

New locality records and geographic distribution map of *Dendropsophus meridensis* (Rivero, 1961) (Anura: Hylidae) in the Andes of Venezuela

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Abstract: *Dendropsophus meridensis* is a medium-sized tree-frog endemic to the Cordillera de Mérida in the Venezuelan Andes. The geographic distribution of this species is poorly known, and only 10 localities known in the literature. Most of these localities do not have associated geographic coordinates and altitude. In this note we provide eight new locality records and a geographic distribution map of *D. meridensis*, based on field work, revision of Venezuelan museum collections, and species distribution modeling. Three of these new localities were found after performing species distribution modeling. Additionally, some comments on natural history and color variation are included.

Key words: Cordillera de Mérida, endemic species, Massif El Tamá, northern Andes, species distribution modeling

The genus *Dendropsophus* Fitzinger, 1843 currently comprises 99 valid species (AmphibiaWeb 2014) and is distributed from Mexico to Uruguay and northern Argentina (Frost 2014). About 23% inhabit highlands (>1,000 m) of the northern Andes. In Venezuela, there are 12 species (Barrio-Amorós 2009), of which *Dendropsophus meridensis* (Rivero, 1961) is the only species endemic to the Cordillera de Mérida (La Marca 1992). This species is included in the *labialis* species group (Duellman 1989; Faivovich *et al.* 2005; Wiens *et al.* 2010) with *D. labialis* (Peters, 1863), *D. luddeckei* Guarnizo, Escallón, Cannatella & Amézquita, 2012, and *D. pelidna* (Duellman, 1989). The later was suggested to be a junior subjective synonym of *D. meridensis* by Guarnizo *et al.* (2012), but they did not formally propose a taxonomic reassignment because their study lacked robust data. Therefore, we continue to recognize *D. pelidna* as a valid species and only refer to *D. meridensis* those populations inhabiting the Cordillera de Mérida, until such time that the taxonomic status of these taxa are clarified.

According to Rivero (1961) and Duellman (1989), *D. meridensis* is characterized by having yellow spots in the groin and the hidden surfaces of the limbs, and by being smaller than *D. labialis* (SVL of males <40 mm; SVL of females >40 mm).

It was described by Rivero (1961) from Mérida (city) and two other localities: La Culata and Chama. La Marca (1994), Barrio (1998), and La Marca (2004) mentioned eight additional localities, also in the Mérida state: La Mucuy, La Carbonera, La Culata, Monte Zerpa, Páramo de Mucubají, Páramo de El Tambor, Valle Grande, and Vía El Morro. However, only two of these localities were provided with coordinates (Table 1). *Dendropsophus meridensis* was listed as “Endangered” (EN) by the IUCN Red List (La Marca 2004) because its extent of occurrence is less than 5,000 km² and its distribution is severely fragmented, it has a high prevalence of infection of *Batrachochytrium dendrobatidis* in wild populations (Sánchez *et al.* 2008), it is sympatric with the introduced species *Lithobates catesbeianus* (reservoir for *Batrachochytrium dendrobatidis*) (Villarroel *et al.* 2013), and there is continuing decline in the extent and quality of its habitat in the Venezuelan Andes. However, based on the poorly known of its geographic distribution and natural history, this species has been categorized as “Data Deficient” (DD) in the Venezuelan Red List (Rodríguez and Rojas-Suárez 2008).

Herein, we provide new records and a geographic distribution map of *Dendropsophus meridensis* in the Cordillera de Mérida. The data were compiled from: i) examining specimens housed in several Venezuelan herpetological collections (Appendix 1); ii) revising published literature and an online database (<http://www.herpnet.org>); and iii) field work in some localities of the Cordillera de Mérida. Although the HerpNet database includes a locality at La Grita (based on two specimens collected in 1970 and housed at the USNM), this locality has not been recorded in the scientific literature or by the IUCN; we do not know the reasons why this has happened, but perhaps it is because La Grita is located out Mérida state, far from the historical localities (round the Mérida city), and no one has revised these specimens and verified its locality.

We visited the collections at the Museo de Historia Natural La Salle (MHNLS), Museo de Biología of the Universidad Central de Venezuela (MBUCV), Colección de Vertebrados of the Universidad de los Andes (CVULA), Laboratorio de Biogeografía of the Universidad de Los Andes (ULABG), and

Table 1. Locality records of *Dendropsophus meridensis*. AMNH: American Museum of Natural History; CNHM: Chicago Natural History Museum; CVULA: Colección de Vertebrados of the Universidad de los Andes; MBUCV: Museo de Biología of the Universidad Central de Venezuela; EBRG: Estación Biológica de Rancho Grande; MHNLS: Museo de Historia Natural La Salle; MCZ: Museum of Comparative Zoology, Harvard University; ULABG: Laboratorio de Biogeografía of the Universidad de Los Andes UMMZ: Museum of Zoology of the University of Michigan; USNM: National Museum of Natural History, Smithsonian Institution.

No.	Locality	Coordinates	Municipality	m a.s.l.	Museum data	Source
1	Chama	—	—	—	USNM, UMMZ, CNHM	Barrio (1998), Rivero (1961)
2	San Eusebio, La Carbonera	08°39'27" N, 071°24'09" W	Andrés Bello	2,100–2,200	CVULA*, MBUCV*, MHNLS*	Barrio (1998), La Marca (2004), this study
3	Páramo El Tambor	—	Campo Elías	2,895	ULABG*	La Marca (1994)
4	Los Suárez	08°38'34" N, 071°22'56" W	Andrés Bello	—	—	Guarnizo <i>et al.</i> (2012)
5	La Culata	08°37' N, 071° 09' W	—	2,890	AMNH, ULABG*	Barrio (1998), Rivero (1961), this study
6	Monte Zerpa – Sierra de La Culata	—	Libertador	—	—	La Marca (1994)
7	Las Cruces	—	Campo Elías	1,873	EBRG*	This study
8	Las Cruces-Miraflores	08°35'19" N, 071°20'26" W	Campo Elías	2,014	MHNLS*	This study
9	Mérida	08° 34' N, 071° 9' W	Libertador	1,300	USNM	HerpNet
10	Mérida (Type locality)	—	Libertador	1,630	MCZ (Holotype)	Rivero (1961)
11	La Mucuy	—	Mérida	2,000	MHNLS*	Barrio (1998), this study
12	San Javier del Valle	08°39'15" N, 071°07'01" W	Libertador	2,070	ULABG*, MHNLS*	This study
13	Páramo Mucubají	08°47' N, 071°48' W	—	—	—	Barrio (1998), La Marca (1994)
14	Vía El Morro	—	Libertador	—	—	Barrio (1998)
15	Sector La Sucia – vía Páramo de Mariño	08°19'05" N, 071°48'25" W	Rivas Dávila	2,076	MHNLS*	This study
16	Sector La M	08°13' N, 071°52' W	Rivas Dávila	—	—	This study
17	La Lagunita	08°09' N, 071°55' W	Jáuregui	2,483	MHNLS*	This study
18	La Grita	08°7'58" N, 071°58'58" W	Jáuregui	—	USNM	HerpNet

*Revised collections in this study.

Estación Biológica de Rancho Grande (EBRG). Voucher specimens obtained from field work were euthanized in 2% lidocaine solution, fixed in 5% formaldehyde solution, transferred to and kept in 70% ethanol, and deposited in the herpetological collection of the MHNLS under the codes MHNLS 20407–20416, MHNLS 21167–21169.

Complementarily, we performed a species distribution modeling (SDM) (Phillips *et al.* 2006) in order to infer its potential geographic distribution in the Andean region. This analysis was based on eight localities: seven were obtained from literature and herpetological collections with geographic coordinates when available, and one from our field work. We used 19 climatic variables, which were obtained of the WorldClim Project (Hijmans *et al.* 2005), and were reduced to 10: Bio2, Bio6, Bio15, Bio3, Bio4, Bio17, Bio7, Bio18, Bio16, Bio14 (see variables names in: <http://biogeobio.berkeley.edu/worldclim>), based on a Pearson correlation test, according to Pearson *et al.* (2007).

During the field work in the Mérida state, we found two new localities for *D. meridensis*. On 13 June 2011 ten specimens (three males and seven females) were collected in La Sucia sector, Sierra de Tovar, Tovar municipality, southwestern of Mérida state (08°18'35" N, 071°47'51" W; 2,070 m a.s.l. [above sea level]). These individuals were found in a pond nearby the road Tovar-Páramo de Mariño. In this site, there were some calling males between 19:00 and 20:40 h, of which three were collected. Females captured were around the water body. This locality is about 57 km southwest of the type locality and of the others reported in literature (Table 1, Figure 1). Additionally, we collected three male specimens on 3 October 2012 in San Javier del Valle, Libertador municipality, close Mérida city (08°39'15" N, 071°07'0.98" W; 2,000 m a.s.l.). These individuals were in a large artificial pond (about 200 m of diameter), at the Fundación Fe y Alegría. This pond had herbaceous vegetation

in its edge where there were many calling males between 17:30 and 20:30 h (none of those were collected). There, we observed also several individuals of *Hypsiboas crepitans* (Wied-Neuwied, 1824). In this pond was common the presence of buffaloes feeding on pastures.

The SDM predicted an environmental suitability area for *D. meridensis* including the north slope of the Sierra de La Culata (Cordillera de Mérida), northern the Cordillera de Mérida and part of the Massif El Tamá (Figure 2). The SDM shows the north slope of the Cordillera de Mérida as the area with high probability (>70%) for the presence of *D. meridensis*, followed by Massif El Tamá (Andes of Colombia and Venezuela) and the north-eastern Cordillera de Mérida (Figure 2); with a intermediate probability (40–64%), other areas of the Cordillera de Mérida and the Colombian Andes are shown as potential zones for the presence of *D. meridensis* (Figure 2). We visited part of the predicted area by the SDM with intermediate probability in the southern the Cordillera de Mérida and found new three localities: two in the Táchira state, and another in the Mérida state (Table 1). In the first of these three sites, on 24 June 2013 we heard several individuals along the road between Las Porqueras and La Grita but it was not possible to recording their calls. On 25 June 2013 we found two individuals calling in a pond the side of the road La Grita-Tovar, at 19:20 h. Of these two individuals, one was collected (MHNLS 21422), which exhibited green color with no spots (Figure 3A). At the same date, we found several individuals calling in a pond near the road at the Sector La M (municipality of Rivas Dávila, Mérida state) at 20:10 h, but they were not collected. With these findings, we confirm the presence of *D. meridensis* in the estate of Táchira as reported at the HerpNet online database.

The presence of *D. meridensis* in these new localities is not unexpected due to the characteristics of these localities: open areas and farms with ponds. Our review of collections allowed

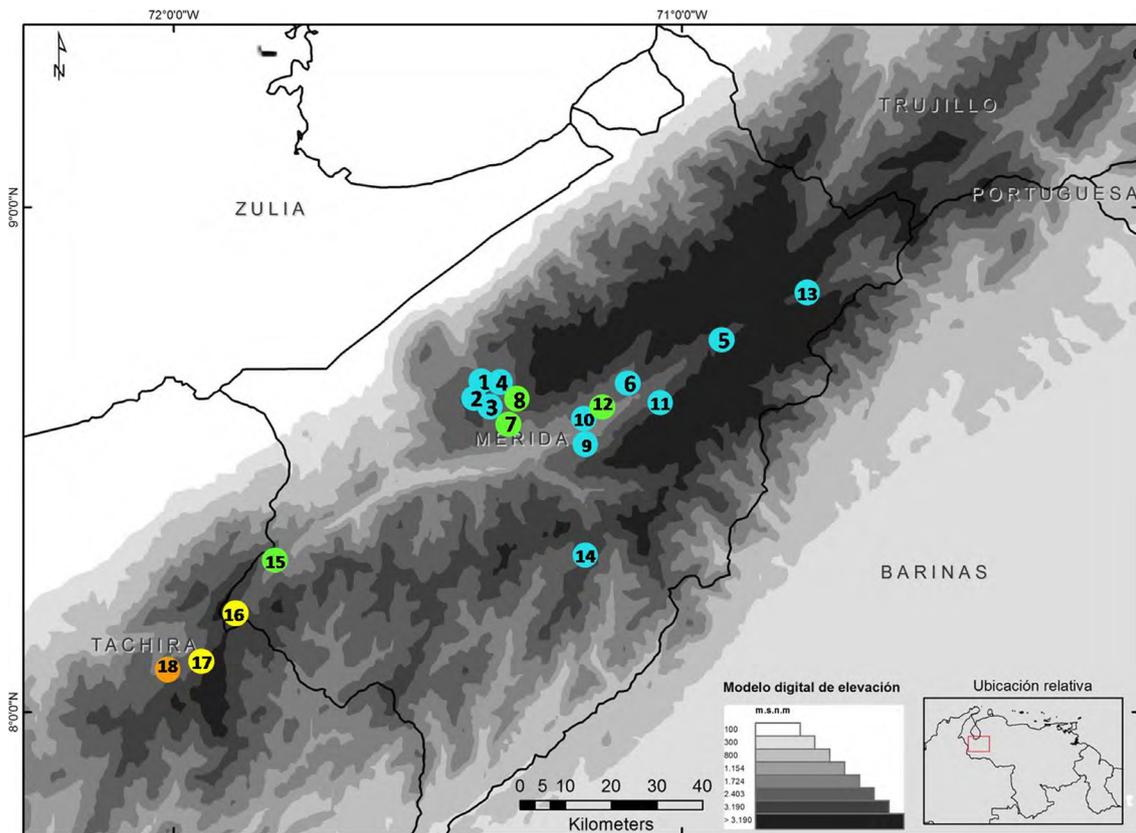


Figure 1. Geographic distribution map of *Dendropsophus meridensis*. 1. Chama; 2. San Eusebio, La Carbonera; 3. Páramo El Tambor; 4. Los Suárez; 5. La Culata; 6. Monte Zerpa; 7. Las Cruces; 8. Las Cruces-Miraflores; 9. Mérida; 10. Mérida (Type locality); 11. La Mucuy; 12. San Javier del Valle; 13. Páramo Mucubají; 14. Vía El Morro; 15. La Sucia-vía Páramo de Mariño; 16. Sector La M; 17. La Lagunita; 18. La Grita. Blue circles = localities reported in literature; green circles = museum localities reported in this study; yellow circles = new localities; orange circle = locality reported in HerpNet and confirmed in this study.

us to determine the altitudinal distribution of this species (between 1,630 and 2,895 m; Table 1). This species inhabits open and disturbed sites in cloud forest (La Marca 1994), temporary and artificial ponds with abundant grasses, and in pasturelands without nearby forest cover, as reported for other members of the *D. labialis* species group (see Guarnizo *et al.* 2012). Although the species has been reported from paramo and subparamo, its presence in these ecosystems is considered as consequence of recent invasion (La Marca 1994). These additional records and the SDM allow filling geographic gaps for *D. meridensis*, and suggest that it has a larger geographic distribution. The individuals observed by us exhibit greater color variation than previously reported. Green color is predominant as the dorsal background, but some individuals have the dorsum green but mottled with bronze, solid brown or cream. The spots on their inner surfaces of the thighs and groins can be blue with black or yellowish green; these spots may be of different sizes. We also observed that the skin of *D. meridensis* may be smooth (Figure 3B), as described by Rivero (1961), or with small tubercles (Figures 3C, 3D).

The SDM also predicted the distribution of *D. meridensis* in the Massif El Tamá, near the type locality of its sister species, *D. pelidna*, suggesting that both might coexist in this area. Although the taxonomic status of *D. pelidna* is doubtful and it is possibly synonymous with *D. meridensis*, according to a recently published study, there yet is not additional evidence to support this for now (Guarnizo *et al.* 2012).

Our results show that *D. meridensis* may have a wider geographical distribution and also indicate the usefulness of SDM

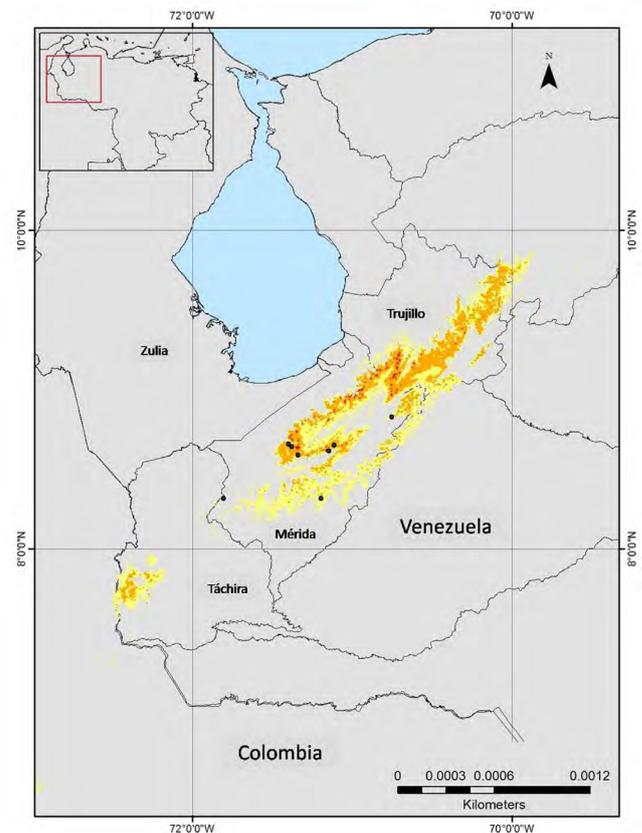


Figure 2. Potential distribution model of *Dendropsophus meridensis* in the Colombian and Venezuelan Andes. Black points indicate localities used in analyses.

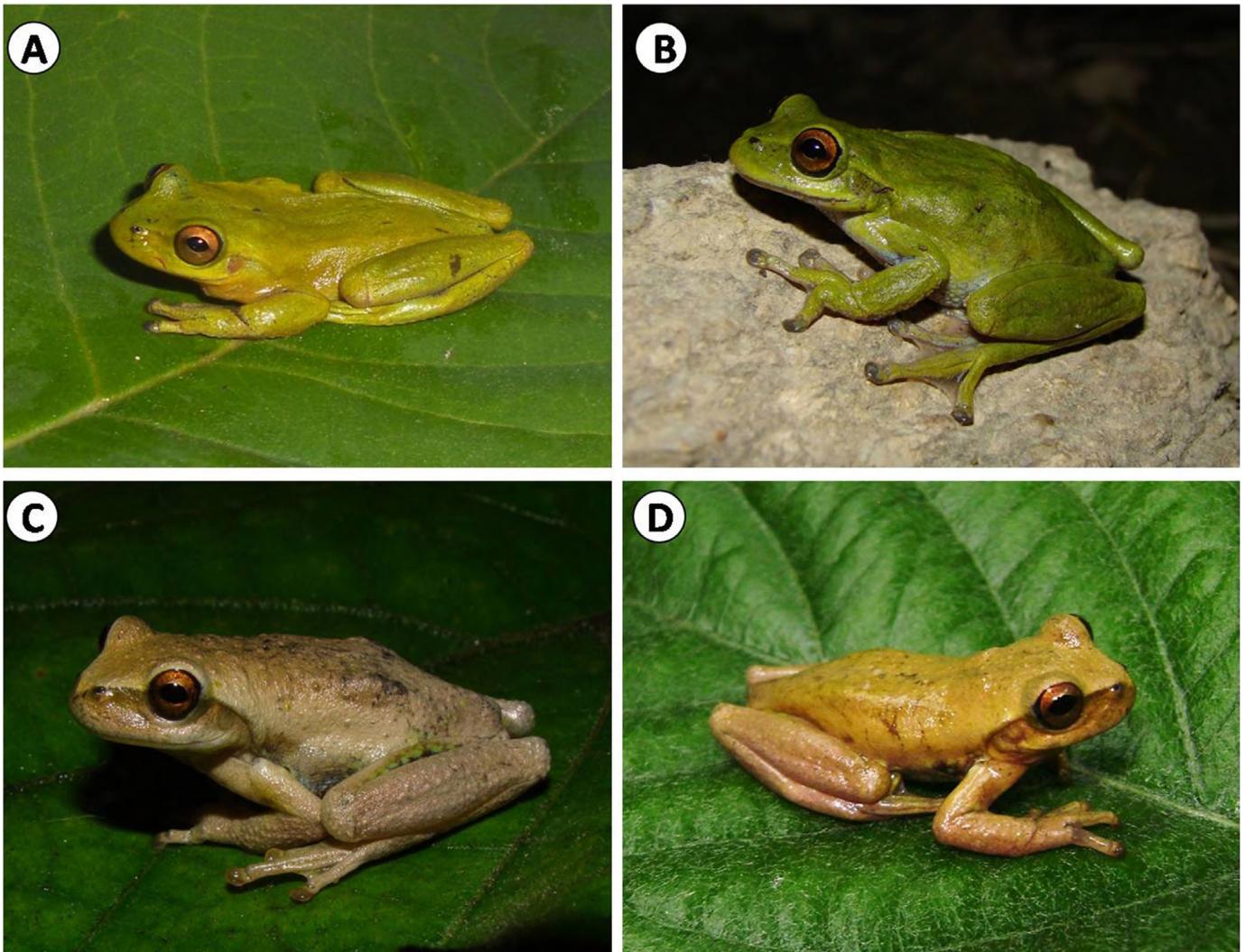


Figure 3. Individuals of *Dendropsophus meridensis* from three localities in the Cordillera de Mérida. Táchira state: (A) adult male from Las Porqueras, Jáuregui. Mérida state: (B) adult female from La Sucia, Tovar; (C) adult male from Las Cruces, Campo Elías; (D) adult male from San Javier del Valle, Libertador. Photos: O. Armesto (A, D), F.J.M. Rojas-Runjaic (B, C).

to identify suitable in Andean region for exploration. Our new localities for *D. meridensis* provide the basis for a reassessment of *D. meridensis* and show that this species is not endemic to Mérida and does not have a restricted range. Moreover, geographical predictions made from small numbers of occurrence records can be of great value, for example, in developing field studies to accelerate the discovery of unknown species and populations (Pearson *et al.* 2007). This suggests the importance of increasing field work in several areas of the Venezuelan Andes to better understand the true geographical distributions of Andean amphibians.

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APPENDIX 1. Examined specimens.

Dendropsophus meridensis: CVULA 1242–1243, 1529–1532, 2641, 2644, 3346, 3375, adult males, and CVULA 3347, 3374, adult females, from San Eusebio, La Carbonera, Andrés Bello municipality, Mérida state; MHNLS 625–629, 632–633, adult males, from La Mucuy, Mérida state (2,000 m a.s.l.), collected by G. Matos on 7 April 1952; EBRG 6024 and 6026 male and EBRG 6025, female, from Las Cruces, Campo Elías municipality, Mérida state (1,873 m a.s.l.), collected in 2009; MBUCV 4031, from San Eusebio, La Carbonera, Andrés Bello municipality, Mérida state (08°39'27" N, 071°24'09" W; 2,200 m a.s.l.); MHNLS 20327–20328, adult males, from road between Las Cruces and Miraflores (08°35'19.6" N, 071°20'06.7" W; 2,070 m a.s.l.), Campo Elías municipality, Mérida state, collected by Fernando Rojas-Runjaic on 20 November 2010; MHNLS 20407–20408, 20414, MHNLS 20409–20413, 20415–20416, adults, from Laguna La Sucia, vía al Páramo de Mariño, Tovar municipality, Mérida state, collected by Fernando Rojas-Runjaic, Orlando Armesto and Francisco Nava, on 13 June 2011; MHNLS 21167–21169, adult males, from Fundación Fe y Alegría, San Javier del Valle, Libertador municipality, Mérida state (08°39'–15" N, 071°07'–01" W; 2,000 m a.s.l.), collected by Orlando Armesto, on 3 October 2012; ULABG 1640–1644, males, and ULABG 1639, female, from Prado Verde, El Valle, Libertador municipality, Mérida state (2,070 m a.s.l.), collected on 2 March 1984; ULABG 2055 female, Páramo El Tambor, Campo Elías municipality, Mérida state (2,890 m a.s.l.), collected on 7 October 1987; ULABG 387, juvenile, Páramo La Culata, Mérida state, collected on 1 March 1979.