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REDISCOVERY OF THE TYPES OF *COLOSTETHUS MERIDENSIS*, WITH DESCRIPTION OF A RELATED NEW SPECIES AND REDESCRIPTION OF *AROMOBATES MAYORGAI* (AMPHIBIA: ANURA: DENDROBATIDAE)

ENRIQUE LA MARCA[1,3] AND LUISA MATILDE OTERO LÓPEZ[2]

[1] *Laboratorio de Biogeografía, Escuela de Geografía, Facultad de Ciencias Forestales y Ambientales, Universidad de Los Andes, Mérida, Venezuela.*

[2] *Estudiante graduada del Departamento de Biología, Facultad de Ciencias, Universidad de Los Andes, Mérida, Venezuela.*

Abstract: In this paper we discuss the rediscovery of the types of *Colostethus meridensis* (= *Aromobates meridensis*), during long time believed to be lost, give a redescription of the holotype, and redescribe its sympatran *Aromobates mayorgai*, a taxon previously known only from the type specimens. In addition, we describe a new species from the mountains of Piñango, Merida State, in the Andes of Venezuela. The new species can be diagnosed from its closely resembling *Aromobates meridensis* by being a smaller frog, bearing conspicuous lateral dermal folds on toes, having the tympanum with paler coloration, larger dark brown dorsal spots, two irregular pale bands from upper eyelids to the level of shoulders, larger oblique pale inguinal band, throat and chest with inconspicuous spots made up of fine dark stippling that do not form well-defined spots; ventral surfaces of arms and thighs almost immaculate, tarsal fold evident, more extended foot web, tip of snout more acute, and metacarpal tubercle more pronounced.

Key words: Dendrobatid frogs, Aromobatinae, Venezuela, Andes, Merida State, taxonomy, conservation.

Resumen: E. La Marca y L.M. Otero López. "Redescubrimiento de los ejemplares tipo de *Colostethus meridensis***, con descripción de una nueva especie emparentada y redescripción de** *Aromobates mayorgai* **(Amphibia: Anura: Dendrobatidae)"**. En este trabajo discutimos el redescubrimiento de los tipos de *Colostethus meridensis* (= *Aromobates meridensis*), que por mucho tiempo se creyó estaban perdidos, damos una redescripción de su holotipo, y redescribimos una especie simpátrica, *Aromobates mayorgai*, un taxón previamente conocido sólo por sus ejemplares tipo. Adicionalmente, describimos una especie nueva proveniente de las montañas de Piñango, Estado Mérida, en los Andes de Venezuela. La nueva especie puede ser diagnosticada de la muy parecida *Aromobates meridensis* por ser una rana más pequeña, con pliegues dérmicos a los lados de los dedos el pie, tímpano con coloración más clara, manchas dorsales pardo oscuras de mayor tamaño, dos bandas claras irregulares desde los párpados superiores hasta el nivel de los hombros, banda clara inguinal oblicua más larga, garganta y pecho con manchas inconspicuas conformadas por un fino punteado oscuro que no constituye manchas bien definidas; superficies ventrales de brazos y muslos casi inmaculadas, pliegue tarsiano evidente, membrana del pie con mayor extensión, punta de la nariz más aguda, y tubérculo metacarpiano más pronunciado.

Palabras clave: Ranas dendrobátidas, Aromobatinae, Venezuela, Andes, Estado Mérida, taxonomía, conservación.

INTRODUCTION

The genus *Aromobates* possesses high species diversity in the Venezuelan Andes (Barrio *et al*. 2011, Rojas-Runjaic *et al*. 2011). Most species in the genus have received little attention, and some have complex taxonomic histories.

One of such cases is that of *Aromobates meridensis*. Originally described under the genus *Colostethus* by Dole and Durant (1972), it was transferred to the genus *Nephelobates* by La Marca (1994), and lastly allocated in the genus *Aromobates* by Grant *et al*. (2006). Although actually lacking black markings on the chest, Edwards (1974a) diagnosed the species as a "collared" species, and listed the species under his "black chest bar" category of *Colostethus* frogs (Edwards 1974b:2), a trait that was later employed by La Marca (1992) to partially diagnose his genus *Mannophryne*. Edwards most likely misapplied the species name in these cases, through misidentification of the available specimens to him. Our examination of the specimens on which Edwards (1974a,b) based his description and some character states of his *Colostethus meridensis* revealed that these individuals do not actually belong to this species, but rather are members of the genus *Mannophryne*. Since the specimens are not representative of the species, and they may contribute to confusion in *Aromobates* and *Mannophryne* taxonomy, we addressed this issue and advanced a redescription of *Aromobates meridensis* during the 8th Latin American Congress of Herpetology (Otero Lopez and La Marca **2008**).

[3] Send correspondence to / *Enviar correspondencia a*:
enrique.lamarca@gmail.com

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Barrio *et al*. (**2010**) later published a redescription of *Aromobates meridensis*. Although these authors stated that they were unable to access the type series of the species, the evidence at hand to us suggests that, at least, the first author was able to handle them, albeit apparently not realizing he was dealing with the actual types (see notes below). In lieu of the later redescription, we present here (contrary to what we originally contemplated) only a redescription of the holotype, comparing it to its original description, and provide comments on additional specimens collected by the senior author in 1983. Additionally, we describe a new and closely resembling species, and provide a redescription for *A. mayorgai*, a sympatric species to *A. meridensis*.

MATERIAL AND METHODS

Morphological measurements (in mm) were taken under a dissecting stereo-microscope with a Helios® dial caliper with a precision of 0.01 mm. Measurements taken for post-metamorphic specimens were snout-vent length (SVL); head length from posterior part of the tympanum to tip of snout (HL); head width at level of tympanum (HW); eye-to-nostril distance from anterior corner of eye to center of naris (EN); internostril distance (IN); eye length from anterior to posterior corner of eye (EYE); horizontal length of tympanum (T); hand length from proximal edge of palmar tubercle to tip of finger III (HAND); tibia length from outer edge of flexed knee to heel (TL); foot length from proximal edge of outer metatarsal tubercle to tip of toe IV (FOOT). Foot-web formulae and terminology follow La Marca (1997). Sex was determined by dissection. Adults are defined as follows: males having vocal slits and enlarged testes, and females having deeply convoluted oviducts.

Museum abbreviations for specimens listed in Appendix I and in text, as follows: AMNH, American Museum of Natural History; BMNH, British Museum of Natural History; CVULA, Colección de Vertebrados de la Universidad de Los Andes, Mérida, Venezuela; FMNH, Field Museum of Natural History; KU, Kansas University herpetological collection; MCNG, Museo de Ciencias Naturales Guanare; ULABG, Colección de Anfibios y Reptiles del Laboratorio de Biogeografia de la Universidad de Los Andes, Mérida, Venezuela; UMMZ, University of Michigam, Museum of Zoology; UPRM, University of Puerto Rico at Mayagüez, herpetological collection.

TAXONOMIC ACCOUNTS

Aromobates meridensis (Dole *et* Durant, 1972)

Original designation: *Colostethus meridensis* Dole *et* Durant, 1972:191.

Aromobates meridensis is a relatively large member of the genus, being only smaller to *A. nocturnus* and *A. leopardalis*. It is unique among *Aromobates* frogs by having yellow ventral surfaces. Definition, diagnosis and description of the species, and comparison with other *Aromobates* were provided by Barrio-Amorós *et al.* (2010). In general overlook, *A. meridensis* more closely resembles the new species described herein (see account below).

Redescription of the holotype

The following description is based on the holotype (MBUCV 6168; Fig. 1a,b). Head about as wide as long, head width about 35% SVL;

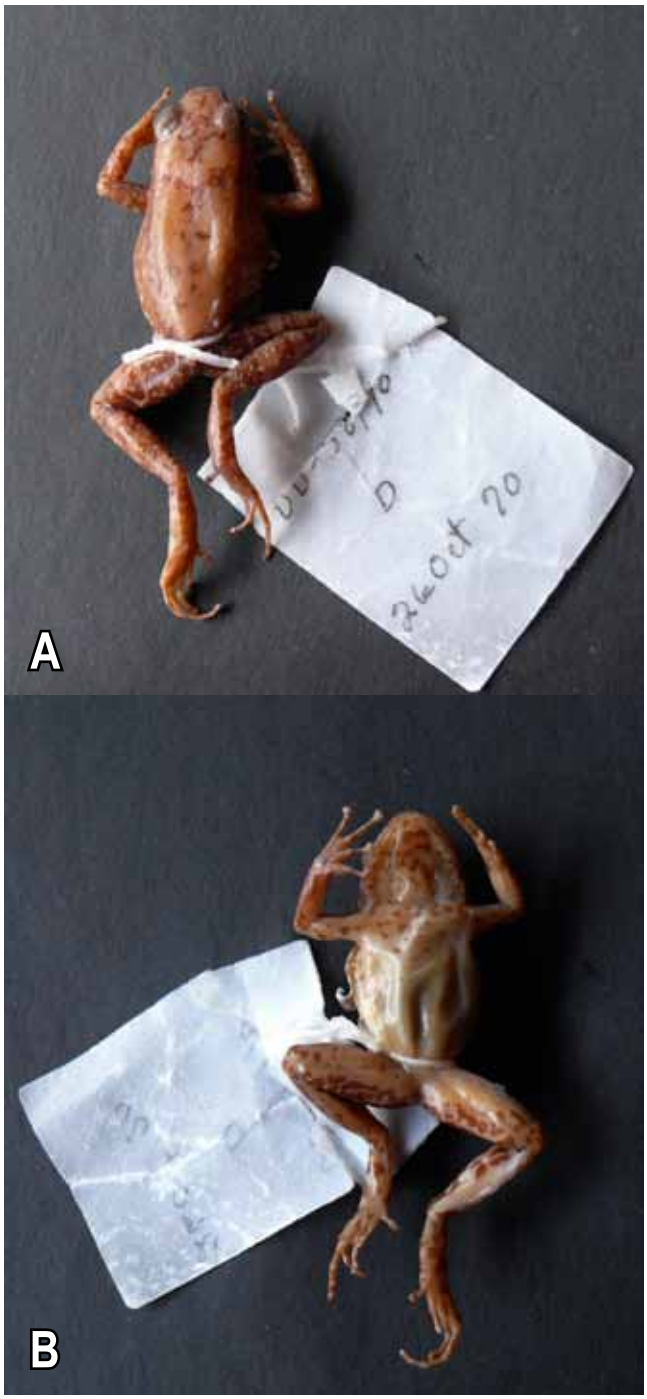

FIG. 1. Holotype of *Colostethus meridensis* (= *Aromobates meridensis*) (MBUCV 6168). (A) Dorsal view. (B) Ventral view.

Holotipo de Colostethus meridensis (= Aromobates meridensis) *(MBUCV 6168). (A) Vista dorsal. (B) Vista Ventral.*

interorbital space smooth and without any apparent craneal ridges, relatively flattened; interorbital distance about 1.4 times the upper eyelid width; canthus rostralis more or less well-defined, with a small convexity in the middle part, almost straight; nostrils not elevated, directed laterally; nostrils closer to tip of snout than to eye, about 46% of the distance between the anterior border of eye and tip of snout; loreal region relatively smooth, nearly vertical and descending abruptly to lips, slightly concave; lips slightly widen; snout subovoid; tip of snout widely rounded; length of eye about 1.6 times eye-to-nostril distance; internarial distance about 1.8 times eye-to-nostril distance; tympanum and tympanic ring not conspicuous, about 1/3 length of eye, slanted, with anterior part more elevated; tympanum separated from eye by a distance about 20% less than the horizontal length of tympanum; thick supratympanic region, without forming a fold; a single conspicuous tubercle at angle of the jaws; two tubercles posterior to corner of the mouth may be present at level of upper arm insertion, although on the left side of the body these tubercles are more conspicuous than on the right one, the size of the tubercles is slightly less than the size of pad on the third finger; tongue longer than wide, with parallel lateral borders; maximum width is 41% of length of the tongue, slightly notched in its posterior end; approximately, ¼ of the posterior part of tongue is not adherent to floor of mouth; lingual process absent; choanae rounded, completely or partially concealed by palatal shelf of maxillary arch; choanae ovoid to rounded, with the anterior border partially hidden by the palatal shelf of the maxillary arch; vomer teeth processes not evident; maxilla and premaxilla toothed; teeth pedicelate and long, not fang-like.

Dorsum finely granular, with tubercles almost imperceptible, becoming more evident towards the posterior region of the back, where they are manifested as rounded to flattened tubercles at level of groin and at the tip of the urostyle; arms and forearms with conspicuous tubercles on dorsal parts, smooth on ventral parts; flanks shagreened; a line of low dorsolateral tubercles from the level of the shoulders to level of groin; arms and forearms bearing inconspicuous tubercles through their external borders; hand length 26.9 ± 0.01% SVL (n=3); throat, chest and venter smooth; palmar tubercule single, widely rounded, about 2.5 size of thenar; thenar tubercule elevated, elongate, about twice as long as wide; supernumerary tubercles are absent; subarticular tubercles moderate-sized, inconspicuous, flattened, rounded to oval; small discs on finger, oval, slightly wider than long; largest disc on fourth finger about two times wider than width of adjacent phalanx; largest finger disc approximately 2/3 size of tympanum; discs wider than long; fingers free; broad flattened lateral fringes, more pronounced to the distal part of the fingers, more conspicuously on the second and third finger of the hand; first finger equal in length to second; second finger equal or slightly larger than first; relative length of the fingers: **II≥I<IV<III** (Fig. 2A).

Cloacal opening well above midlevel of thighs, directed posteroventrally, covered by a short, thick cloacal sheath with entire border; thighs, shanks and tarsi with flat tubercles on its dorsal parts, smooth on its ventral parts; conspicuous tubercles through the distal superior portion near to the tibiotarsal articulation; tarsal fold

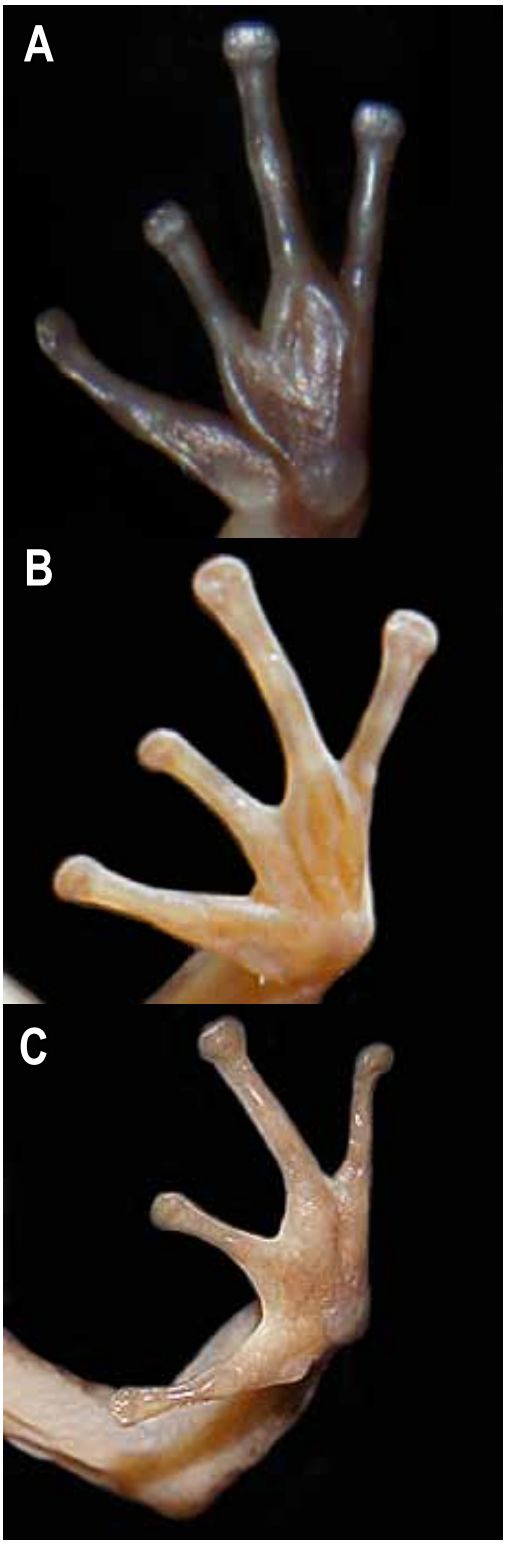

FIG. 2. Comparisons of hands of (A) *Aromobates meridensis*, MBUCV 6168 (holotype), (B) *A. sp. nov.* ULABG 2087 (holotype of species described herein); and (C) *A. mayorgai* ULABG 5225.

Comparación de manos de (A) Aromobates meridensis*, MBUCV 6168 (holotipo), (B)* A. sp. nov. *ULABG 2087 (holotipo de especie descrita aquí); y (C)* A. mayorgai *ULABG 5225.*

not very conspicuous, located on the 3/5 distal part of the tarsus, aligned with a keel-like fold on the first toe, but separated by the inner metatarsal tubercle; tarsal fold not ending in tubercle; tarsi and tibiae with little tubercles relatively aligned along their external edges; tibia conspicuously tuberculate on dorsal parts, bearing subconical tubercles moderately elevated; tibia smooth below; tibia length about 46% SVL; foot length about 48% SVL; outer metatarsal tubercle rounded in dorsal view and in lateral profile, somewhat flattened; inner metatarsal tubercle oval, about 2.5 times longer than wide, about three times larger than outer; no supernumerary tubercles; subarticular tubercles inconspicuous, flattened, rounded to oval; toes slightly webbed, foot-web formula **I**0.5-0.5**II**1-0.5**III**1-1**IV**0.5-1**V**; web between first and second, and fourth and fifth toes is basal, thickened; toes with lateral keels, more evident on toes III and IV; discs on toes wider than long; largest toe disc on third toe, about two times wider than adjacent phalanx, about 2/3 the tympanum size; tibia length about less than ½ the SVL distance; relative length of the toes: **IV>III>V>II>I** (Fig. 3A). Heels slightly overlap when thighs are held at right angle to body axis, reaching to anterior border of eye when legs are adpressed forward.

Variation

The paratypes, as well as previously unreported material coming from the vicinities of the type locality (ULABG 1004, 1013, 1017-1019), largely agree with the former description. Some noted variation in these specimens include: canthus rostralis well-defined; tip of snout almost truncate in dorsal and lateral views; tympanum separated from eye by about its own horizontal length; a single tubercle posterior to corner of the mouth may be present at level of upper arm insertion; tongue oval, entire to deeply notched; posterior 3/5 of tongue not adherent to floor of mouth; dorsum with conspicuous tubercles on lower back; flanks bearing tubercles; largest disc on third finger about 1.5 times wider than adjacent phalanx; largest finger disc about ½ size of tympanum; second and third fingers inconspicuously keeled; inner metatarsal tubercle oval, about three times longer than wide, about twice as large as outer; toe disc on third toe, about 1.6 times wider than adjacent phalanx; and heels just touch or overlap when thighs are held at right angle to body axis, reaching to posterior corner of eye.

Barrio *et al.* (2010) redescribed *Aromobates meridensis* based on specimens purportedly stated to come from the type locality. A list of these specimens was presented in their species account and later listed again in their Appendix. We assume specimens CVULA 1448, 2329 and 5062, coming from similar localities as the ones listed in the given account and Appendix were also employed in the description, although they were left out in Barrio-Amorós *et al*. (2010) list of "referred specimens" accompanying the species account. From their redescription of the species, we noted the following differences regarding the holotype description presented here: canthus rostralis straight but indistinct; nostrils directed slightly antero-laterally; snout subacuminate; tongue rounded, with posterior 1/3 not adherent to floor of mouth; no ulnar tubercles present; and keel-like fringes absent on fingers.

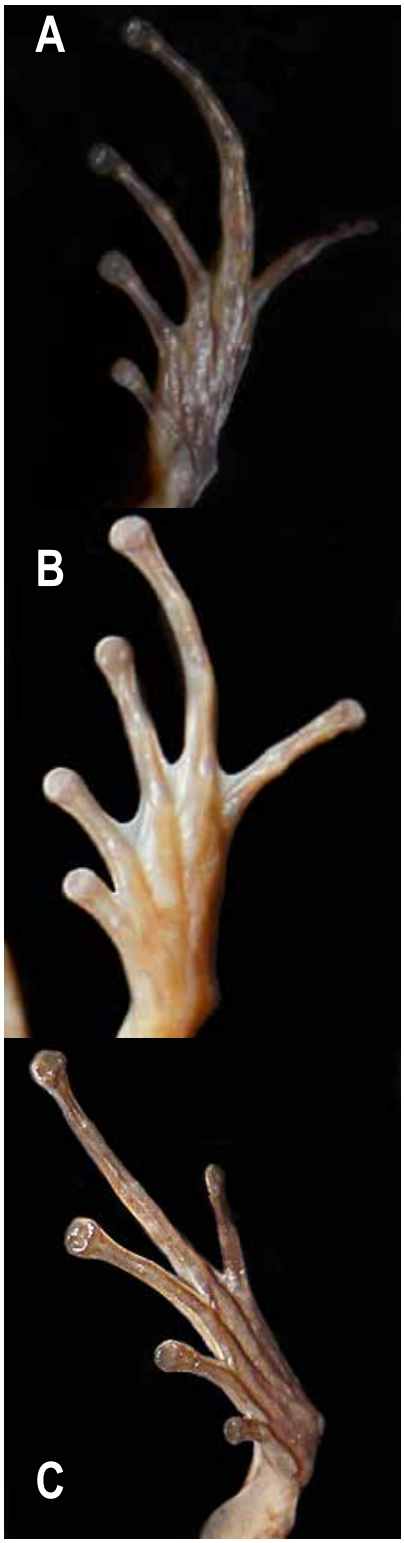

FIG. 3. Comparisons of feet of (A) *Aromobates meridensis*, MBUCV 6168 (holotype), (B) *A. sp. nov.* ULABG 2087 (holotype of species described herein); and (C) *A. mayorgai* ULABG 5225.

Comparación de pies de (A) Aromobates meridensis*, MBUCV 6168 (holotipo), (B*) A. sp. nov. *ULABG 2087 (holotipo de especie descrita aquí); y (C)* A. mayorgai *ULABG 5225.*

Coloration of the holotype in preserving solution (ethanol 70%) Dorsum pale cream, with some little dark brown spots, concentrated mainly on the head; there are no big dorsal dark spots. Arms and forearms as the dorsum, but somewhat more spotted; posterior part of the arm dark, forming almost a band. The ventral parts of the arm and forearm are cream, bearing few tiny dark spots. The fingers are like the arms and forearms in being pale brown with little brown spots; the palms are dark brown (it seems as if the color extends from the superior and inferior part of the forearm through the palms, differing from the cream color of the internal region of the forearm). Dorsal scutes on fingertips are dark brown, preceded by the cream color of the adjacent portion of the digit. Pads are bi-colored: cream on their anterior ¾, and brown on the rest. Dorsal tip of fingers are pale brown, with dark brown dorsal scutes. Hind legs brown, with large brown spots concentrated mainly on thighs. On the tibiae, the spots become bands not surrounding the tibiae, alternate with paler brown bands similar in color to spots on the dorsum. Toes with tiny pale brown spots, although blurred. Thighs marbled on their ventral part, with cream and dark brown color. Flanks dark brown, with cream-color spots; cream tiny spots from the snout and loreal region, until the groin.

Dorsum and flanks separated by a narrow band, darker than the flanks, and with the same color intensity than spots on dorsum and extremities; this band extends from tympanum and upper eyelid to upper part of flanks, ending on the urostyle. Infraorbital region bears irregular cream spots. Maxillae dark brown, bearing cream spots. Cream-colored sinuous inguinal band on the left side, extending onto the flank approximately ¼ the length from groin to insertion of arm. On the right side, there are not-connected spots, aligned in the same position, that become imperceptible towards the center of the flank. Loreal region cream, with some little brown spots. Lips pale brown with some little dark spots. Upper lip dark brown, darker than the inferior lip, bearing cream-colored irregular spots. Tongue cream color.

Throat cream, with brown spots. Chest and ventral region of arm cream with some brown spots. Tibiae and tarsi with cream bands, alternating pale and dark color. Ventral region cream, with little brown spots through the anterior portion. Palms and soles dark brown, with little cream spots. Subarticular tubercles gray. Webbing of toes cream colored, bearing inconspicuous tiny dark dots. Dermal scutes on toe tips dark brown, some of them with a paler center and darker surrounding.

Color variation in preserving solution (ethanol 70%)
Barrio *et al.* (2010) provided color pattern and variation for specimens of *Aromobates meridensis* stated to come from the type locality. Following, we provide accounts of color variation for different additional populations.

Specimens from El Chorotal, 2025 m elevation (see Appendix I) have dorsum pale brown, usually with three large spots on interorbital region, shoulders and sacral region, connected or not by a paravertebral dark stripe; a pale band may be present from anterior corner of eye-to-nostril and may surround the tip of the snout; lower lip dusted with black; upper lip with dark and pale irregular spots; wide dark canthal band surrounding snout and continuing posterior as a supratympanic band that widens at level of shoulders; dark flanks with pale round or irregular spots; an oblique pale stripe from inguinal region to mid flank or beyond; thighs, shanks and tarsi conspicuously cross-barred; pale cream bands between the narrower dark crossbars; an anterior horizontal dark bar on anterior part of thighs and upper arms; single (or coalescent) dark dots on postero-ventral surfaces of thighs and shanks; ventral surfaces pale cream; tubercles on dorsal parts of thighs generally with paler color than the rest of femoral parts; palms and soles dark. There appears to be sexual dimorphism in ventral coloration of females and males. Females have pale cream venters bearing minute dark stippling. Some conspicuous dark spots may be present on the heavily stippled throat; males with dark reticulation on throat, chest and venter, leaving rounded pale spots on upper venter; a dark chest band ("collar") is never formed (unlike *Mannophryne* frogs).

Specimens from El Chorotal, 2100 m elevation (see Appendix I), have dorsa slightly darker than the holotype, with dark spots somewhat blurred, except ULABG 1710, that presents both dark and pale spots on dorsum. Specimen ULABG 1708 has little whitish spots on venter, chest and throat, the loreal region slightly darker, and arms with darker spots. Specimen ULABG 1710 presents a large quantity of pale spots surrounding the cloacal opening (Fig. 4A) and an immaculate venter (Fig. 4B). ULABG 1708 and 1711 have few or no spots on arms, and ventral parts of thighs have slightly darker spots. Specimen ULABG 1711 lacks spots on venter, chest and throat. Specimens ULABG 1708, 1711 and 1712 bear less or more blurred spots on head, and have dark, conspicuous bands on thighs, with continuous coloration, with few or no mottling. The rest of specimens possesses bands similar to those of holotype, but darker on thighs and shanks. The band that separates dorsum from flanks is inconspicuous in ULABG 1715 and, in general, is wider. In comparison with the rest of specimens from this locality, the later specimen has hands with less quantity of spots, but darker; legs have darker spots; discs on fingers and toes are slightly darker.

Specimens from the University of Los Andes' experimental station at El Joque (see Appendix I): ULABG 2561 has darker dorsum than holotype, without conspicuous spots. Palms pale brown. Posterior extremities dark with few darker spots not forming bands. Thighs little or non-marbled. Narrow dark band, separating dorsum from flank, inconspicuous (except in specimen ULABG 2528). Inguinal band made up of interconnected dots, extending about 1/3 of flank. Flanks darker than dorsum, but the difference in color is not as big as in the holotype. Spots on neck, chest and anterior portion of abdomen are more diffuse. Bands on thighs are less contrasting than in the holotype. Flanks slightly darker than in the holotype (except ULABG 2560). Hands and feet are slightly darker and with less spots than the holotype. Loreal region darker than the holotype and, in general, more uniform regarding coloration. Arms are slightly darker and with less distinct spots. Thighs have few or no spots on ventral parts. Venter and chest spot-free (except ULABG 2561). Throat with few or no spots (except ULABG 2560 and ULABG 2561).

FIG. 4. Topotypical specimen *Aromobates meridensis* (ULABG 1710) (Field number ELM 1710). (A) Dorsal view. (B) Ventral view.

Ejemplar topotípico de Aromobates meridensis (ULABG 1710 (Número de campo ELM 1710).*(A) Vista dorsal. (B) Vista Ventral.*

Specimens from Sierra La Culata, Cabaña del Oso, 3300 m elevation (see Appendix I): Darker dorsum than the holotype, with larger quantity of spots. Bigger spots present on head. Bands on thighs and feet are darker. Band separating dorsum from flank is conspicuous in ULABG 2865 and more blurred in ULABG 2866. Darker flanks. Hands have darker spots. Legs bear darker and more contrasting spots. Discs on digits are dark in specimen ULABG 2866. Loreal region is darker and more mottled. Arms darker, with darker spots forming bands in ULABG 2866. Thighs with larger quantity of dark spots on its ventral part; tibia are more marbled in ULABG 2866. Specimen ULABG 2865 possesses fewer spots. Spots on venter and chest are darker. Throat have large amount of slightly darker spots.

Notes on Distribution and Habitat

Aromobates meridensis was previously reported to occur at elevations between 1880 and 2400 m (La Marca and García Pérez 2004b) at the type locality and surroundings SW of the city of Mérida and SSE of the town of La Azulita, in Mérida state. Barrio-Amorós *et al.* (2010) reported its presence in Altos de San Luis, near La Azulita, albeit not voucher specimens were secured. They also noted two additional records, both personal communications by Pedro Durant (one of the original describers of the species) from San Javier del Valle, on the way to La Culata and a sighting at an elevation of 3300 m, both range extensions to the NE of the city of Mérida. In Appendix I we list previously not reported specimens from the type locality of El Chorotal, at elevations from 2025 to 2100 m.asl., which fall within the previously reported range for the species, plus some specimens from El Joque (on the road between Las Cruces and La Carbonera), which represents a new distribution record closest to the town of Jají, plus an outstanding record from Sierra La Culata, on the Lake Maracaibo versant, about 40 Km ENE of type locality, at an elevation of 3300 m. The later constitutes the highest documented record, rendering credible the report of 3300 m on the way from Mérida to La Culata, which lies on the other side across the same mountain range of Sierra de La Culata, on the Chama river drainage (Fig. 5).

With the previous information, *Aromobates meridensis* is revealed as a high cloud forest species endemic to the Sierra de La Culata mountain range, in the central Venezuelan Andes. In Holdridge's Life Zone system (Ewel *et al*. 1976) the known localities fall either within the "bosque muy húmedo Montano Bajo" (very humid Lower Montane forest) or within the "bosque muy húmedo Montano" (very humid Montane forest).

Conservation

La Marca and García-Pérez (2004a) indicated that the primary threats to the species are habitat loss due to agriculture and livestock (Fig. 6) and agricultural pollution, and regarded the invasive bullfrog (*Lithobates catesbeianus*) as a threat. La Marca (2007) in a study carried out to ascertain the conservation status of populations of dendrobatid frogs in the Venezuelan Andes, pointed out that the type locality of *A. meridensis* was in a highly degraded environment, experiencing habitat fragmentation and presence, from moderate to high, of solid and liquid pollutants. Both works were overlooked by Barrio *et al.* (2010), although an account on the species in Stuart *et*

al. (2008:235) partially gathers this information. Lampo *et al*. (2008) and Barrio *et al*. (2010) reported the presence of the chytrid fungus *Batrachochytrium dendrobatidis* in specimens of this taxon, and the later authors reported that the only seemingly remaining population lives in places with unpolluted waters.

We alert that the type locality and all other known localities may be experiencing climate alterations (mainly decrease in the amount of rainfall), since clouds carrying condensed water from the plains in the South of Lake Maracaibo may have diminished after the massive deforestation that is taking place in the later area since the decade of the 1950´s.

Although habitat loss can be considered one of the main threats to *Aromobates meridensis*, the finding of specimens (ULABG 2865-2866) in the Sierra de La Culata National Park (so far the only documented record for the species within a protected area) which have a large extension of pristine forests, offer a new look to conservation of this taxon. The species was considered by La Marca and García Pérez (2004a) as a Critically Endangered species (CR/B2ab(iii), as reflected in Young *et al*. (2004) and Stuart *et al*. (2008). The first reference was overlooked by Barrio *et al*. (2010) who suggested the category as CR/A2ace; B1ab(iii,v), based on their new findings. The available record on extend of distribution and the new distribution data given in this paper, points to a refinement in the conservation status of the species. In this sense, it reflects that the area of occupancy of *Aromobates meridensis* has experienced decline and it is likely that this trend will extend onto the future; at the

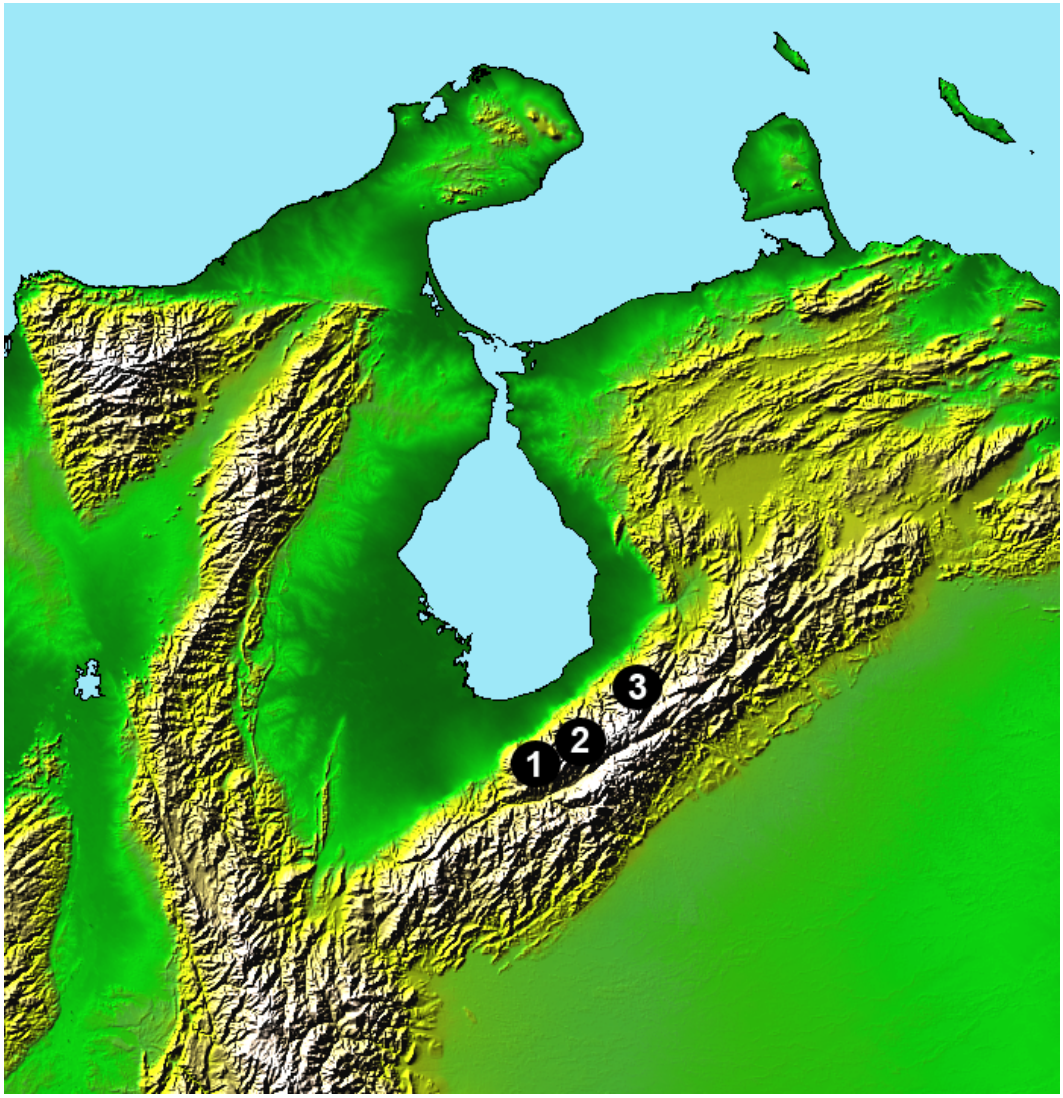

FIG. 5. Distribution map showing localities in Mérida State, Venezuela, for *Aromobates* species described in text. (1) La Azulita, El Chorotal, El Joque; for *A. meridensis* and *A. mayorgai***.** (2) San Javier de El Valle and Cabaña del Oso, in Sierra de La Culata, for *A. meridensis***.** (3) Piñango, for *Aromobates* sp. nov. described in this work.

Mapa de distribución con las localidades en el Estado Mérida, Venezuela, para especies de Aromobates *descritas en el texto. (1) La Azulita, El Chorotal, El Joque; para* A. meridensis *y* A. mayorgai*. (2) San Javier de El Valle y Cabaña del Oso, en la Sierra de La Culata, para* A. meridensis*. (3) Piñango, para* Aromobates *sp. nov. descrito en este trabajo.*

FIG. 6. Cloud forest near El Chorotal, type locality of *Aromobates meridensis*. Note deforestation and cattle ranching. From a color slide taken in July 1983 by E. La Marca.

Bosque nublado cerca de El Chorotal, localidad tipo de Aromobates meridensis. Note la deforestación y ganadería de altura. De una diapositiva tomada en julio 1983 por E. La Marca.

same time, the number of localities or subpopulations have been in decline. Additionally, although the number of mature individuals has been inferred or projected to have a continuing decline, the data is only available for only one population and it is unknown for the remaining populations that remain largely without studies. Accordingly, we suggest the category of CR/A2ace; B1ab(ii,iii,iv) to reflect our current understanding of this critically endangered endemic species.

Comments

Taxonomic re-allocations

Edwards (1974a) included a *Colostethus meridensis* account in his unpublished thesis at Kansas University; and later (Edwards 1974b:2) published a table with character states for some dendrobatid frogs then in the genus *Colostethus*. In the later paper, his *Colostethus meridensis* was listed as a distinctly webbed species with 'Black chest bar present'.

Specimens in KU most likely used by Edwards (1974a,b) were studied by the senior author to ascertain their identity. It turned out that only KU 133213-33214 (adults) and KU 139461 (tadpoles) were listed in KU as *Colostethus meridensis*. Specimen KU 133213 was referred to *M. collaris* (Boulenger, 1912), while KU 133214 represents *M. cordilleriana* La Marca, 1994 (See Appendix I for a list detailing locality data for specimens studied by Edwards). Both specimens bear a dark collar on chest, reason why we infer they were used by Edwards (1974b:2) to erroneously state that *Aromobates meridensis* (then within the genus *Colostethus*) had a "Black chest bar present"; albeit the later species actually lacks this trait. We did not check larvae in lot KU 139461, from same locality as KU 133213; therefore, we are not sure about their taxonomic identity. These larvae most probably were used in Edward's (1974a) unpublished thesis for the description of the larvae of *C. meridensis*. We warn about the identification based on locality, since three dendrobatid frogs, *Aromobates mayorgai*, *A. meridensis* and *Mannophryne* cf. *collaris* live in the same general area.

Comments on types

The type series of *Colostethus meridensis* Dole *et* Durant, 1972, during a long time was believed to be lost (Delia Rada, MBUCV, *in*

FIG. 7. Type specimens of *Colostethus meridensis* Dole *et* Durant, 1972 (=*Aromobates meridensis*). From left to right (specimens bearing original field tags, not museum numbers; see text): DD 38/70 A, DD-39[sic! see text]/70 B, DD-38/70 C, DD 38/70 D (holotype), and DD 38/70 E.

Ejemplares tipo de Colostethus meridensis *Dole et Durant, 1972 (=*Aromobates meridensis*). De izquierda a derecha (ejemplares con etiquetas de campo originales, no son números de museo; ver texto): DD 38/70 A, DD-39[sic! ver texto]/70 B, DD-38/70 C, DD 38/70 D (holotipo), y DD 38/70 E.*

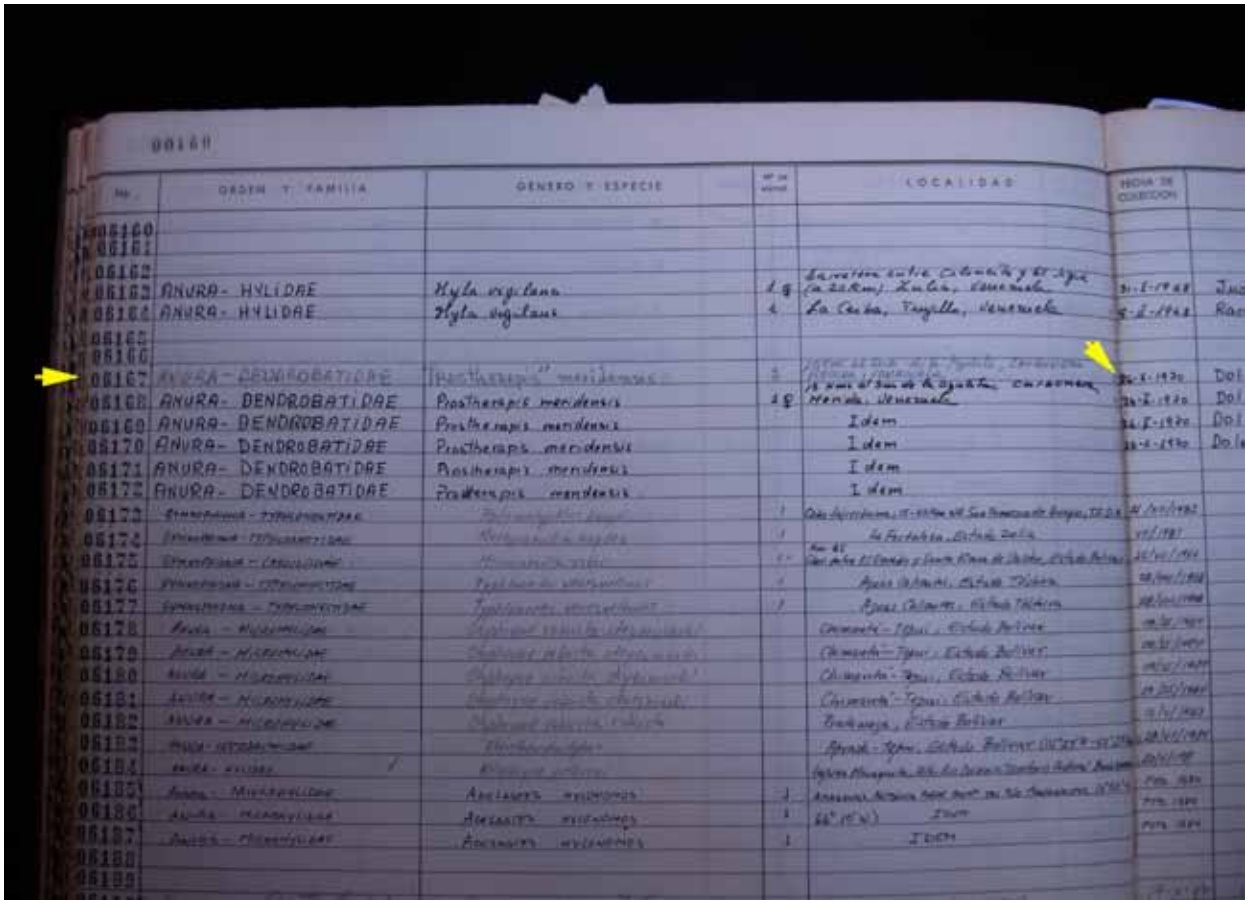

FIG. 8. Detail of MBUCV Catalog (facing pages '00160') to pinpoint (left arrow) additional entry (06167) apparently created (note different handwriting and color) to match date of collection of *Colostethus meridensis*' holotype accidentally (most probably; see right arrow) filled out on the wrong line of opposite facing page. See text for more details.

Detalle del Catálogo del MBUCV (páginas opuestas '00160') para destacar (flecha a la izquierda) entrada adicional (06167) aparentemente creada (note el tipo de escritura y color diferentes) para corresponderse con la fecha de colección del holotipo de Colostethus meridensis accidentalmente (muy probablemente; ver flecha a la derecha) escrita en la línea opuesta equivocada de la siguiente página. Ver texto para más detalles.

litt. 11 January 1991; Pedro Durant, CVULA, pers. comm., 1991; both to ELM). During a study visit to the herpetology section at the Museum of Biology at the Universidad Central de Venezuela (MBUCV) in Caracas, where the types were originally deposited, the senior author found a jar with five preserved frogs, with a free label inside (dimensions 10 x 2.5 mm) indicating on one side: "Museo de Biología, U.C.V. MBUCV: 6645. *Nephelobates meridensis*. Det. Cesar Barrio"; on the other side of the label showing: "Col.:??? La Carbonera- Merida. 26/X/70". Curator Mercedes Salazar told the senior author that she thought the re-cataloging of all these specimens under this single number was done about a week before his visit on 26 May 2000.

The five specimens (Fig. 7) did not have any museum numbers attached to their bodies; rather they have hand-written delicate white paper-bond labels written most likely with 'Chinese' ink. All the tags are in their lower part dated "26 Oct 70", and each is identified separately in their middle part with the letters "A", "B", "C", "D" and "E", and having in common an upper indication "DD-38/70" (with the exception of specimen "B" which bears the indication "DD-39/70"). The label (of about 43.5 x 32.0 mm) identified by the letter "D" was ripped apart at its upper part; the later remaining attached to the frog at the pelvic region, perhaps indicative of further handling of the specimen before our examination, while the rest of it was free inside the containing jar.

The shape of specimen "D" agrees with the figured holotype specimen in the original description of *Colostethus meridensis* (compare Fig. 1 here with Fig. 1 in Dole and Durant 1972:193). Furthermore, the abbreviations "DD" in all the labels most likely refer to the last names of Jim Dole and Pedro Durant, the collectors and original describers of the species, while "70" likely refers to the year of collection (1970). The number "38" in the combination "38/70" we assume refer to the collection site or protocol for that specific year, reason why we interpret the indication "DD 39/70" as *lapsus calami* for DD 38/70. An alternative explanation is that this specimen comes from another site or another collecting protocol, something we discard in face of the information given in the original description stating that

all paratypes bear the same data as holotype.

With all this information at hand, we conclude that the five specimens now catalogued with the single museum number MBUCV 6645 constitute indeed the type series of *Colostethus meridensis* Dole *et* Durant, 1970. It is evident that this label, having the determination of the species as "*Nephelobates meridensis*" by Cesar Barrio, is of more recent data than the original deposition of the types in the museum. We do not know when this label was written, but it was already in place by the time of our visit. Although Mr. Barrio identified them correctly as *Nephelobates meridensis*, apparently he was unaware that he was handling the actual type series of the species, as inferred from the paper he coauthored (Barrio *et al*. 2010) where they stated that they were unable to access the type of the species. If these are the types of *Colostethus meridensis*, and all the available evidence points to that, the re-cataloging process of this type series under the number MBUCV 6645 should be considered invalid and the original museum deposition numbers (MBUCV 6168 to 6172; five individual numbers) must be restored and maintained associated with the type specimens (although we could not find evidence of association of each of the individual types "A", "B", "C" and "E" to specific museum numbers; only specimen "D" being referred in the original description as the holotype, MBUCV 6168). We have to point out that, additionally, to date, these are the only specimens recorded in MBUCV with the name "*meridensis*" under any dendrobatid genus.

In the museum catalog at the herpetology section of MBUCV (on facing pages, each numbered "00160") there are five entrances corresponding to equal numbers that we could match with those given in the original publication of the type series of *Colostethus meridensis*; namely, MBUCV 6168 (identified as the holotype in the original description) and 6169, 6170, 6171 and 6172 (identified as paratypes in the original description). All of them are identified as *Prostherapis meridensis* in the catalog entries (in spite of being originally described as *Colostethus*); the holotype is explicitly stated to come from "15 kms al sur de la azulita, carbonera, Merida, Venezuela" (somewhat different from the original, stated to be "from "Chorotal," 15 km south east of Azulita, Mérida State, Venezuela") while for each of the other a quotation mark was employed to indicate that they come from the same locality. It seems as if there was a mistake in matching the line with the holotype's data (Catalog number, Order and Family, Genus and Species, Number of specimens, Locality) with the corresponding opposite line with additional information (Collection date, Collector, Altitude, Identifier, Comments), a mistake that generates a mismatch for each subsequent type specimen entry (Fig. 8). Hence, the collection date, and subsequent data, for specimen MBUCV 6168 (the holotype, according to original description) falls one line above on the facing catalog's page, thus making it actually pertaining to catalog entry 06167. Another person most probably filled the data on the first page for this later specimen (entry that was most likely empty by the time the types were registered in the catalog, as deducted from the different type of ink and handwriting), accidentally "creating" a new entry that could be mistaken with another "type specimen", or even worst, with the holotype, since as such is identified in the comments ("Observaciones") of this particular line's entry! To create more confusion, there are missing data for entries 06171 and 06172 on the opposite facing page, with only 06171 indicated as "Paratipo" in the comments' ("Observaciones") column; consequently, leaving 06172 without any indication of being a type specimen, although actually being such. We emphasize that entry MBUCV 06167 (if any specimen was ever recorded under that number) is not part of the type series of the original taxon *Colostethus meridensis* Dole *et* Durant, 1972 (= *Aromobates meridensis*), and that all museum numbers published in the original description must be maintained.

Aromobates walterarpi sp. nov.
Figs. 9, 10

Holotype: ULABG 2087 (Field number ELM 2087), an adult female (Fig. 9) from stream at about 500 m away from 'Plaza Bolívar' of Piñango, close to the cemetery, on the road from Piñango to Pico El Águila 2325 m (9º01'59.8''N 70º53'02.5''W), Estado Mérida, Venezuela; collected on 12 June 1988 by Enrique La Marca, Juan Elías García Pérez, Abraham Mijares, and Hans-Peter Reinthaler.

Paratopotypes: ULABG 2085-2086, 2088-2094, bearing the same data as holotype; and ULABG 1575-1586, 1588-1589, collected on 17 August 1985 by Enrique La Marca and Juan Elías García Pérez.

Additional material: ULABG 461-466, ULABG 467 (tadpoles), collected by Enrique La Marca and Ingo García, 22 July 1981, from type locality; ULABG 1587 (tadpoles), same data as holotype.

Etymology

This new species is dedicated to our common friend and inspirer, Walter Arp (1927-2006), painter, naturalist and poet who for more than fifty years dedicated himself to the study, illustration and divulgation of the Venezuelan bird fauna. His passion for nature led him to explore most of Venezuela, with the Andes being one of his favorite places.

Definition and diagnosis

A relatively medium-sized *Aromobates* (mean SVL; males: 21.9 mm, females: 26.2 mm) distinguished from other *Aromobates* by the following combination of characters: (1) skin of dorsum finely granular, bearing inconspicuous rounded to oval tubercles on lower back; (2) tympanum and tympanic annulus not conspicuous; supratympanic region thickened, without forming a fold; (3) snout subovoid; tip of snout sub-triangular; (4) canthus rostralis very well defined; (5) length of eye 1.8 times greater than eye-to-nostril distance; (6) upper eyelid width narrow, about 0.6 times the interorbital distance; (7) first finger equal or slightly longer than second; (8) disc on third finger more than 3/5 size of tympanum; (9) keels on fingers absent; (10) third finger not swollen in male; (11) short thick cloacal fold, with entire free border; (12) tarsal fold distinct, raised, not ending in tubercle; (13) inner metatarsal tubercle oval, about 2.5 times larger than rounded outer; (14) toes conspicuously webbed, web formula **I**1.5-0.5**II**1.5-1**III**1.5-1**IV**1-1.5**V**; (15) third toe bearing conspicuous folding flaps; (16) discs on toes slightly larger than those on fingers;

(17) dorsolateral stripe absent; (18) pale, oblique inguinal stripe present; (19) ventrolateral stripe absent; (20) collar absent; (21) throat with pale brown irregular markings; (22) venter whitish, immaculate; (23) teeth of moderate size, robust, slightly curved backwards; (24) lingual process absent; (25) pad absent on distal portion of forearms in males; (26) testes cream.

The species most closely resembling *Aromobates walterarpi* sp. nov. is *A. meridensis*. The new species can be diagnosed from the later (characters of *A. meridensis* given within parentheses), by being a smaller frog (larger; see Table 1), and having the tip of snout more acute (rounded), tympanum with paler coloration (darker), larger dark brown dorsal spots (smaller), two irregular bands from upper eyelids to the level of shoulders (absent), oblique inguinal band larger (shorter), throat and chest with inconspicuous spots made up of fine dark stippling that do not form well-defined spots (having discrete dark brown spots), ventral surfaces of arms and thighs almost immaculate (well-differentiated dark brown little spots), tarsal fold evident (almost absent), metacarpal tubercle more pronounced (less pronounced), tend to have a more extended foot web (less webbed), and bearing conspicuous folding flaps on toes (bearing keels).

Description of the holotype

Adult female with mature eggs (ova about 2.8 mm in diameter) (Figs. 9, 10). Head approximately as long as wide (width 95% of the HL); interorbital region smooth, without any apparent cranial ridges, relatively flat; upper eyelid width about 0.6 times the interorbital distance; canthus rostralis very well defined, sharp and straight on the left side and just straight on the right; nares closer to tip of the snout than to eye (29.7% of the distance from tip of the snout to anterior border of eye); eye-to-nostril distance about 60% of the total length of eye; eye-to-nostril distance about

FIG. 9. *Photo in life of holotype of Aromobates walterarpi* sp. nov. (ULABG 2087), coming from Piñango, estado Mérida, Venezuela, 2325 m.asl. From a color slide by Enrique La Marca.

Foto en vida del holotipo de Aromobates walterarpi *sp. nov. (ULABG 2087), proveniente de Piñango, estado Mérida, Venezuela, 2325 msnm. De una diapositiva a color tomada por Enrique La Marca.*

TABLE 1. Comparison of measurements between *Aromobates meridensis* and *Aromobates walterarpi* sp. nov. For abreviations, see section on Materials and Methods.
TABLA 1. *Comparación de medidas entre* Aromobates meridensis *y* Aromobates walterarpi *sp. nov. Para abreviaciones, ver sección de Materiales y Métodos.*

Aromobates meridensis	SVL	TL	HW	HL	T	EYE	EN	IN	HAND	FOOT
	29.17±3.28 (23.7-32.7)	14.21±1.71 (11.6-15.6)	9.44±1.37 (7.6-11.6)	9.81±1.22 (8.4-12)	1.69±0.29 (1.3-2)	3.74±0.5 (3.1-4.6)	2.11±0.11 (1.9-2.2)	3.54±0.46 (3-4.5)	8.30±0.93 (6.7-9.2)	14.18±1.35 (12.3-16.5)
Aromobates walterarpi	SVL	TL	HW	HL	T	EYE	EN	IN	HAND	FOOT
	24.61±2.68 (19.6-28.6)	12.15±1.18 (9.7-13.5)	8.03±1.04 (6.0-9.4)	8.39±0.97 (6.5-9.9)	1.18±0.17 (1.0-1.6)	3.08±0.37 (2.5-3.8)	1.81±0.28 (1.2-2.2)	2.82±0.32 (2.3-3.2)	7.51±0.72 (6.4-8.9)	11.91±1.22 (10.3-13.9)

36% shorter than the internostril distance; loreal region relatively smooth and almost vertical, descending abruptly to lips; lips not expanded; snout subovoid; tip of snout subtriangular; distance between anterior border of tympanum and posterior border of eye about 60% the length of tympanum; tympanum and tympanic ring little conspicuous; thick supratympanic region, without forming a fold, on posterior and superior part of the tympanum; one posterior coalescent tubercle at angle of jaws (more evident on the right side) with the width of tubercle slightly minor than the width of the disc of the third finger; tongue piriform, 25% longer than wide; lingual process not evident; posterior part of tongue not adherent to floor of mouth in approximately ¼ of the total length of tongue; lingual process absent; choanae rounded to ovoid, partially hidden by the anterior border of the palatal shelf of maxillary arch; dentigerous processes of vomer not evident; maxilla and premaxilla toothed; teeth of moderate size, robust, slightly curved backwards.

Dorsum finely granular, bearing almost imperceptible rounded to ovoid tubercles that are located towards the posterior part of dorsum, close to urostyle; flanks shagreened; throat, chest and venter, smooth; thenar tubercle oval, not very elevated, approximately twice longer than wide (approximately 1.5 times the size of the palmar tubercle); palmar tubercle rounded; no supernumerary tubercles; subarticular tubercles flattened, rounded to oval in shape; discs of the fingers ovoid, slightly wider than long; largest discs are those on fingers III and IV, being IV the largest; disc width in finger IV, 1.6 times wider than adjacent phalanx; biggest disc on fingers cover approximately 4/5 of tympanum; keels on fingers absent; first finger equal or slightly larger than second; relative length of fingers: **I≥II<IV<III**; third finger not engrossed; nuptial excrescences absent (Fig. 2B).

Cloacal opening at midlevel of thighs, covered by a cloacal fold with an entire free border; thighs smooth, without tubercles; length of tibia about 47% the snout-to-vent distance; ventral and dorsal sides of tibiae smooth; tarsal fold conspicuous, elevated, not ending in tubercle; tarsal fold located towards half distal portion of tarsum, aligned with dermal keel coming alongside border of first toe, although separated by the metatarsal inner tubercle; inner metatarsal tubercle ovoid, approximately three times longer than wide and 2.5 bigger than the external metatarsal tubercle; no supernumerary tubercles; subarticular tubercles ovoid, flattened and little conspicuous; toes webbed; foot-web formula: **I**(1.5-2)-(0.5-1) **II**(1-1.5)-(0.5-1)**III**(1.5-2)-(1-1.5)**IV**(1-1.5)-1.5**V** (Fig. 3B); toes with very conspicuous membranous keels, especially along toes I, II and III; folds along toe IV tend to be flap-like; discs on toes slightly larger than those on fingers; largest disc on toe III, about 55% wider than preceding phalanx.

Heels do not overlap when thighs are held at right angles to body axis, reaching to posterior corner of eye when legs are adpressed forward.

Measurements (in mm) of the holotype
SVL 28.6, TL 13.4, HW 9.3, HL 9.8, T 1.0, EYE 3.6, EN 2.2, IN 3.1, HAND 8.9, FOOT 13.9.

Coloration of holotype in life
Throat, chest and belly whitish, with a yellowish-green tinge; thighs, ventrally, cream on its anterior part and pale orange on its posterior portion; dermal scutes on tip of digits, gray to whitish; short inguinal band cream with a greenish tinge; irregular dark brown (with a greenish tinge) spots on a pale brown background; posterior extremities with dark brown bands; iris golden (Fig. 9)(ELM field notes, 17 August 1985).

Coloration of the holotype in preserving solution (ethanol 70%)
Pale brown dorsum from tip of the snout to urostyle, bearing large dark brown blotches on the posterior and medium part of back, becoming smaller on head (Fig. 10A). Arms cream colored with brown spots more noticeable on elbows and near wrist. Forearm and arm cream on their ventral sides, with brown markings, mostly on the external side of forearms. There is a dark-brown band on the anterior part of forearm. Upper part of hands cream, with pale brown spots concentrated on the third and fourth fingers. Palms brown. Hand tubercles brown-gray, same as finger discs, but the later are paler toward their central part and darker on their posterior part.

Legs are cream, with brown markings that are concentrated to form stripes that do not get around the leg; dark stripes on the dorsal part of the legs, making an irregular band when thighs and

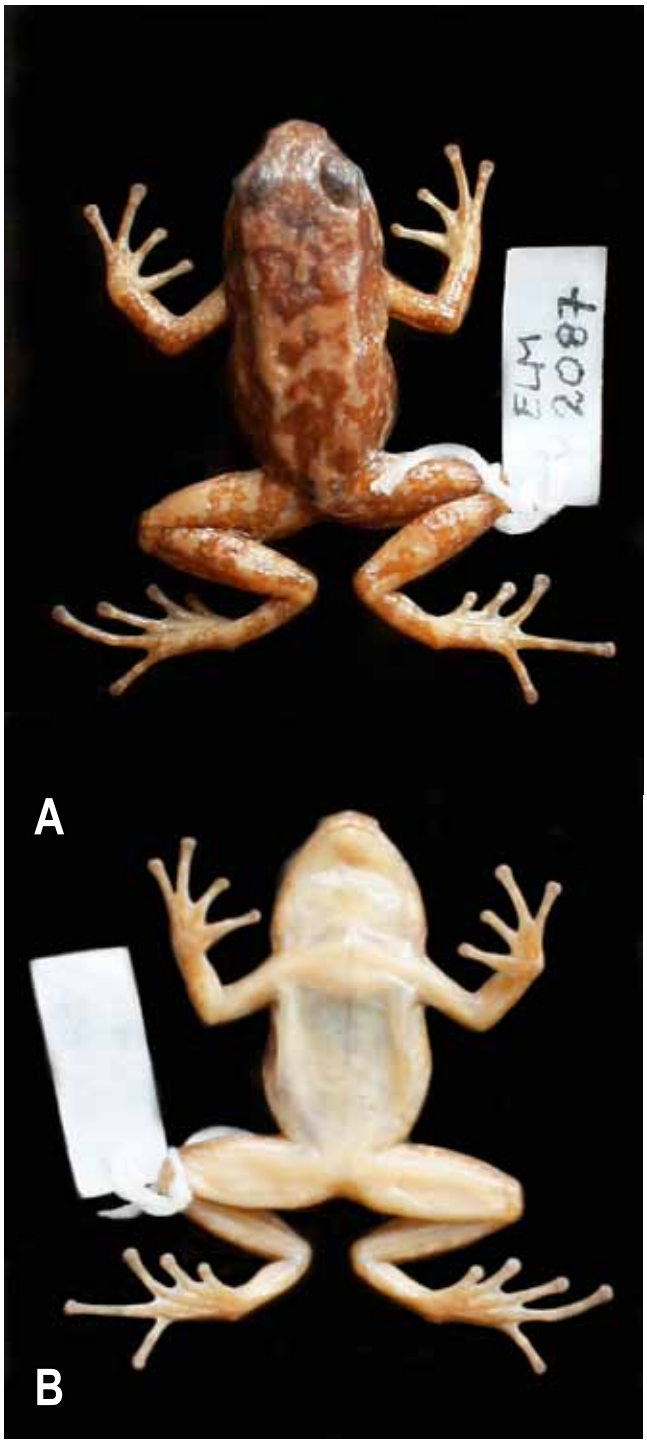

FIG. 10. (A) Dorsal view and (B) ventral view of preserved holotype of *Aromobates walterarpi* sp. nov. (ULABG 2087), coming from Piñango, estado Mérida, Venezuela, 2325 m.asl. Field tag: "ELM": Enrique La Marca field number.

(A) Vista dorsal y (B) vista ventral del holotipo de Aromobates walterarpi *sp. nov. (ULABG 2087), proveniente de Piñango, estado Mérida, Venezuela, 2325 msnm*. Etiqueta de campo: "ELM": número de campo de Enrique La Marca.

shanks are placed alongside. Ventral part of legs immaculate cream. Dorsal part of feet mostly cream, except on bases of toes I, II and III. Dermal scutes brown. Feet dark brown on ventral parts, except for foot-web and the internal basal part of toes III and IV, that are immaculate cream. Toe-discs tend to be bicolor, with the anterior half part grayish and posterior part dark gray.

Flanks dark brown with little cream spots. On the left flank there is an oblique cream irregular inguinal band that is broken at the middle and almost reaches the arm insertion. On the right flank, this oblique inguinal band barely reaches the middle of the flank; flanks are darker than dorsal ground color; infraorbital region is brown with little cream markings, similar as those on loreal region; a canthal dark brown band surrounds the snout from eye to snout. Venter and chest cream (Fig. 10B). Borders of mandibles, geniohyod region, chin and chest, with pale brown irregular markings. Maxillae and premaxillae brown with little cream spots, and with two irregular cream lines that are between the anterior border of eye and tip of the snout. Mandibulae are cream, with some little brown spots. Tympanum cream, dusted with brown, with upper parts partially covered by a dorsolateral dark brown band originating on the posterior part of eye.

Color variation (in paratypes and other specimens) in life

All data taken from ELM field notes, 22 July 1981, 17 August 1985 and 12 July 1988.

ULABG 461 possessed a golden dorsum with a gray spot at shoulders; two posterior-orbital pale bands continued to groin, although inconspicuously after sacrum; dark flanks, with a yellow band from groin to close to the level of forearm insertion at mid-flank; extremities cross-barred; forearm pale yellowish-brown with black lines on anterior part; whitish line on upper lip, with two entries of the same color to nares opening; Thighs ventrally caramel (pale reddish-brown), dorsally with black reticulations; throat and belly milky-white; golden tympanum with a posterior golden projection on the inferior-posterior portion of tympanum; yellowish canthal line; a large dark spot between eyes on top of the head; a butterfly-shaped dark spot at the level of forearm insertion, on dorsum; a small spot on sacral region and another on urostyle, blurred; dark discs preceded by a pale line.

ULABG 462 had a dorsum with a pale reddish-brown background; three spots: interorbital, interbrachial and on sacrum-urostyle; two golden-brown bands from anterior part of eyelids to sacrum where they fade away; whitish band from groin to near forearm insertion on the right part of body, and curving at the level of sacrum to unite to same color on venter; shanks ventrally uncolored; right tympanum covered on upper part with a pale golden band; golden canthal band; discontinuous white band on upper lip; lower portion of naris opening with a pale dot; a black band on top of the golden canthal band, from posterior part of eye, bifurcating at mid-level of flank due to a pale inguinal band; dorsum greenish alongside of dark spots, rendering golden to the sides of body; two pale dots on upper part of groin; digits banded. ULABG 463 with anterior part of dorsum greenish-brown, and irregular dark spots on top of head, at level of shoulders and sacral and urostyle regions; inguinal band broken in dots towards anterior part (on right flank); belly whitish, throat uncolored, darker

than belly; pale tympanum.

ULABG 1575 had an olive-green dorsum with a large spot, with an ochre tinge, between eyes to shoulders; throat pale greenish-white; posterior part of belly yellowish-cream; shanks, ventrally, pale greenish; inguinal band pale green; canthal band ochraceous-green. ULABG 1576 with throat slightly marbled; tubercles near corner of mouth (rictus) milky-white; inguinal band yellowish-cream; copperish iris. ULABG 1577 with dark grayish-green throat, marbled; venter yellowish-green; thighs, ventrally, yellowish-green on anterior part, orange on posterior; shanks greenish below; inguinal band pale green; copperish iris; canthal band, ochre; dirty white little dots on dorsum. ULABG 1578 bearing white little spots on upper lip; inguinal band yellowish-green; little spots with a satin-yellow tinge on ventral portion of thighs, close to groin; dirty-white tubercles at corners of mouth; canthal band, ochre.

ULABG 1579 possessed orange-red ventral portion of thighs. ULABG 1580 had posterior part of thighs ochraceous-orange; extremities paler than dorsum; grayish background on dorsum; inguinal band yellowish-cream; ULABG 1581 with throat and chest dirty-white; belly greenish to yellowish-cream; posterior ventral part of thighs intense reddish-orange; ochre tinge from posterior part of upper eyelids to shoulders; little pale-green paravertebral and sacral dots on dorsum; dorsum with background grayish-green; extremities caramel-colored; upper lip with dirty-white border, same as tubercles near corners of mouth.

ULABG 1582 with grayish-green throat and chest; shanks and anterior part of thighs, ventrally, olive green; Inguinal band greenish-cream. ULABG 1583 had a yellow venter and throat pale yellowish-gray. ULABG 1584 with greenish-gray throat, marbled; venter yellowish-green; under thighs orange-caramel; inguinal band pale greenish-cream. ULABG 1585 with grayish throat and yellowish dirty-white venter; ventral surfaces of thighs anteriorly greenish-gray and posteriorly ochraceous-orange; inguinal band pale green; discs bluish-white. ULABG 1586 with throat and chest dirty-white; posterior ventral portion of thighs reddish-caramel; dorsum with a grayish-green background; ochraceous tinge from upper eyelids to shoulders; inguinal band greenish-cream. ULABG 1588 with posterior part of thighs, ventrally, orange-caramel; throat, chest and venter silvery; inguinal band greenish-white.

ULABG 1589 bear a yellow belly, and marbled chest and

FIG. 11. General view of the type locality of *Aromobates walterarpi* sp. nov. The village of Piñango (with the church highlighted as its biggest building) is seen in the center of the picture. Note the large amount of deforestation in the place; the general condition is strikingly similar to that present in the late 1980's when the species was discovered. Photo by E. La Marca, August 2011.

Vista general de la localidad tipo de Aromobates walterarpi *sp. nov. El pueblo de Piñango (con su iglesia que destaca como el edificio más grande) se ve en el centro de la foto. Note la gran cantidad de deforestación en el lugar; la condición general es sorprendentemente similar a la encontrada a finales de la década de 1980 cuando se descubrió la especie. Foto por E. La Marca, August 2011.*

throat; under parts of thighs dark caramel to orange; inguinal band yellowish. ULABG 2085 presented two not-well defined copperish bands from eyes to sacral region. Inguinal band cream in ULABG 2085 and 2093, yellowish in ULABG 2088, 2089 and 2094. Dark stippling on chest, not forming a collar, in ULABG 2085. Throat marbled grey and dirty white in ULABG 2089. Throat with stippling along borders in ULABG 2090-2091. Chest and belly whitish in ULABG 2086, yellowish-white in ULABG 2088 and 2092.Throat and belly greenish-white in ULABG 2094. Darker orange coloration on posterior ventral portion of thighs in ULABG 2085, 2086, 2088 and 2094; reddish in ULABG 2093. Greenish-cream coloration on anterior part of ventral surfaces of thighs in ULABG 2094.

Color variation in preserved paratype specimens

In ULABG 2085-2094 series, some specimens have a paler dorsal ground-color than the holotype, especially ULABG 2089 and the male ULABG 2091. The dorsal markings have different shapes in all individuals; most of them share the same distribution of markings, except ULABG 2090. The flanks of ULABG 2089, 2090 and 2091 are paler than the flanks of the holotype; and the flanks of ULABG 2094 and 2093 have less dark spots than the holotype. The inguinal band of ULABG 2086 is shorter than the rest of the series. In some individuals, the elbows are less covered with brown spots than the holotype, and in some individuals the proximal part of the forearm have less spots than in the holotype. The upper part of the hands is paler in most of the specimens, compared to that of holotype. In most individuals, the cross-bands on the legs are more differentiated and more organized than in the holotype. ULABG 2092 and 2093, which are the biggest females of the series, and ULABG 1581 and 1585, have the cross-bands on legs similar to those of the holotype. The arms, forearms and the upper part of the hands have less spots than the holotype.

The ventral part of all the specimens is immaculate (except for a few almost imperceptible paler brown spots located at the chin), which is in clear contrast with the condition exhibited by the holotype and by ULABG 1582, 1577 and 1584, which have a few very little inconspicuous pale brown spots. The upper part of the head varies in number and concentration of spots; in general, most individuals have fewer spots on the head than the holotype. ULABG 2086 has many little dark spots, as the holotype, but the rest of the specimens have fewer spots or those are less conspicuous. The loreal region is darker in ULABG 2094 and 1577, specimens that are, in general, darker than the holotype. The canthal region is paler in some individuals.

In the ULABG 1575-1586 and 1588-1589 series, the males have a paler dorsal ground color than the holotype. The dorsal markings of all the males are also paler than the markings of the holotype, except for ULABG 1580. The flanks of males are paler than the flanks of the holotype. In most males, and in some females, the inguinal band is longer, almost reaching to the arm's insertion level.

Tadpoles

Larvae of this species are unknown, although a lot of tadpoles, ULABG 467 from the type locality, not associated to adults carrying larvae on dorsum, may belong to the new species. They will be treated elsewhere.

Distribution and Natural History Notes

Aromobates walterarpi sp. nov. comes from a mountain stream at 2325 m.asl., in the vicinities of Piñango (Fig. 11), a small town in the Andean Sierra de La Culata, at the northeaster-most corner of Mérida state. The type specimens were collected at a small water stream close to Piñango, at the entrance of this town, along the road from Pico del Águila to Piñango. An apparently undescribed salamander (*Bolitoglossa* sp.), currently under study by the senior author, was found along with the holotype and paratopotypes of the new frog species. Limited climatic data gathered in situ by ELM for these specimens on 12 July 1988, at 9:45 am was: relative humidity 70%, air temperature 20 °C. On 22 July 1981 ELM registered air temperatures of 16.2 °C at 8:00 pm at the type locality, and on 25 July 1981 it was 10.8 °C at 8:00 am in the nearby town of Piñango.

Specimens were collected below rocks along a little mountain stream. Males were uttering calls within cavities along stream and road ditches, separated from each other by a distance of about 1 m.

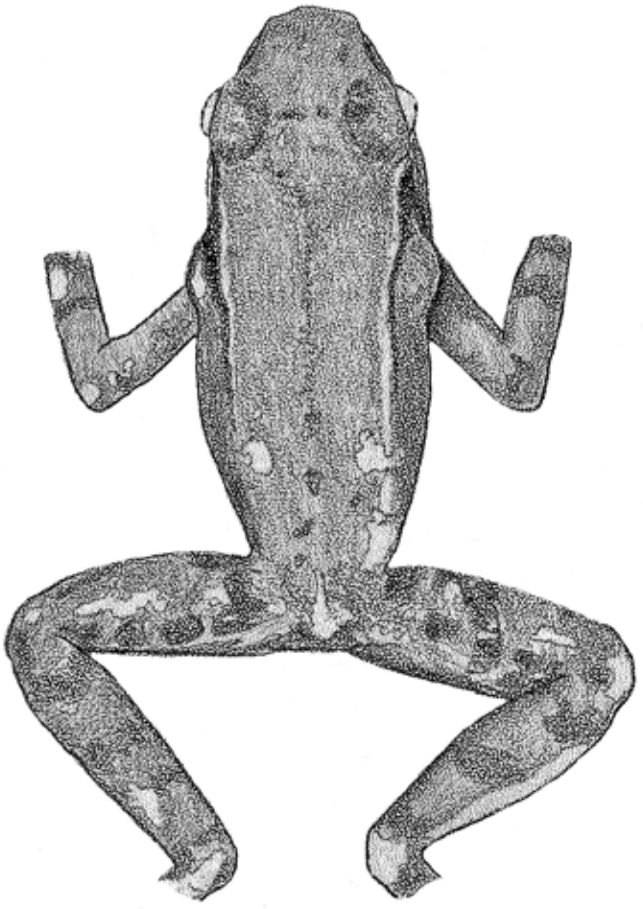

FIG. 12. Holotype of *Colostethus mayorgai* Rivero, 1978. From a 1984 Coquille board drawing by Enrique La Marca.

Holotipo de Colostethus mayorgai *(Rivero, 1978). De un dibujo de 1984, en cartón Coquille, por Enrique La Marca.*

According to field notes by the senior author, the call is a series of short "peets" (about nine in a period of three seconds), unlike that of the closely resembling *Aromobates meridensis*, with possesses a fluttery call.

The original environment for this species was most probably a cloud forest (that could be classified as "bosque húmedo Montano Bajo" –humid Lower Montane forest, following Ewel *et al*. 1976), but the actual natural surroundings are very much impoverished after heavy deforestation. The forest cover at the type locality was completely gone by the mid-1980's (La Marca and García-Pérez 2004b). Cattle and crop fields were common along the type locality in the collecting years from 1981 to 1988; and the general view of the area remains almost the same in 2011 (Fig. 11).

Conservation

In the Venezuelan Andes, amphibian populations in general have experienced severe declines (La Marca 2004, 2007, 2009). A conservation study on frogs of the family Dendrobatidae in these highlands revealed (La Marca 2007) that 56% of the species of the family living in the Venezuelan Andes have experienced declines. In the case of *Aromobates walterarpi* sp. nov., the main threats to its survival are habitat fragmentation and total habitat destruction for agricultural and livestock purposes, as can be deducted from extrapolation of potential threats highlighted for *Atelopus pinangoi*, a harlequin frog coming from the same type locality of the new species; introduced trout may pose an additional threat to the species (La Marca and Mijares 2005).

We suggest that *Aromobates walterarpi* sp. nov. be considered as a threatened endemic frog, and recommend its placement in the category of Critically Endangered, to be listed as CR/B2ab(iii), because of the likelihood of this species facing a very high risk of extinction in the wild. The rationale for this is given by its reduced potential geographic range with an extent of occurrence estimated to be less than 10 km^2, in severely fragmented forest remnants, which are not protected. The later implies that the deforestation process in the general area will not stop in the near future, because of new forest clearings for high altitude farming and livestock. Moreover, the species is just known from a single population in a highly disturbed environment, and has not been found elsewhere in the general herpetological surveys we have performed in the area.

Aromobates mayorgai (Rivero, 1978)

Original designation: *Colostethus mayorgai* Rivero, 1978:100. Holotype: UPRM 5160 (Fig. 12). Type locality: El Chorotal (El Sineral), carretera Mérida- La Azulita, 1800 m, estado Mérida, Venezuela.

Definition and diagnosis. A medium sized *Aromobates* (mean SVL; males: 23.6 mm, females: 25.7 mm) distinguished from other *Aromobates* by the following combination of characters: (1) Skin of dorsum shagreened, with low rounded tubercles toward posterior end of the body; (2) tympanum moderate-sized, distinct in its lower part, its length about ½ that of eye; (3) snout subovoid to truncate in dorsal view; (4) canthus rostralis well defined, from sinuous to slightly curved; loreal region almost vertical to slightly concave, descending abruptly to lips; (5) length of eye greater than eye-to-nostril distance; (6) upper eyelid width narrower than interorbital distance; (7) first finger equal to second; fingers not bearing lateral keels; (8) disc on third finger 1.4 times wider than preceding phalanx; (9) second and third fingers inconspicuously keeled; (10) third finger not swollen in males; (11) short thick cloacal sheath, with entire border; (12) slight tarsal fold; (13) inner metatarsal tubercle oval, about twice as large as rounded outer; (14) toes with basal webbing, web formula: **I**1-0.5**II**1-0.5**III**1-(0.5-1)**IV**0.5-1**V**; (15) third

FIG. 13. (A) Dorsal and (B) ventral views of preserved specimen *of Aromobates mayorgai* (ULABG 5225).
Vistas (A) dorsal y (B) ventral de un ejemplar preservado de Aromobates mayorgai *(ULABG 5225)*.

toe with lateral fringes; (16) discs on toes slightly larger than those on fingers; (17) pale dorsolateral stripe present; (18) inguinal stripe absent; (19) ventrolateral stripe absent; (20) collar absent; (21) heart-shape pattern of melanophores on throat; (22) venter yellowish or pale-cream with copper markings; (23) moderate-sized teeth, robust, slightly curved posteriad; (24) medial lingual process absent; (25) pad absent on distal portion of forearms in males; (26) testes cream.

Aromobates mayorgai is diagnosed from other members of the genus by the combination of its copper dorsal coloration, conspicuous pale dorsolateral stripes (Fig. 13A), yellowish ventral coloration (cream in preservative)(Fig. 13B), basal web and the long and curved teeth. The frog most closely resembling *A. mayorgai* is *A. alboguttatus*. The latter species lacks the yellowish ventral coloration, tends to possess a dull dorsal coloration, and usually have large pale spots on the venter. The holotype of *A. alboguttatus* (BMNH 1903.4.28.23, Re-registered BMNH 1947.2.13.88) was not examined. The late Miss Alice G. Grandison informed the senior author (*in litt*. 8 March 1983) that the holotype of the late species was in a fragile state, with the right foot very badly damaged. Foot drawings of A. *alboguttatus* generously provided by Miss Grandison show a foot web similar to that of *A. mayorgai*. Boulenger (1903:481) reported *A. alboguttatus* as coming from Mérida, 1600 m. The senior author examined several specimens from the same or nearby localities (see Appendix I), including some A. *alboguttatus* identified by Boulenger.

When checking the types of *A. mayorgai* against the relatively short original description of *A. meridensis*, one could find an almost complete agreement between the two nominal taxa. Detailed comparisons reveal that *A. meridensis* differs from the diagnostic characters of *A. mayorgai* given above, by having a larger size, finely granular dorsum, tubercular limbs and flanks; indistinct (or hidden) tympanum with a length about 1/3 that of the eye; tarsal fold more distinct, tarsal tubercle absent, dark canthal band running from eye to eye absent, pale dorsolateral band absent, reddish tinge of the dorsal color, and a bright yellow or lemon-yellow venter.

The nominal taxon *Colostethus mayorgai* was previously known only from the type series. The following description is based on the holotype of the species and on additional specimens (largely topotypical) deposited in KU and MCNG (see Appendix I). More recent material deposited in ULABG (Appendix I) was not taken into account, although they document expansion of the known range of occurrence of the species (see below).

Redescription

Males and females of nearly the same size (SVL in males=23.6 ± 1.4 mm (range = 21.7-27.0; n=11); SVL in females = 25.7 ± 2.0 mm (range = 21.9-28.0; n=13); head wider than long, head width 35.1 ± 1.4% SVL (n=16); interorbital space smooth; interorbital distance about 1.5 times upper eyelid width; canthus rostralis well defined, slightly curved; nostrils not elevated, directed laterally backwards; nostrils closer to tip of snout than to eye; loreal region almost vertical to slightly concave, descending abruptly to lips; snout subovoid in dorsal view; tip of snout broadly rounded in dorsal view, nearly truncated in some specimens; tip of the snout rounded in lateral profile; length of eye about 1.6 times eye-to-nostril distance; internarial distance about 1.6 times eye-to-nostril distance; tympanum about ½ length of eye, distinct in its inferior parts, slanted with anterior part more elevated; tympanum separated from eye about 2/3 its horizontal length; thick supra-tympanic fold; two conspicuous tubercles at corner of mouth. Tongue longer than wide, oval, entire or slightly notched on its posterior end; posterior 3/5 of tongue not adherent to floor of mouth; choanae rounded, concealed or not by palatal shelf of maxillary arch; maxilla and premaxilla toothed; teeth pedicelate, medium-sized, robust and curved posteriad.

Dorsum shagreened, with small low rounded tubercles posteriorly; flanks tuberculate; throat smooth to finally tuberculate; chest and venter shagreened to minutely tuberculate; upper arm and forearm tuberculate; hand length 27.1 ± 1.6% SVL (n=16); palmar tubercle single, rounded, about twice the size of thenar; thenar tubercle elongated, twice as long as wide; no supernumerary palmar tubercles; subarticular palmar tubercles moderate size, flattened, rounded to oval; small discs on fingers; of largest disc on third finger, 1/3 size of the tympanum; discs wider than long; disc on third finger about 1.4 times wider than preceding phalanx; fingers free, not bearing lateral fringes; first finger equal in length to second (Fig. 2C); third finger not swollen in males.

Cloacal opening well above midlevel of thighs, directed posteroventrally, covered by a short, thick cloacal sheath; thighs tuberculate above, more conspicuously toward anterior part, smooth below; shanks and tarsi tuberculate above, smooth below; slight tarsal fold not ending in tubercle; tibiae length 49.0 ± 1.8%SVL in males (n=11), 46.0 ± 1.8% SVL in females (n=12); foot length 48.1 ± 1.6% SVL in males (n=6), 45.1 ± 1.8% SVL in females (n=10); outer metatarsal tubercle rounded, subconical; inner metatarsal tubercle oval, about 2.5 times longer than wide, about twice as large as outer; no supernumerary plantar tubercles; subarticular tubercles rounded to oval, flattened; toes slightly webbed, web formula **I**1-0**II** 1-0.5**III**1-(0.5-1)**IV**0-1**V**; web between IV and V toes is thickened; toes with lateral fringes (Fig. 3C); discs wider than long; largest disc on fourth toe; slightly larger than disc on third finger; largest toe disc about 1.6 times larger than preceding phalanx; heels just touch or slightly overlap when things are held at right angles to body axis, reaching to anterior corner of eye when legs are adpressed forward.

Coloration in preserving solution (ethanol 70%)

In general, adult males have paler dorsa than adult females, and more frequently posses two dorsolateral pale bands from posterior border or eye to sacral region; dark coating prevails over dorsal markings in some females; both males and females have conspicuously barred limbs or diffuse blotches, spots or markings that may or may not form a barred pattern; crossbars on thighs tend to converge forming a horizontal irregular band running along midlevel on the posterior part of thigh; a dorsolateral dark band usually well-delimited on its dorsal edge by paler area that may tend to form a pale stripe; dorsolateral dark band coalescent with coloration of flank towards the ventral side; the dorsolateral dark band runs from inguinal region to anterior border of eye, usually covering

upper part of tympanum, with its broadest part occurring posterior to tympanum (at shoulder's level); a dark canthal band running from eye to eye, bordering snout and encompassing nostril openings; loreal region with irregular pale spots on dark background; paracloacal tubercles pale. The most constant dorsal marking is a dark interorbital triangular spot with base connecting centers of upper eyelids and apex directed backwards; other dorsal spots may be present, but are variable and irregular in appearance.

Flanks dark, bearing pale spots; in a few specimens there is an inguinal row of pale spots, sometimes coincident with tubercles; no continuous pale inguinal band is formed, even when sometimes two pale spots may coalesce.

Both males and females have irregular markings on ventral parts of the body; some females have the venter almost immaculate; there is a tendency for melanophores to concentrate on borders of lips and medial-anterior part of throat, in a heart-shaped pattern. This may be more evident in some specimens than others; no solid collar, or concentration of melanophores suggesting one, is present. From a distance, the distribution of ventral melanophores gives the impression of pale spots on a dark background. Close examination reveals a dark reticulation on a pale base. Only in adult males is seen a condition in which white spots (probably iridophores) are present on throat and venter. Palms and soles are darker than other ventral surfaces.

Coloration in life

Dorsum from pale to dark reddish-brown with numerous small blotches or spots; flanks dark brown to black, with white or blue-greenish spots, sometimes with a yellowish tone; yellow spots on inguinal region; copper or creamy-tan dorsolateral stripe from eye to inguinal region; a dark band below the pale stripe; black canthal band; upper lip dark brown, with white or greenish blue flecks; iris reddish-gold; arms and legs with narrow black bars on a yellowish or tan background; thighs with brown dots on posteroventral surfaces; throat pale gray or yellowish with fine copper flecks; chest and venter yellowish-lemon or cream, sometimes with copper markings (S.R. Edwards: field notes, June 1970; E. La Marca: field notes, July 1983).

Tadpoles

Larvae of *Aromobates mayorgai* were described by La Marca and Mijares-Urrutia (1988).

Distribution and natural history notes

Aromobates mayorgai occurs in high Venezuelan Andean cloud forests located in central Mérida state, WNW from Mérida city, just North of the Chama river valley, at the westernmost part of the mountain range known as Sierra de La Culata. Specimens have been found along the road from Mérida city to La Azulita (see Appendix I), at elevations from 1700 to 2400 m (La Marca and García Pérez 2004). A record from Río Limones (ULABG 5225) lowers the inferior limit of occurrence to 793 m. asl.. The main habitat for the species appears to be cloud forest ("bosque muy húmedo Montano Bajo" –very humid Lower Montane forest, in the classification of Ewel *et al*. 1976), although some specimens reported here were taken at lower humid montane forests. La Marca and Mijares-Urrutia (1988) provided information on the reproductive biology of the species.

Conservation

The main recognized threats for *Aromobates mayorgai* are agriculture and livestock (La Marca and García Pérez 2004a), and the area in general is suffering from agrochemical water pollution; climate change, as a possible output from massive deforestation in the formerly dense forests South of Lake Maracaibo, may pose an additional problem (La Marca and Esqueda 2005). The introduced bullfrog (*Lithobates catesbeianus*), a potential predator known to carry a pathogenous chytrid fungus (*Batrachochytrium dendrobatidis*), poses an additional threat.

Aromobates mayorgai is currently listed as Endangered in the IUCN Red List, because of its extent of occurrence being less than 5,000 km2 and its area of occupancy being less than 500 km2; additionally, its distribution is severely fragmented, and there is a continuing decline in the extent and quality of its habitat (La Marca and García Pérez 2004c). No changes are proposed to the current status.

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Appendix I

Specimens examined.

All specimens from Venezuela: Estado Mérida.

***Aromobates alboguttatus* (Boulenger).**

AMNH 639-641, 646-648, 3147, Mérida, Río Albirregas [= Albarregas?], nr. Mérida; UMMZ 51266, 58904 (5, identified by Boulenger), Mérida; FMNH 3661-3662, Mérida, 1630 ft [=m?].

***Aromobates mayorgai* (Rivero).**

UPRM 5160 (holotype), El Chorotal (El Sineral), carretera Mérida-La Azulita, 1800 m. KU 132922-132937, KU 139459 (11 tadpoles associated with KU 132931), KU 139460 (1 tadpole and 3 newly metamorphosed froglets), KU 139462 (11 tadpoles), 15-20 Km NW Mérida, road to La Azulita, 1900 m. KU 132938132941, 32 Km NW Mérida, road to La Azulita, 2010 m. MCNG 702-704, El Chorotal, 16 Km SE La Azulita, 2025 m. MCNG 469, MCNG 470 (10 tadpoles carried on back by MCNG 469), Bosque San Eusebio, La Carbonera, 2260 m. KU 16 7808 (7 tadpoles), San Eusebio, 21 Km SE La Azulita, 2100 m. ULABG 1014-1016, El Chorotal, 16 Km SE La Azulita, 2025 m. ULABG 1059-1061, Cascada después de la Chorrera Las González (en la vía hacia Jají). ULABG 2931, La Azulita, 915 m, ULABG 5225, Río Limones, 6 Km NNE La Azulita, 793 m, 8º42'30"N 71º26'36". ULABG 6549-6550, 6590-6591, 6617, Mirabel, cerca de La Azulita, 8º41'00"N 71'26'08"W, 1405 m. ULABG 6804-6808, Finca La Bravera, on road between Las Cruces and La Carbonera.

***Aromobates meridensis* (Dole et Durant).**

MBUCV 6168-6172 (holotype plus paratypes), 15 Km South La Azulita, La Carbonera; ULABG 1013, 1017-1019, El Chorotal, 16 Km SE La Azulita, 2025 m. ULABG 2558-2561, El Joque (estación experimental ULA), vía Las Cruces (nr. Jají) to La Carbonera, 2100 m. ULABG 2865-2866, Sierra La Culata, Cabaña del Oso, on trail from Pico Pan de Azúcar to El Charal-Santa Apolonia, 3300 m. ULABG 1708-1712, El Chorotal, Vía Jaji, La Azulita, 2100 m.

***Aromobates walterarpi* species nova.**

ULABG 1575-1586, ULABG 1588-1589, ULABG 2085-2094. ULABG 461-466. Specific data are given in the account for the new species.

***Mannophryne collaris* (Boulenger).**

BMNH 1947.2.14.12, 1947.2.4.14.29-40 (syntypes); 1947.2.4.14.40 (Leptoholotype designated by La Marca 1994), Mérida, 5200 ft.

***Mannophryne* cf. *collaris*.** KU 133213 (treated as *Colostethus meridensis* by Edwards, 1974a), 15-20 Km NW Mérida, road to La Azulita, ± 1700 m.

***Mannophryne cordilleriana* La Marca.**

ULABG 763 (holotype), 749-765 (paratypes), Presa Hidráulica José Antonio Páez, 1600 m, near La Mitisús, on road Santo Domingo-Barinas. KU 133214 (misidentified as *Colostethus meridensis* by Edwards; see comments here under *Aromobates meridensis*), between Mérida and La Mitisús, nr. police checkpoint.