



Notes on the distribution of *Gastrotheca testudinea* (Jiménez de la Espada, 1870) in Ecuador

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Abstract

We present new information on the distribution of the marsupial frog *Gastrotheca testudinea* (Jiménez de la Espada, 1870) in Ecuador. We provide the first record from the province of Cañar, and the southernmost locality for Ecuador (which also corresponds to the third known report from the province of Zamora-Chinchipec). In addition, we review the elevation range of the species, and propose to change the lowest elevation limit of *G. testudinea* from 1100 to 700 m.

Key words

Andes; Amphibia; Anura; elevation; Hemiphractidae; new records; range extension.

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Introduction

Most members of the family Hemiphractidae are restricted to specific physiographic regions, with narrow latitudinal and elevation ranges (Duellman 2015). The arboreal direct-development marsupial frog, *Gastrotheca testudinea* (Jiménez de la Espada, 1870), is however an exception, having a widespread latitudinal range along the eastern (Amazonian) slopes of the Andes of Ecuador, Peru, and Bolivia (Duellman 2015, Frost 2016). This species dwells in Foothill, Low Montane, and Cloud forests up to 2775 m (Icochea et al. 2004, Duellman and Chávez 2010, Duellman 2015). Despite its wide distribution, *G. testudinea* is seldom collected or recorded, probably due to its arboreal habits, and much remains to be known about its distribution and natural history (Duellman 2015).

In Ecuador, *G. testudinea* has been reported in few localities in the provinces of Orellana, Tungurahua, Pastaza, Morona-Santiago, and Zamora-Chinchipec (Table 1). The first goal of this publication is to report several records that expand the distribution of *G. testudinea* in Ecuador: the first record from the province of Cañar, and the southernmost Ecuadorian locality. Furthermore, we comment on data regarding the lowest elevation limit of *G. testudinea*, which at present is controversial. Duellman's (2015) monographic work reported the lowest elevation of *G. testudinea* as 1100 m, but a previous work cited the species' lowest elevation as 550 m (Duellman and Venegas 2005; Table 1). Thus, the second goal of this paper is to evaluate the lowest elevation limit of *G. testudinea*.

Methods

Specimens examined for this work are deposited at: Museo de Zoología, Universidad del Azuay, Cuenca, Ecuador (MZUA) and National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA (USNM). Specimens deposited at MZUA were collected under permits 065-DPA-MA-2014 and 019-IC-FAU/FLO-DPZCH-MA issued by Ministerio del Ambiente, Ecuador. We determined the position most closely related to the locality description using Google Earth™ mapping service (7.1.5.1557 released by Google, Inc. in May 2015). Toponymic information is based on the Geographic Names Database, containing official standard names approved by the United States Board on Geographic Names and maintained by the National Geospatial-Intelligence Agency (<http://geonames.nga.mil/gns/html/>), with supplementary information from physical maps of the Republic of Ecuador available via the Instituto Geográfico Militar.

Results

Specimens reported herein were identified as *G. testudinea* by their large body size; head wider than long; tibia length less than 60% of snout-vent length; skin of dorsum areolate, adherent to the skull but not co-ossified; supraciliary processes absent; heel bearing a tubercle; Finger I > Finger II; finger discs wider than digits proximal to discs; inner tarsal fold present on distal one-third of tarsus; and webbing extending to the distal subarticular tubercle on Toe V (Duellman 2015). *Gastrotheca testudinea* is the largest member of the subgenus *Gastrotheca* (sensu Duellman 2015), and the only member with the skin on the head adherent with the underlying dermal bones (Duellman 2015).

Discussion

An adult male *G. testudinea* (MZUA.An.0572, Fig.1) was collected along a ravine, 300 m off the Mazar dam (Table 1, Fig. 4), near Guarainag, province of Cañar, Ecuador, on 12 June 2014. This is the first known record of *G. testudinea* in the province of Cañar, extending the species' distribution ca 57 km north-northwest from the nearest known locality (18.6 km southwest of Plan de Milagro). The frog was found vocalizing from a small branch, 1.5 m over the ground, in a riparian montane forest remnant.

An adult male (MZUA.An.1084, Fig. 2) and an adult female (MZUA.An.1085, Fig. 3) were collected at two different points in the Estación Científica San Francisco (Table 1, Fig. 4), on March and October 2015, respectively. This site is the third known locality in the province of Zamora-Chinchipe and the southernmost record of the species in Ecuador, extending the species' distribution ca 82 km east-southeast from the nearest known locality (Machinaza Alto). These frogs were active at night on shrubs, 3 and 6 m above the ground, respectively.



Figures 1–3. *Gastrotheca testudinea*. **1.** Adult male (MZUA.An.0572), Mazar dam, near Guarainag, province of Cañar, Ecuador, 12 June 2014. **2.** Adult male (MZUA V.An-1084), and **3.** Adult female (MZUA. An.1085), both from Estación Científica San Francisco, province of Zamora-Chinchipe, Ecuador, March and October 2015, respectively.

A specimen of *G. testudinea* (USNM 258757) collected at Loreto, province of Orellana, Ecuador, in January 1951, corresponds to the lowest known elevation for the species. Based on this specimen, Duellman and Venegas (2005) cited 550 m as the species' lowest elevation (Table 1). However, Duellman (2015) disregarded this locality and reported the lowest elevation of *G. testudinea* as 1100 m. Although Duellman (2015) did not mention his reasons for invalidating the locality, it was probably because Loreto lies at a much lower elevation than other known localities of *G. testudinea*.

Specimen USNM 258757 is part of a collection gathered by Carlos A. Olalla and sent by Gustavo Orcés to James A. Peters at the National Museum of Natural History, Smithsonian Institution. The Olalla family worked at Loreto over several decades, gathering large collections

Table 1. Data of known collection localities of *Gastrotheca testudinea* in Ecuador

Locality*	Province	Coordinates	Elev. (m)	Source
San José de Moti (type locality)	Orellana	-00.4334, -077.3334	n/a	Jimenez de la Espada (1870); Duellman (1974) [†]
Loreto	Orellana	-00.6329, -077.3432	550	USNM 258757 (this paper)
Baños and surroundings (including Tungurahua volcano and River Pastaza watershed)	Tungurahua	-01.3954, -078.4228	1800	Anderson (1945); Duellman and Venegas (2005)
Cerro La Candelaria	Tungurahua	-01.4516, -078.3082	2000	Reyes-Puig et al. (2013)
Abitagua	Pastaza	-01.4497, -078.1452	1150	Duellman and Venegas (2005); Duellman and Chávez (2010)
300 m off the Mazar dam, near Guarainag	Cañar	-02.6317, -078.6264	2200	MZUA.An.0572 (this paper)
Yapitya, E slope of Cordillera del Cutucú	Morona-Santiago	-02.75253, -078.0835	1700	Duellman and Lynch (1988)
18.6 km SO of Plan de Milagro	Morona-Santiago	-03.14734, -078.5778	2275	Duellman and Hillis (1987)
Zuñac [‡]	Morona-Santiago	-02.1853, -078.3658	2200	Brito and Almendáriz (2013)
Agua Rica, SW of Limón, Gualaico–Limón–Mendez road [§]	Morona-Santiago	-03.03, -078.45	ca 1890	USNM 258754 (examined for this paper)
0.5 km E of Sapote, Gualaico–Limón–Mendez road [§]	Morona-Santiago	-03.0043, -078.5124	2393	USNM 258755 (examined for this paper)
ca. 2 km W of Sapote, Gualaico–Limón–Mendez road [§]	Morona-Santiago	-03.0080, -078.5322	2560	USNM 258756 (examined for this paper)
San Vicente, Gualaico–Limón–Mendez road [§]	Morona-Santiago	-03.0249, -078.5855	2770	USNM 260787 (examined for this paper)
Machinaza Alto [¶]	Zamora-Chinchipec	-03.7667, -078.4833	1630	Almendáriz et al. (2014)
Paquisha Alto [¶]	Zamora-Chinchipec	-03.9167, -078.5000	1900	Brito et al. (2014)
Estación Científica San Francisco, point 1	Zamora-Chinchipec	-03.9800, -079.0733	2220	MZUA.An.1084, this paper
Estación Científica San Francisco, point 2	Zamora-Chinchipec	-03.9717, -079.0733	1832	MZUA.An.1085 (this paper)

* Additional localities from the provinces of Napo, Morona-Santiago and Zamora-Chinchipec are mentioned in the webpages of AmphibiaWebEcuador (Chasiluisa et al. 2016) and AnfíbiosWebEcuador (Coloma and Duellman 2014). They are not included pending confirmation of identification and formal publication.

[†] See discussion by González Fernández (2004, 2006) and Gonzalez Fernández et al. (2009) about the position of the type locality of *Gastrotheca testudinea*.

[‡] Brito and Almendariz (2013) is a photographic guide of the amphibians of the Sangay National Park, without details about localities. The precise locality was provided by one of the coauthors: Jorge Brito (in litt. 13 April 2016).

[§] Peters (1973, fig. 24) provided specific details on these localities.

[¶] Almendáriz et al. (2014) cited *G. testudinea* from the region of Alto Machinaza region (1300–1850 m), without details about the collection point. The precise locality was provided by one of the coauthors: Jorge Brito (in litt. 13 April 2016).

[¶] Brito et al. (2014) mentioned *Gastrotheca testudinea* as a sympatric species with *Phyllomedusa ecuatoriana*, but did not provide locality data. The precise locality was provided by one of the coauthors: Jorge Brito (in litt. 13 April 2016).

that are now deposited in museums of Ecuador, USA, and Brazil (Paynter 1993, Wiley 2010). It is clear that the Olalla family was knowledgeable about the Loreto region, and careful enough as to discriminate Loreto from nearby localities (such as Avila, San José, or Sumaco; Wiley 2010). Collection localities and data by Carlos A. Olalla have been shown to be accurate (Wiley 2010). We thus consider that there is no evidence to discard the validity of the locality of Loreto for *G. testudinea*.

While the general locality of Loreto is valid, the exact collecting point of USNM 258757 is less clear. Most Olalla's specimens labelled as "Loreto" were collected in the surroundings of the town of Loreto at 400–450 m. However, some specimens were also collected along trails departing from Loreto to nearby areas and reaching up to ca 700 m (e.g., Sumaco volcano, River Suno; Cisneros-Heredia and McDiarmid 2005, 2007). Consequently, and conservatively, we propose to update the lowest elevation limit of *G. testudinea* from 1100 to 700 m.

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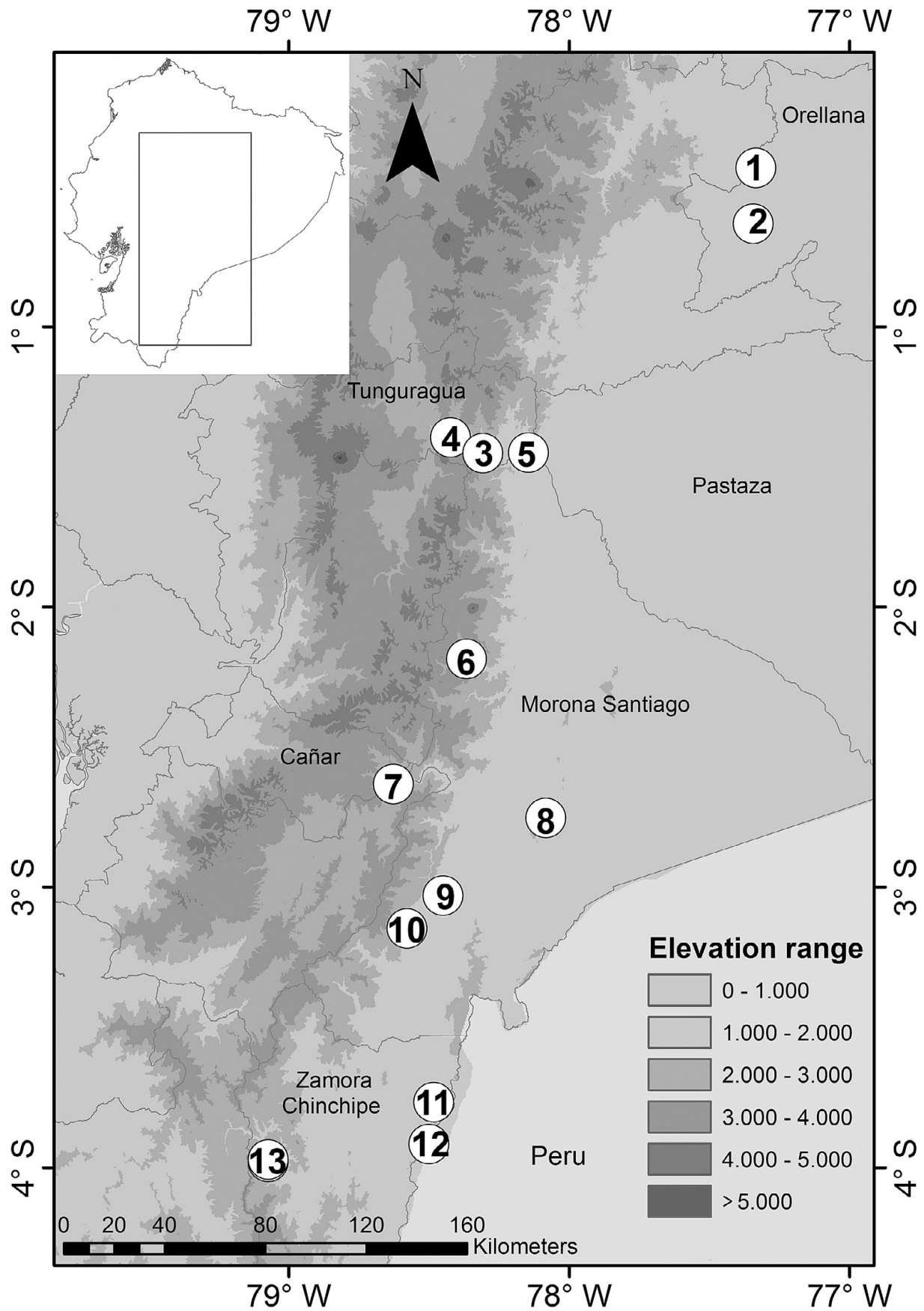


Figure 4. Map of central and southern Andes of Ecuador showing reported localities of *Gastrotheca testudinea* in the country (some numbers represent more than one nearby-locality; for additional references see Table 1): 1 San José de Moti (type locality), 2 Loreto, 3 Baños and surroundings (incl. Tungurahua volcano and River Pastaza watershed), 4 Cerro Candelaria, 5 Abitagua, 6 Zuñac, 7 Mazar dam, 8 Yapitya, 9 18.6 km SO of Plan de Milagro, 10 all localities along the Gualaceo–Limón–Mendez road, 11 Machinaza Alto; 12 Paquisha Alto, 13 Estación Científica San Francisco (both locality-points).

Authors' Contributions

VLU, JCSN and DFCH collected the data, made the analysis, and wrote the text.

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