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PENSOFT

Pristimantis tinguichaca Brito, Ojala-Barbour, Batallas & Almendariz, 2016 (Anura, Strabomantidae): range extension and notes on variation in color pattern

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Abstract
In this paper we extend the known distribution of the endemic and recently described *Pristimantis tinguichaca* Brito et al., 2016, a terrestrial robber frog characterized by its beige and brown to dark-brown dorsal coloration, flanks with longitudinal or diagonal cream-coloured bands which are separated by brown, and reddish iris. The new records, based on two specimens collected from the Cerro Candelaria and Cerro Mayordomo reserves of Fundación Ecominga in the upper Pastaza River watershed, Tungurahua province, east-central Ecuador, represent the northern limit of the species and extend this species to the Llanganates–Sangay ecological corridor.

Keywords
Eastern Andes, endemic species, Llanganates–Sangay ecological corridor, terrarana, upper Pastaza watershed.

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Introduction

Frogs of the genus *Pristimantis* Jiménez de la Espada, 1870 reach their greatest species richness in the cloud forests of the tropical Andes of Colombia, Ecuador and Peru (Lynch and Duellman 1997; Hedges et al. 2008; Duellman and Lehr 2009; Pinto-Sánchez et al. 2012; Meza-Joya and Torres 2016). In Ecuador, members of this genus represent up to 70% of the species that form the amphibian fauna in the eastern foothills of the Andes (Reyes-Puig et al. 2014). Inventories in unexplored areas across the upper Pastaza River watershed on eastern Andes of Ecuador have increased substantially in the last 10 years, triggering the description of many new species (Reyes-Puig et al. 2010, 2013, 2019; Yánez-Muñoz et al. 2010; Reyes-Puig and Yánez-Muñoz 2012; Reyes-Puig, 2014).

We recently surveyed the anurans from several of the isolated mountains in the upper Pastaza River watershed. During these surveys, we recorded *Pristimantis tinguichaca* Brito, Ojala-Barbour, Batallas & Almendariz, 2016, a species previously known only from Sangay National Park between 2750 and 2830 m (Brito et al. 2017). The new localities extends the lower altitudinal limit of this species to 2472 m, previously thought to be 2750 m.

Methods

For taxonomic determination of the new records and measurements of the morphological variation of the species, we examined comparative specimens in the collection of División de Herpetología of Instituto Nacional de Biodiversidad (INABIO - DHMECN). Description, measurements and terminology follow the standardized format of Lynch and Duellman (1997). The diagnostic characters follow the definitions of Duellman and Lehr (2009). The collected specimens were euthanized with lidocaine, fixed in 10% formalin and preserved in 70% ethanol. The sex and age of the specimens were determined by secondary sexual characteristics (nuptial pads, vocal slits, and size) and direct inspection of the gonads through a dorsolateral incision. The following measurements were taken with calipers to nearest 0.1 mm by DFM at least three times and were averaged: snout–vent length (SVL), tibia length (TL), and foot length (FL).

Life color patterns of the specimens were assessed from field notes and photographs taken *in situ*. Geographic coordinates and elevation were recorded with a GPS unit (WGS84 datum). The examined specimens were deposited in the Instituto Nacional de Biodiversidad (INABIO - DHMECN), in Quito, Ecuador. In addition, we used GeoCat (Bachman et al. 2011) and applied the IUCN Red List Criteria (IUCN 2012) to determine the conservation status of the species.

Results

Pristimantis tinguichaca Brito, Ojala-Barbour, Batallas & Almendariz, 2016

New records. Ecuador, Province of Tungurahua • Machay Ecological Reserve owned by Fundación Ecominga (01°23′15″S, 078°15′56″W), Mario H. Yánez Muñoz, Juan Pablo Reyes-Puig and Daniela Franco Mena (collectors), 1 March 2018 (1 adult ♀, DHMECN 14426). • Cerro Candelaria Protective Forest, Fundación Ecominga (01°26′24″S, 078°18′15″W), Juan Pablo Reyes-Puig (observer), 8 March 2015 (1 individual photographed; Fig. 1.).

The two specimens were found within montane forest. The adult specimen was collected at night sitting on a palm leaf, inside the forest in shrubby vegetation at 50 cm above the soil. A second individual, a photographic record only, was within a bromeliad at ground level.

Identification. The collected specimen and the photographic record coincided with the species diagnostic characters (Brito et al. 2016), including its beige and brown to dark-brown dorsal coloration, flanks with longitudinal or diagonal cream-colored bands which are separated by brown, and reddish iris. The upper eyelid has a conical tubercle, the heel and tarsus have rounded digital pads, and the webbing on toes is widely expanded and basal (Fig. 2.).

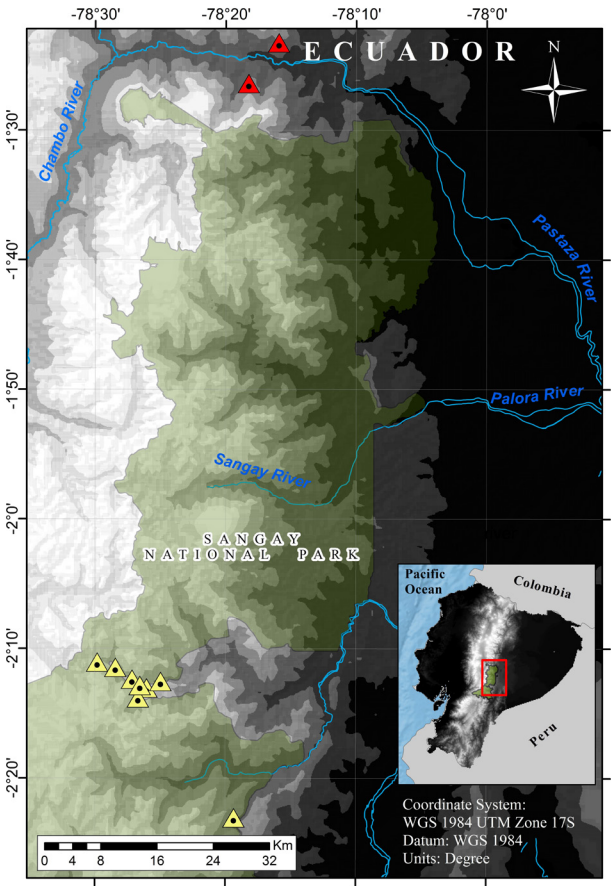

Figure 1. Distribution of *Pristimantis tinguichaca*. Yellow triangles represent the previously known distribution for the species; the red triangles are the new records in the province of Tungurahua.

Discussion

Brito et al. (2017) proposed several endemic species of *Pristimantis* from Sangay National Park. However, the new records reported here show that the distribution of *Pristimantis tinguichaca* extends beyond the northern limits of the Sangay National Park and crosses the canyon of the Pastaza River, thought to be a major barrier. More investigation is required on this species' distribution and biogeographical studies because they may be restricted to an altitudinal band of the montane forest as noted elsewhere in the area such as in Río Zuñag Reserve (Reyes-Puig et al. 2015).

The new records extend the known distribution of *P. tinguichaca* by 82 and 92 km north of the type locality, from Candelaria and Mayordomo, respectively (Brito et al. 2016, 2017; Ron et al. 2019). These records also extend the lower altitudinal limit of this species to 2472 m; it was previously known from 2750 m altitude. These two records are the first reports of *P. tinguichaca* in the province of Tungurahua and are the northernmost locations known for this species.

An additional review of the material deposited in the Division de Herpetología of the Instituto Nacional de Biodiversidad (INABIO – DHMECN; Appendix Table A2) allowed us to expand on the reported variation in

color patterns in preserved specimens of this species. The dorsal coloration varies from homogeneous brown to beige (Fig. 3.) with dark-brown, round marks on back and on the surface between the nostrils.

Pristimantis tinguichaca is reported from nine sites within Morona Santiago Province (Sangay National

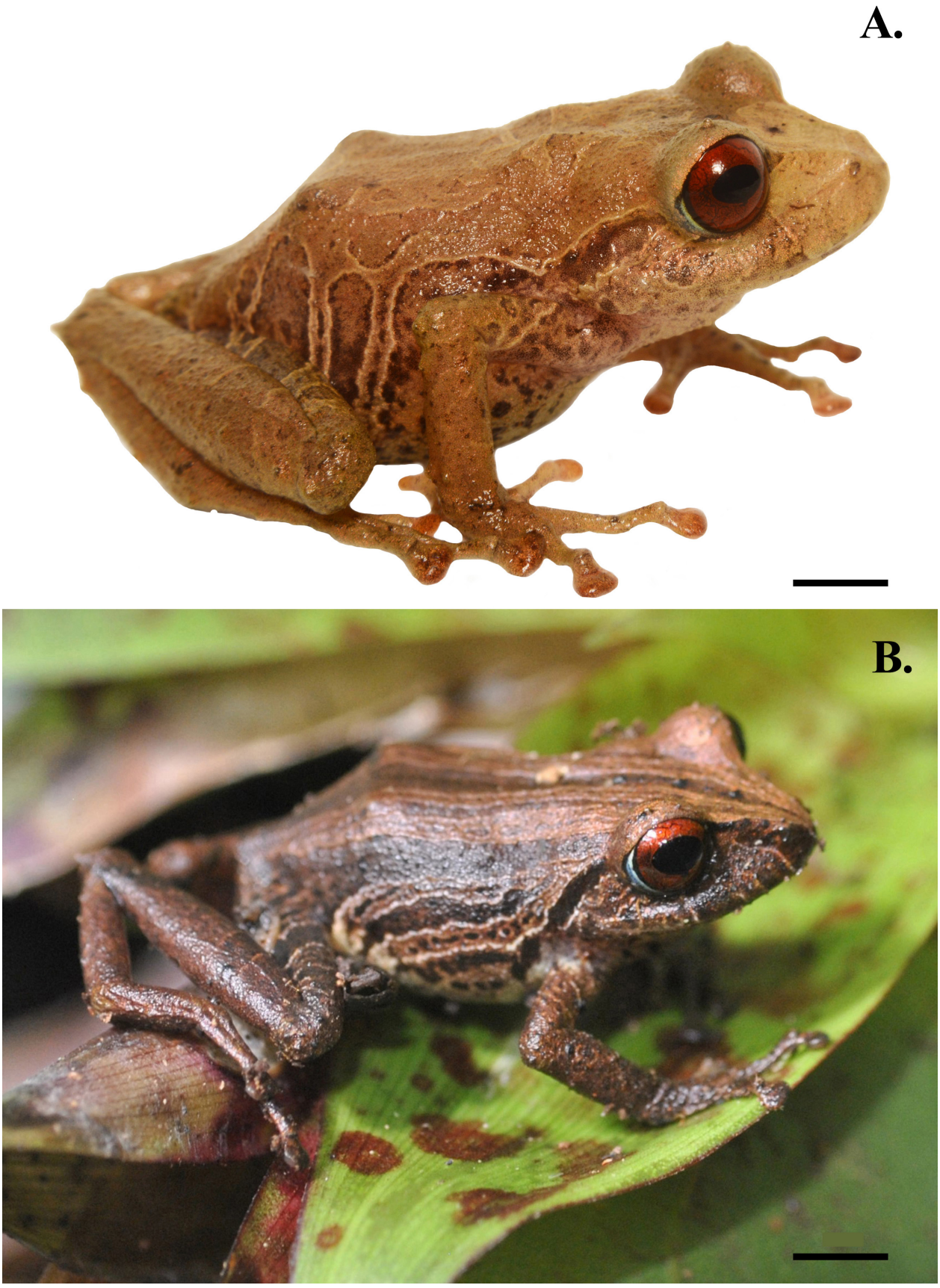

Figure 2. *Pristimantis tinguichaca* from Ecominga reserves in province of Tungurahua. **A.** DHMECN 14426. **B.** photographic record. Scale bars = 10 mm.

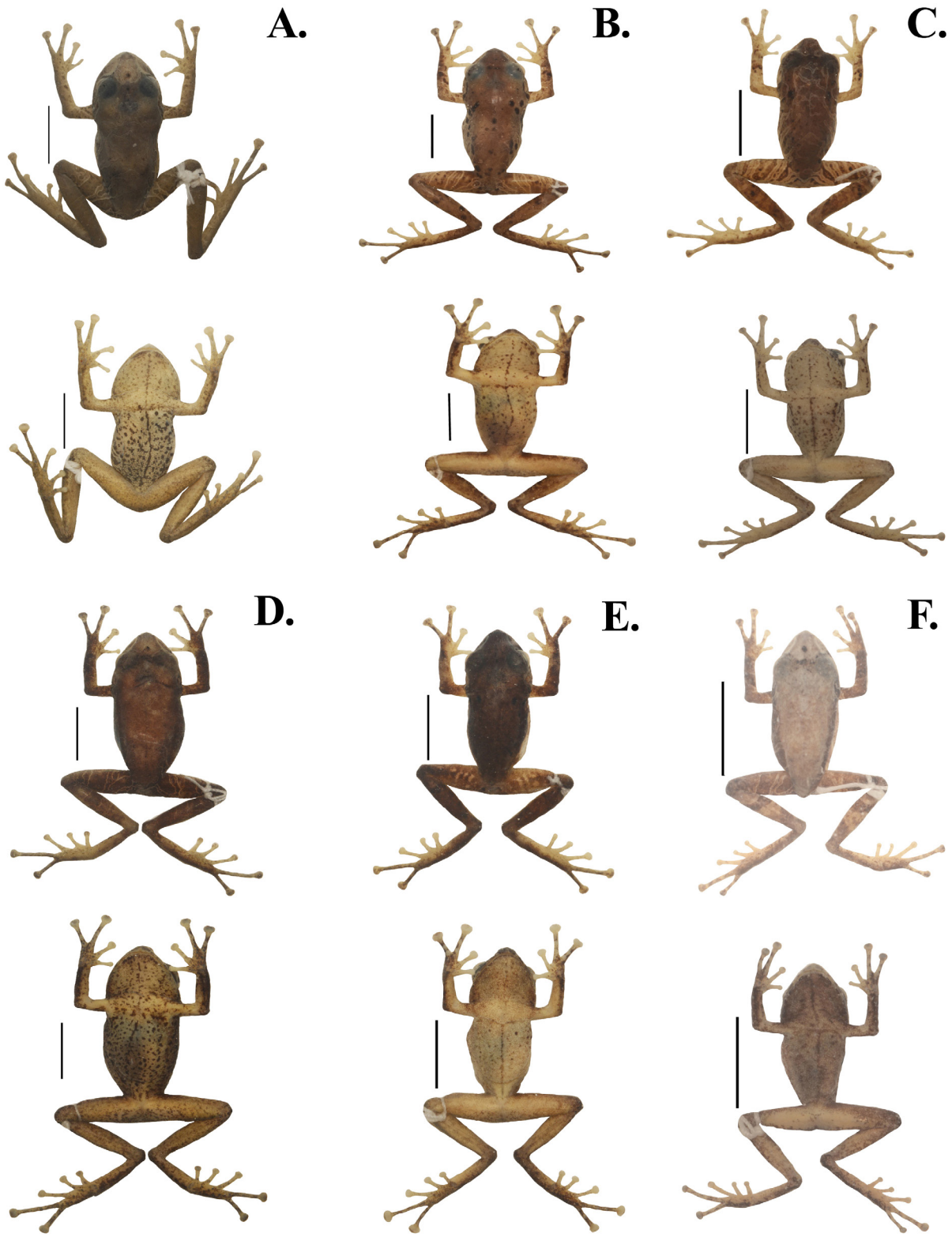

Figure 3. Dorsal and ventral variation in the series of males, females and juveniles of *Pristimantis tinguichaca*. First and second row (from left to right): **A.** DHMECN 14426. **B.** DHMECN 12293. **C.** DHMECN 12296. Third and fourth row (from left to right): **D.** DHMECN 12294. **E.** DHMECN 12295. **F.** DHMECN 12299. Scale bars = 10 mm.

Park); with the addition of new occurrence data reported here from Tungurahua, the extent of occurrence, which was calculated by enclosing all known occurrences within a convex polygon, is 1,373 km^2. This polygon is mostly located within Sangay National Park and the buffer zone of protected areas, and the new records are from new privately protected areas (Machay Ecological Reserve and Cerro Candelaria Protective Forest, Fundación Ecominga). We propose the Red List category Data Deficient (IUCN 2012) for this species because extensive adjacent areas in Sangay National Park remain unexplored.

The new records reveal the importance of additional fieldwork to fill information gaps in the diversity

and distributions of anuran communities in the upper Pastaza valley.

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Authors' Contributions

DFM, JRP, and MYM reviewed and prepared the manuscript.

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Appendix

Table A1. Records of *Pristimantis tinguichaca* (Brito et al. 2016) used in Figure 1.

No.	Country	Province	Locality	Latitude	Longitude	Source/Reference
1	Ecuador	Tungurahua	Machay Ecological Reserve	1°23′15″S	078°15′56″W	DHMECN-14426
2	Ecuador	Tungurahua	Cerro Candelaria Protective Forest	1°26′24″S	078°18′15″W	Photographic record
3	Ecuador	Morona Santiago	Tinguichaca	2°13′03.1″S	078°26′03.0″W	DHMECN-12283
4	Ecuador	Morona Santiago	Sambalán	2°12′22.1″S	078°27′09.7″W	DHMECN-12288
5	Ecuador	Morona Santiago	Tinguichaca	2°23′20.19″S	078°18′6.00″W	Brito et al. 2016
6	Ecuador	Morona Santiago	Guabisai, Sangay National Park	2°13′04.7″S	078°82′04.1″W	Brito et al. 2017
7	Ecuador	Morona Santiago	Sangay National Park	2°12′32.72″S	078°24′58.06″W	Ron et al. 2019
8	Ecuador	Morona Santiago	Sangay National Park	2°12′51.29″S	078°26′33.21″W	Ron et al. 2019
9	Ecuador	Morona Santiago	Sangay National Park	2°11′3.40″S	078°29′49.88″W	Ron et al. 2019

Table A2. Specimens of *Pristimantis tinguichaca* (Brito et al. 2016) photographed for Figure 3.

No.	Country	Province	Locality	SVL (mm)	Source
1	Ecuador	Tungurahua	Machay Ecological Reserve	26.92	DHMECN-14426
2	Ecuador	Morona Santiago	Sucua, Sangay National Park	31.11	DHMECN-12293
3	Ecuador	Morona Santiago	Sucua, Sangay National Park	19.82	DHMECN-12296
4	Ecuador	Morona Santiago	Sucua, Sangay National Park	29,47	DHMECN-12294
5	Ecuador	Morona Santiago	Sucua, Sangay National Park	24.09	DHMECN-12295
6	Ecuador	Morona Santiago	Sucua, Sangay National Park	16.30	DHMECN-12299