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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 country's southernmost locality (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 *Gastrotheca testudinea* from 1100 to 700 m.

Key words: Andes; Amphibia; Anura; elevation; Hemiphractidae; new records; range extension.

Most members of the family Hemiphractidae are restricted to specific physiographic regions, with short latitudinal and elevation ranges (Duellman 2015). *Gastrotheca testudinea* (Jiménez de la Espada, 1870) is an exception, having a widespread latitudinal range along the eastern (Amazonian) slopes of the Andes of Ecuador, Peru and Bolivia, (Frost 2016; Duellman 2015). An arboreal direct-development marsupial frog, *G. testudinea* 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, *Gastrotheca 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 from few localities in the provinces of Orellana, Tungurahua, Pastaza, Morona-Santiago, and Zamora-Chinchipe (Table 1). The first goal of this paper is to report the first locality of *G. testudinea* from the province of Cañar, and the southernmost Ecuadorian locality, also corresponding to the third report in the province of Zamora-Chinchipe. Furthermore, we comment on data about 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: 302–303, Appendix 1 and Table 1). Thus, the second goal of this paper is to evaluate the lowest elevation limit of *G. testudinea*.

Specimens examined for this paper are deposited at: Museo de Zoología de Vertebrados, 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 with the locality description using Google Earth™ mapping service (7.1.5.1557 release by Google, Inc. on 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 through the Instituto Geográfico Militar.

Specimens reported herein were identified as *Gastrotheca testudinea* by its 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).

An adult male *Gastrotheca testudinea* (MZUA V.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 locality of *G. testudinea* in the province of Cañar, extending the species' distribution ca. 57 km NNW from the closest known locality (18.6 km SO of Plan de Milagro). The frog was found while vocalizing from a small branch, 1.5 m over the ground, in a riparian montane forest remnant.

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

A specimen of *Gastrotheca testudinea* (USNM 258757) collected at Loreto, province of Orellana, Ecuador, in January 1951, corresponds to the lowest known elevation for the species. Duellman and Venegas (2005) studied the specimen and, based on it, cited 550 m as the species' lowest elevation (Duellman and Venegas 2005: 302–303, Appendix 1 and Table 1). However, Duellman (2015) disregarded this locality and reported the lowest elevation of *G. testudinea* as 1100 m. Although Duellman (2015) did not cite his reasons to invalidate 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 that are now deposited in museums of Ecuador, USA and Brazil (Paynter 1993, Wiley 2010). It is clear that the Olalla family were 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). In consequence and to be conservative, we propose to change the lowest elevation limit of *Gastrotheca testudinea* from 1100 to 700 m.

ACKNOWLEDGEMENTS

VLU and JCSN are thankful to Florian Werner for his tutorship and to Danny Villalta and Fredy Nugra for their help in the field. Work by VLU and JCS was possible thanks to research funding provided by Universidad del Azuay, under budget code Fondos UDA 2016 [39, 2016]. DFCH is thankful to Jorge Brito for sharing data of his specimens of *G. testudinea* from Zuñac, Machinaza Alto and Paquisha Alto, and to Roy W. McDiarmid, George R. Zug, and W. Ron Heyer for access to specimens at USNM and provision of working space and hospitality. Work by DFCH was supported by the 2002 Research Training Program (National Museum of Natural History, Smithsonian Institution) and the Smithsonian Women's Committee; Programa “Becas de Excelencia”, Secretaría de Educación Superior, Ciencia, Tecnología e Innovación (SENESCYT), Ecuador; Universidad San Francisco de Quito USFQ; María Elena Heredia and Laura Heredia. We are grateful to the Biodiversity Heritage Library BHL and the American Museum of Natural History for making freely available important literature.

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Author contributions:

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

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

Locality*	Province	Coordinates	Elevation (in m)	Source
San José de Moti (type locality)	Orellana	-0.4334, -77.3334	n/a	Jimenez de la Espada (1870); Duellman (1974) †
Loreto	Napo	-0.6329, -77.3432	550	USNM 258757 (this paper)
Baños and surroundings (incl. Tungurahua volcano and River Pastaza watershed)	Tungurahua	-1.395368°, -78.422771°	1800	Anderson (1945); Duellman and Venegas (2005)
Cerro La Candelaria	Tungurahua	-1.4516, -78.3082	2000	Reyes-Puig et al, 2013
Abitagua	Pastaza	-1.449735°, -78.145228°	1150	Duellman and Venegas (2005); Duellman and Chávez (2010)
300 m off the Mazar dam, near Guarainag	Cañar	-2.631667, -78.626389	2200	MZUA V.An-0572, this paper
Yapitya, E slope of Cordillera del Cutucú	Morona-Santiago	-2.752534°, -78.083528°	1700	Duellman and Lynch (1988)
18.6 km SO of Plan de Milagro	Morona-Santiago	-3.147337°, -78.577838°	2275	Duellman and Hillis (1987)
Zuñac ‡	Morona-Santiago	-2.185314°, -78.365804°	2200	Brito and Almendáriz (2013)
Agua Rica, SW of Limón, Gualaceo–	Morona-Santiago	-3.03, -78.45	ca. 1890	USNM 258754,

Limón–Mendez road §				examined for this paper
0.5 km E of Sapote, Gualaceo–Limón–Mendez road §	Morona-Santiago	-3.0043, -78.5124	2393	USNM 258755, examined for this paper
ca. 2 km W of Sapote, Gualaceo–Limón–Mendez road §	Morona-Santiago	-3.0080, -78.5322	2560	USNM 258756, examined for this paper
San Vicente, Gualaceo–Limón–Mendez road §	Morona-Santiago	-3.0249, -78.5855	2770	USNM 260787, examined for this paper
Machinaza Alto	Zamora-Chinchipe	-3.7667, -78.4833	1630	Almendáriz et al. (2014)
Paquisha Alto ¶	Zamora-Chinchipe	-3.9167, -78.5	1900	Brito et al. (2014)
Estación Científica San Francisco, point 1	Zamora-Chinchipe	-3.9800054, -79.073291	2220	MZUA V.An-1084, this paper
Estación Científica San Francisco, point 2	Zamora-Chinchipe	-3.9717324, -79.07333919	1832	MZUA V.An-1085, this paper

* Additional localities from the provinces of Napo, Morona-Santiago and Zamora-Chinchipe are mentioned in the webpages of AmphibiaWebEcuador (Chasiluisa et al. 2016) and AnfibiosWebEcuador (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) discussed 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).

Figures 1–3. *Gastrotheca testudinea*. **1:** Adult male (MZUA V.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 V.An-1085), both from Estación Científica San Francisco, province of Zamora-Chinchipe, Ecuador, March and October 2015, respectively.



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).

