphological description of females based on two specimens, compare them with the male type and paratype, add some observations to the original description, and comment on variation in the species.

Key words: *Eleutherodactylus mercedesae*, Anura, Leptodactylidae, Bolivia, Peru, distribution, variation

Resumen

Aportamos información novedosa sobre la distribución de *Eleutherodactylus mercedesae* en Bolivia y la primera cita para Perú, basada en una hembra adulta. Esta especie se consideraba hasta ahora endémica para Bolivia. Su rango conocido de distribución comprende actualmente unos 1000 km de los bosques nublados de las laderas amazónicas de los Andes, desde el sur de Perú al centro de Bolivia. Se describe por primera vez la hembra de esta especie en base a dos ejemplares, que son comparados con el holotipo y el paratipo. Añadimos algunas observaciones sobre la descripción original y la variación morfológica de la especie.

Accepted by S. Carranza: 19 May 2006; published: 3 Aug. 2006

Introduction

Eleutherodactylus mercedesae Lynch & McDiarmid, 1987 is an uncommon species inhabiting the Yungas and Humid Montane Forests of Central Bolivia (Lynch & McDiarmid 1987; De la Riva 1990). Until recently, it was exclusively known from two close localities (De la Riva 1993), but additional findings increased its known latitudinal range, first around the type locality, and subsequently further to the northwest, in Department La Paz, Bolivia (De la Riva *et al.* 2000; Köhler 2000). Thus, our information has shifted from considering this species to be restricted to the surroundings of the type locality to consider it a rare species with a distribution of 300 km wide in the Andean Cloud Forests of Bolivia (De la Riva *et al.* 2000). Despite recent intense fieldwork (Padial *et al.* 2004), including surveys of the type locality, few specimens have been collected and our knowledge of this species is still rudimentary. Nevertheless, recent collections examined (CBG and USNM) by us yielded new distributional information of this species from Bolivia and a record from Peru, where it was previously unrecorded (Lehr 2002; Frost 2004; AmphibiaWeb 2006).

Eleutherodactylus mercedesae was described from two adult males. Since then, the only additional information on the species' morphology was based on juveniles (Köhler 2000). Females of *Eleutherodactylus mercedesae* were unknown (Lynch and McDiarmid 1987). Since *Eleutherodactylus* is a large and complex frog genus, with most species in the same species group diagnosed only by subtle differences, some inter-populational variation could be misinterpreted as specific diagnostic characters if several specimens are not studied. Moreover, with scant distributional data and with long distances between collecting sites, this variation could lead to erroneous recognition of populations as different species. Therefore, we think it is important to provide any new morphological and distributional data.

Methods

Morphological characters studied mainly follow Lynch and Duellman (1997) although, following Padial & De la Riva (2005) and Padial *et al.* (2005), abbreviations and some measurements described below differ from those used by the above-mentioned authors. Measurements and their respective abbreviations are described as follows: snout-vent length, SVL; head length (from posterior margin of the lower jaw to tip of snout), HL; head width (measured at level of rictus), HW; eye length, EL; eye to nostril distance, EN; inter-narial distance, IND; eye to eye distance (distance between the anterior margins of eyes), EE; tympanic membrane height, TYH; tympanic membrane length, TYL; width of terminal disk of third finger, FIII; width of terminal disk of fourth finger, FIV; forearm length (from elbow to the proximal margin of thenar tubercle), ARM; tibia length, TL; thigh length, TH; foot length (from proximal border of inner metatarsal tubercle to tip of

fourth toe), FL; width of terminal disk of fourth toe, TIV. We do not include values of interorbital distance (IOD) and upper eyelid width (EW). Our experience indicates that these parameters are usually of scarce utility because the preservation condition of a specimen highly influences the measurements and makes it difficult to have precise and comparable values. Specimens were measured by JMP with a digital calliper to the nearest 0.01 mm. To avoid pseudo precision we rounded all measurements following Hayek *et al.* (2001). Specimens studied are deposited in the following collections: Colección Boliviana de Fauna, La Paz, Bolivia (CBF); Museo de Historia Natural de Cochabamba, Cochabamba, Bolivia (MHNC); National Museum of Natural History, Washington DC. USA (USNM); Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (ZFMK). All specimens examined are listed in the Appendix.

Results

A single adult female (USNM-346140; Figure 1) collected by A. Salas in a cloud forest at 1700 m in Department Cusco, on 22 September 1991, represents the first and only record for Peru (see appendix). New records in Bolivia are: an adult male from Serranía Bellavista in Department La Paz (CBF-3701); a juvenile from Cotapata National Park, also in Department La Paz (CBF-4120); and an adult female from Pampa Grande, Altamachi, Department Cochabamba (MHNC-AMS-196). Thus, the known distribution of *E. mercedesae* comprises a narrow band of Montane Forest from 1400–1950 m altitude, and about 300 km in length in Bolivia, and a single record in Peru (1700 m), separated by a distance of 480 airline km from the closest Bolivian records (see Figure 2). The Peruvian record, together with recent taxonomic discoveries (e.g. Lehr *et al.* 2004), clearly shows how incomplete our knowledge on the diversity of *Eleutherodactylus* in Peru is.

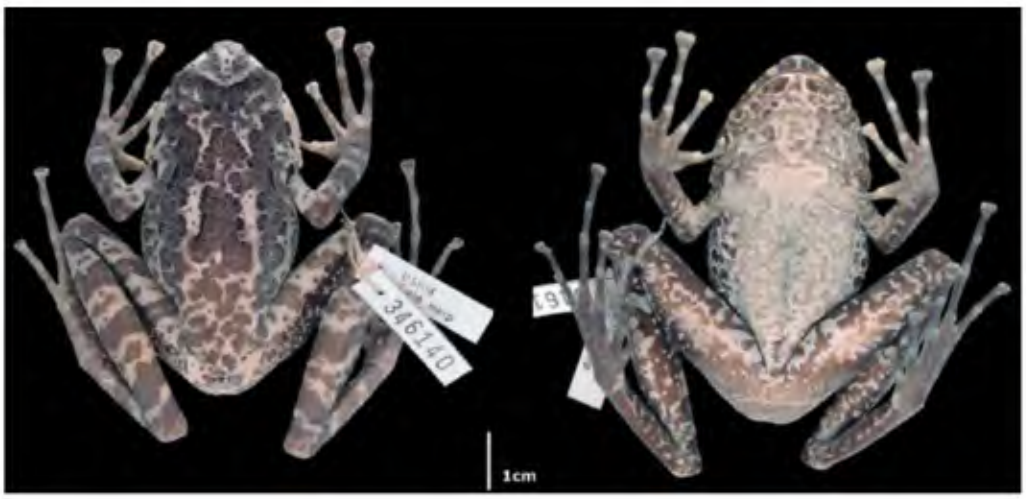

FIGURE 1. Dorsal and ventral views of adult female *Eleutherodactylus mercedesae* (USNM-346140) from Peru (SVL =62.1).

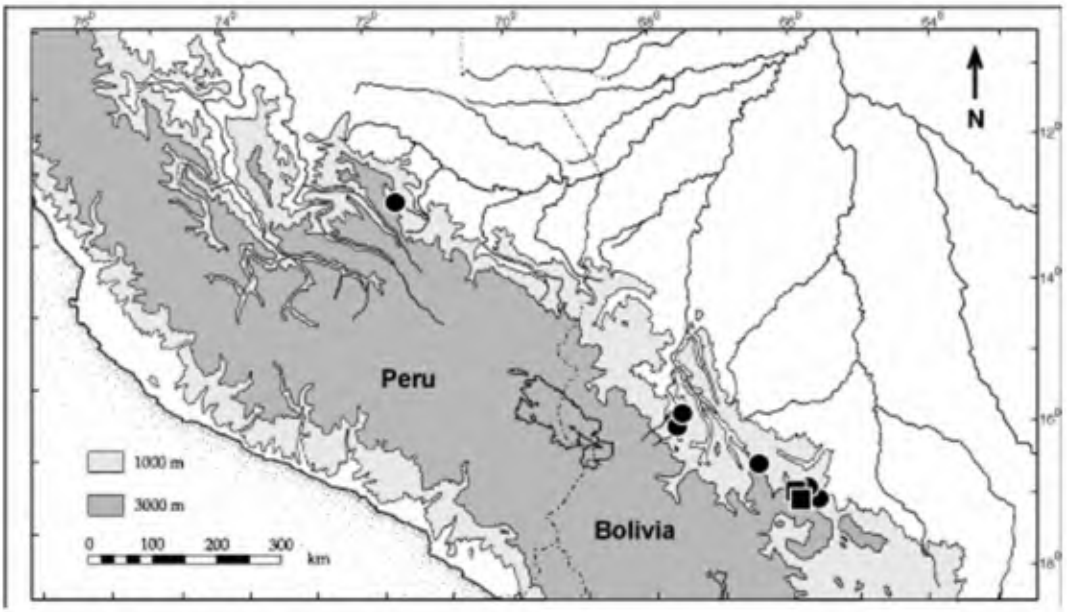

FIGURE 2. Map of Southern Peru and Northern-Central Bolivia showing the collecting sites of *Eleutherodactylus mercedesae*. Squares indicate the localities mentioned in the original description.

We herein provide information on some adult characteristics not mentioned for the types and a more detailed morphometric account (Tables 1 and 2). The description of juvenile *Eleutherodactylus mercedesae* (ZFMK-72571-3, 72597-99) by Köhler (2000) is adequate and coincident with our observations; thus, we do not describe juveniles herein.

Coloration in alcohol. Adult females are very similar to males (both types and CBF-3701) in coloration and pattern (Figure 1). The dorsum is greenish-grey to brownish-grey with cream irregular marks; the belly and throat show a cream background with moderate to intense brown mottling. All specimens have an inverted "V" or a rhomboidal cream mark on brown background on the throat (as the holotype and some specimens of *Eleutherodactylus rhabdolaemus*). Another characteristic is a butterfly-like cream mark on the scapular region (also observed in the holotype). Some black bold marks are present in both sexes, in the anterior margin of flanks, scapular region, interocular region, loreal region, subocular region, supratympanic fold, and dorsal surfaces of forearm.

Skin texture. Although in the original description the dorsal skin was described as finely granular, some specimens have a smooth skin (e.g. MHNC-AMS-196). The number of warts and granules on dorsum, head and flanks is also variable. For example, eyelid tubercles and occipital warts are absent in MHNC-AMS-196 and some of these structures have almost disappeared in the types. Dorsolateral and lateral folds are only present in the paratype.

Sexual characters. USNM-346140 (Figure 1) is a gravid female with unpigmented eggs, grouped in five round and concatenated packets in each oviduct. This morphology of

oviducts has been not previously observed in any of the other Bolivian species (pers. obs.). Males have white testis, as all other Bolivian species (pers. obs.). Lynch & McDiarmid (1987) diagnosed the absence of nuptial pads in males of *E. mercedesae*, but a re-examination revealed a single, faint, low, white glandular nuptial pad on the dorsal surface of the thumb, more evident in the paratype (USNM-165753) than in the holotype (USNM-257848) and the specimen CBF-3701. The sexual dimorphism in size is evident, being females larger than males, although there are not differences in proportions (Tables 1 and 2).

TABLE 1. Measurements (in mm) and proportions of adult specimens of *Eleutherodactylus mercedesae*.

	Males			Females	
	USNM257848 (Holotype)	USNM165753 (Paratype)	CBF3701	USNM346140	MHNC-AMS-196
SVL	41.7	52.2	51.5	62.1	63.3
HL	16.1	19.8	18.2	24.6	24.5
HW	16.5	18.2	18.2	26.1	24.6
EL	5.1	6.2	5.5	7.0	5.9
EN	4.9	6.5	6.4	7.5	6.4
IND	4.0	4.7	4.4	5.7	5.5
EE	7.4	8.4	8.0	10.8	10.3
TYH	2.3	2.9	2.5	4.0	3.6
TYL	1.9	2.6	2.7	3.4	3.3
FIII	2.2	2.9	2.3	3.4	2.8
FIV	2.3	2.9	2.1	3.6	2.8
ARM	9.4	12.0	12.6	15.7	15.1
TL	28.0	35.4	35.5	43.6	42.6
TH	24.8	30.8	31.7	40.8	38.7
FL	23.5	29.3	29.4	38.9	36.5
TIV	1.8	2.2	1.8	2.6	1.9
TL/SVL	0.7	0.7	0.7	0.7	0.7
FL/SVL	0.6	0.6	0.6	0.6	0.6
HL/SVL	0.4	0.4	0.4	0.4	0.4
HW/SVL	0.4	0.3	0.4	0.4	0.4
HW/HL	1.0	0.9	1.0	1. 1	1.0
EN/EL	1.0	1.0	1.2	1.1	1.1
TYL/TYH	0.8	0.9	1.1	0.9	0.9

TABLE 2. Means and ranges of morphometric proportions of adult specimens of *Eleutherodactylus mercedesae*.

Proportions	Males (n = 3)	Females (n = 2)
TL/SVL	0.7 (0.7–0.7)	0.7 (0.7–0.7)
FL/SVL	0.6 (0.6–0.6)	0.6 (0.6–0.6)
HL/SVL	0.4 (0.4–0.4)	0.4 (0.4–0.4)
HW/SVL	0.4 (0.3–0.4)	0.4 (0.4–0.4)
HW/HL	1.0 (0.9–1.0)	1.0 (1.0–1.1)
EN/EL	1.1 (1.0–1.2)	1.1 (1.1–1.1)
TYL/TYH	0.9 (0.8–1.1)	0.9 (0.9–0.9)

Remarks. In most *Eleutherodactylus* from Bolivia, males have more rounded tympanic membranes and females more elliptical ones (JMP pers. obs.). In *E. mercedesae,* both sexes have an elliptical tympanic membrane, being the paratype the only exception. Finger lengths (3>4>1>2), toe lengths (4>3>5>2>1), and disc shapes are similar in males and females. In the female USNM-346140, low occipital "W" shaped crests are also evident, what is exclusive of this specimen. The tarsal fold is absent in MHNC-AMS-196. Finger and toe fringes are present in different degrees in all adult specimens. Development of supernumerary tubercles in the hand is also variable, being big and prominent in the holotype and less prominent in MHNC-AMS-196, which could be an artifact of preservation.

No relevant differences were found among males and females, besides from the usual sexual dimorphism present in other *Eleutherodactylus*. More relevant aspects are that both males and females are identical in the proportions (see Tables 1 and 2) and no remarkable differences were found among specimens from different localities.

The observed discontinuities in the distribution of *E. mercedesae* are surely due to the lack of adequate sampling.

Acknowledgements

JMP's work in Bolivia was financed by a grant from the Mutis program of the MAE-AECI (Spain), and his visits to US museums were funded by an Ernst Mayr Travel Grant in Animal Systematics (Museum of Comparative Zoology, Harvard University). Special thanks to A. Muñoz and R. Aguayo (CBG) for allowing JMP the study of their specimens. JMP and IDlR are grateful to the following persons for the help and space provided at their respective institutions: Dr. M. Suárez, A. Justiniano, R. Vespa, R. Montaño, and L. González (Museo de Historia Natural Noel Kempff Mercado, Santa Cruz, Bolivia), J. Aparicio (Colección Boliviana de Fauna, La Paz), J. Rosado (MCZ), W. R. Heyer

(USNM), and W. Böhme and J. Köhler (ZFMK). This work was partially funded by projects REN/GLO 2001-1046 and CGL2005-03156 of the Spanish Ministry of Education and Science (I. De la Riva, Principal Investigator). We are grateful to Fernando Palacios for his decisive help.

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Appendix

Specimens examined

Eleutherodactylus mercedesae: BOLIVIA. **Department Cochabamba:** "Old" Chapare road, 1400–1500 m, (ZFMK-72571-73); "Old" Chapare road, 1650 m, (ZFMK-72597–99); Pampa Grande, Departmental Protected Area Altamachi, (MHNC-AMS–196); 3.3 km N of Cochabamba to Villa Tunari road on road to San Onofre, at a point 97.5 km from Cochabamba on road from Cochabamba to Villa Tunari, 1690 m, 17°10'S/65°46'W (USNM-257848, holotype); Limbo, 73.5 Km from Cochabamba to Villa Tunari, 1950 m, 17°10'S/65°48'W (USNM–165753, paratype). **Department La Paz:** Hornuni, Cotapata National Park, Prov. Nor Yungas, 16°12'50''S/67°53'10''W (CBF-4120); road to Coroico, Serranía Bella Vista, Province Nor Yungas, 16°14'S/67°43'W (CBF-3701). PERU. **Department Cusco:** Paucartambo, 68 km by road NE of Puente Unión on río Tachila (Bosque de las Nubes, km 150 on Paucartambo-Atalaya road), 1700 m, 13°14'13''S/71°34'00''W (USNM-346140).