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A new dendrobatid frog (Anura: Dendrobatidae: *Colostethus*) from Aprada tepui, southern Venezuela

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Abstract

A new species of *Colostethus* is described from Venezuelan Guayana. It inhabits the slopes of Aprada tepui, a sandstone table mountain in southern Venezuela. The new species is distinguished from close relatives by its particular pattern, absence of fringes on fingers, presence of a lingual process, and yellow and orange ventral coloration. It is the 18th described species of *Colostethus* from Venezuelan Guayana.

Key words: Amphibia, Dendrobatidae, *Colostethus breweri* sp. nov., Venezuelan Guayana

Introduction

In recent years, knowledge of the dendrobatid fauna of the Venezuelan Guayana has increased remarkably. While La Marca (1992) referred four species, Barrio-Amorós *et al.* (2004) reported 17 species; one more species will appear soon (Barrio-Amorós & Brewer-Carías *in press*). The discovery of new species has coincided with progressive exploration of the Guiana Shield, one of the most inaccessible and unknown areas in the world. Barrio-Amorós *et al.* (2004) reviewed the taxonomic history of *Colostethus* from Venezuelan Guayana. Here, I provide the description of an additional new species from Aprada tepui, situated west of Chimantá massif and Apacara river. This species was collected by Charles Brewer-Carías and colleagues, during ongoing exploration of Venezuelan Guayana. The only known amphibian from the Aprada tepui is *Stefania satelles*, from 2500 m (Señaris *et al.* 1996). A species of *Eleutherodactylus* (Leptodactylidae) from the same tepui was mentioned by Gorzula and Señaris (1998) and another *Eleutherodactylus* species was collected together with the series of the new species of *Colostethus*, which will be the subject of future studies.

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Materials and Methods

Specimens examined are hosted in the following collections: Colección de Vertebrados, Universidad de los Andes, Mérida (CVULA); Museo de la Estación Biológica de Rancho Grande, Maracay (EBRG); Colección de Herpetología del Museo de Biología de la Universidad Central de Venezuela, Caracas (MBUCV); Museo de Historia Natural La Salle, Caracas (MHNLS).

The diagnosis follows Grant & Rodríguez (2001), while the description follows Barrio-Amorós *et al.* (2004). Comparative data were taken from Rivero (1961), Rivero *et al.* (1986), La Marca (1996), Meinhardt & Parmelee (1996), Lescure & Marty (2000), Myers & Donnelly (1997, 2001), and Barrio-Amorós *et al* (2004). The toe webbing formula follows the system of Myers & Duellman (1982). Determination of sex and maturity was by dissection (presence of testes or oviducts), plus secondary sexual characters, like presence or absence of vocal slits. Measurements (in mm) were taken with a caliper to the nearest 0.1 mm. Measurements taken exclusively on adult frogs are: SVL: straight length from tip of snout to vent; SL: shank length from outer edge of flexed knee to heel; ThL: thigh length from vent opening to flexed knee; HeL: head length from bony edge of skull to tip of snout; HW: head width between angle of jaws; InD: inter-narial distance between centers of nares; IOD: inter-orbital distance between proximal edges of eyelids; EN: distance of anterior edge of eye to nostril; ED: horizontal eye diameter; TD: horizontal tympanum diameter; ETS: distance between the anterior edge of the eye to the tip of snout; FD: disc width of Finger III; T4D: disc width of toe IV; 1FiL: length of Finger I from inner edge of thenar tubercle to tip of disc; 2FiL: length of Finger II from the junction of Finger I and III to the tip of finger disc.

Colostethus breweri sp. nov.

(Fig. 1)

Holotype—MHNLS 17044. An adult female with circunvoluted oviducts from the entry of Cueva del Fantasma, northwestern slope of Aprada tepui, 05º 27'N, 62º 27'W, 660 m above sea level, Estado Bolívar, Venezuela, collected by Charles Brewer-Carías, Alberto Tovar and Fernando Tamayo, on February 9, 2004.

Paratypes—MHNLS 17045, 17046, two adult males, and MHNLS 17047, an unsexed juvenile with the same data as the holotype.

Diagnosis—A relatively small species (male SVL up to 21 mm, only known female 23.8 mm SVL), Finger I approximately equal to Finger II; Finger III of males not swollen; venter in preservative dirty white in males, immaculate white in the only known female; in life venter of males dirty white, female yellow; toes moderately webbed; dorsolateral stripe absent; oblique lateral stripe short, white; ventrolateral stripe absent; median lingual process (MLP) present; cloacal tubercles absent; anal sheath absent; black armband absent.

Comparison with other species—*Colostethus breweri* shares with the following species from Venezuelan Guayana the presence of a MLP: *C. parkerae*, *C. shrevei*, *C. tamacuarensis*, *C. tepuyensis*, *C. triunfo*, *C. wothuja* (Grant *et al.* 1998; Myers and Donnelly 1997; Barrio-Amorós *et al.* 2004), *C. praderioi* and *C. roraima* (T. Grant, pers. comm.). Species from the Venezuelan Guayana lacking the MLP are *C.* aff. *brunneus* (probably a similar species to *C. brunneus*: see Morales 2000), *C.* aff. *marchesianus* (see Morales 1994 and Caldwell *et al.* 2002), and *C. undulatus* (Myers and Donnelly 2001).

Colostethus breweri can be also distinguished from those species having scanty toe webbing (*C. beebei*, *C. brunneus*, *C. praderioi* and *C. roraima*) because of its moderately developed toe webbing. It is distinguishable from other species from the Guiana Shield that also present MLP and moderate toe webbing by the following character (those of *C. breweri* in parentheses). *Colostethus ayarzaguenai* has a dorsally-rounded snout (nearly truncate), Finger I shorter than II (equal); and an uniform pattern without dorsal spots (consistent pattern). *Colostethus degranvillei* has Finger I shorter than II (equal), oblique lateral stripe absent (present), a post tympanic white bar (absent) and ventral surfaces brown with white spots (whitish or yellow). *Colostethus guanayensis* has Finger I shorter than II (equal), dark ventral coloration (dirty white or yellow). *Colostethus murisipanensis* has a Finger I shorter than II (equal), no oblique lateral stripe (present), dark ventral colouration (dirty white or yellow). *Colostethus parimae* has non consistent pattern (consistent), a dorsally rounded snout (truncate), Finger I shorter than II (equal). *Colostethus parkerae* has a rounded snout in dorsal view (truncate), oblique lateral stripe absent (present). *Colostethus sanmartini* has tympanum large, 57% of eye diameter (indistinct), pale dorsolateral stripes (absent). *Colostethus shrevei* is larger, up to 36 mm (up to 23.8), Finger I shorter than II (equal). *Colostethus tamacuarensis* has anal tubercles (absent), Finger III slightly swollen in males (not swollen). *Colostethus tepuyensis* has a rounded snout in dorsal view (truncate), Finger I shorter than II (equal), oblique lateral stripe absent (present). *Colostethus triunfo* has smooth dorsal skin (granular in life), metacarpal tubercle triangular (rounded), tarsal fold short, 1/3 of the tarsus (1/2). *Colostethus wothuja* has a distinct tympanum (indistinct), and no particular pattern (consistent).

Description of holotype—Dorsal and ventral skin smooth in preservative; shagreen in life with small but protuberant tubercles on the posterior part of the dorsum. Dorsal skin forming usually a well-defined rounded, posteriorly projecting flap well above vent, which opens at upper level of thighs; no anal tubercles; anal sheath absent.

Head slightly longer than wide, head width (between angles of jaws) 33.6% of SVL. Snout protruding in profile, nearly truncate in dorsal and ventral views. Nares situated near the tip of the snout and directed slightly posterolaterally; nares visible from the front, barely or not visible dorsally, but well visible from below. Canthus rostralis rounded, rather indistinct; loreal region barely concave. Interorbital region slightly wider than upper eyelid. Snout slightly longer than eye diameter. Tympanum barely visible; positioned close behind eye and low, nearly touching angle of jaws.

FIGURE 1. Female holotype of *Colostethus breweri* in life. Photo by Charles Brewer-Carías.

Hand length moderate, 27.7 % of SVL. Relative lengths of appressed fingers III>IV>I=II; Finger I equal in length to Finger II. Discs of all fingers moderately expanded; Finger III disc 1.5 times width of distal end of adjacent phalanx. Base of palm with large, nearly round, median palmar tubercle; oval inner thenar tubercle on base of Finger I; one subarticular tubercle on Fingers I and II, and two on Fingers III and IV, distal tubercles small, indistinct; all tubercles low, round. No fringes on fingers.

Hind limbs of moderate length; shank 49.5 % of SVL. Relative lengths of appressed toes IV>III>V>II>I; first toe reaching when appressed half subarticular tubercle of second toe. Toe discs moderately expanded; toe IV disc 1.4 times width of distal end of adjacent phalanx. Feet moderately webbed, the web distally continuous with a narrow fringe on all toes, including external edges of toes I and V. Webbing formula I 1–2 II 1½–3 III 2½–3½ IV 3½–1½ V. One to three non protuberant subarticular tubercles on toes as follows: one on toes I and II, two on toes III and V, and three on toe IV (distal tubercle ill defined). Sole with two metatarsal tubercles, similarly sized, a round outer metatarsal tubercle, and an elliptical inner metatarsal tubercle. A narrow tarsal fold or keel, straight, extending almost half the length of tarsus, distally continuous with the narrow fringe on free (preaxial) edge of toe I; fringe distinctly raised proximally, not tubercle-like.

Maxillary teeth present. Tongue longer than wide, elliptical, posterior half free; MLP very small, longer than wide, positioned on the anterior third of the tongue.

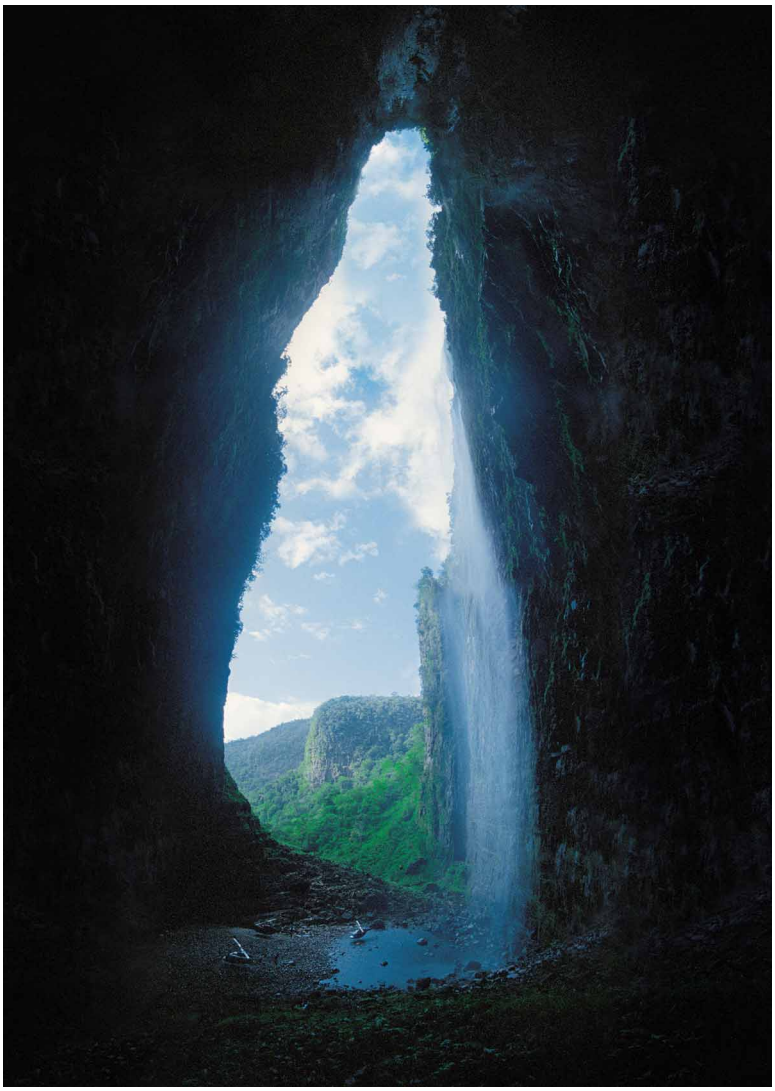

FIGURE 2. View of the type locality (Cueva de El Fantasma, Aprada tepui) from inside. Note the size of the two helicopters at the entrance. This is the first geographic report and photograph of such immense "cave". Photo by Charles Brewer-Carías.

Colour in life—Dorsal ground colour pale brown with diffuse markings on the back, consisting of a dark brown interorbital bar, straight, usually with an apex at the posterior margin, a moderately large chevron between shoulders, three spots at midbody, forming an inverted V; and a single small and median posterior spot near the end of the body. Canthal stripe dark brown; supratympanic stripe black, and very distinct. In the holotype the upper lip bar is immaculate white, containing the indistinct tympanum. Upper lips also white in the other specimens. Supratympanic stripe is continuous above the arm, widening at mid

body, forming a dark brown to black flank, where the white oblique lateral stripe is present. Flanks darker than dorsum but without definite borders. Upper flank dark brown. Throat, chest, and belly immaculate yellow; inferior surfaces of thighs dark orange. Iris bronze.

Upper arms and forearms pale brown, the latter with dark crossbars. Thighs with ill-defined dark brown crossbars.

After one year and a half in preservative, dorsal ground colour became dark brown; flanks dark brown; ventral surfaces white. The rest of the body remains without changes.

Measurements of holotype (in mm)—SVL: 23.8; SL: 11.8; ThL: 12; HeL: 8.3; HW: 8; UEW: 2; IOD: 2.2; ED: 3; TD: 1; ETS: 3.2; FD: 1; 4TD: 1; 1FiL: 3.2; 2FiL: 3.3.

Variation—All specimens have a similar dorsal colour pattern, which is more or less conspicuous. It is most distinct in MHNLS 17045 (a male), and the juvenile (MHNLS 17047) and is less defined (but still detectable) in the female holotype and male MHNLS 17046. The oblique lateral stripe occurs in all specimens, although varying in shape (always short), and never well defined. It is best defined in MHNLS 17045, or fragmented into three small white spots, as in the holotype. Males differ from the single female in at least three external characters (these may be due to sexual dimorphism rather than individual variation): First, the belly of adult males is immaculate white, whereas that of the adult female is immaculate yellow; second, the presence of short vocal slits, extending from near tongue insertion to nearly the end of tongue; and third, the presence of a larger lingual process, longer than wide; this last character was also observed in *Colostethus wothuja* (Barrio-Amorós *et al.* 2004).

In preservative, holotype and MHNLS 17046 dorsal ground colour became dark brown with diffuse markings; MHNLS 17045 and juvenile (MHNLS 17047) pale gray with conspicuous dark gray markings; flanks dark brown to dark gray. Black arm band (*sensu* Grant and Castro 1998) absent, but in all specimens except the juvenile, a black longitudinal stripe on the anterior surface of the arms and forearms is present.

Males (MHNLS 17045 and 17046) with dirty white throat (white with profusion of melanophores) and larger white spots especially at edges of throat; anterior part of chest also with melanophores in MHNLS 17045 but not in MHNLS 17046; posterior part of chest, belly and ventral surfaces of the thighs immaculate white. Testes white.

Distribution—The species is known only from one locality at Aprada tepui, a flat-topped sandstone mesa (tepui) of Guayana highlands in Venezuela, at 660 masl (Fig. 2). This locality lies in medium to tall, evergreen, basimontane and lower montane forests (Huber & Alarcón 1988). To found the type series inside a “cave” must not be significant, as this “Cueva de El Fantasma” (Fig. 2) is a huge, collapsed steep gorge and is not strictly a cave. The maximum altitude of Aprada is at 2500 m, with a tepui surface of 4.37 km^2 (Huber 1995), although its slopes embraces at 1000 m of altitude a wider area including the Chimantá massif and even the whole Gran Sabana area. The species could be an endemic, or more widely expanded through uplands of the Gran Sabana.

Aprada tepui was first explored by an expedition leaded by C. Brewer-Carías on February 25, 1978, accompanied by Roy McDiarmid, as herpetologist, Luis José Joly as enthomologist, Julian Steyermark as botanist and G.C.K. Dunsterville and his wife Nora as orchidologists (Dunsterville 1979). This paper becomes the first written reference about this huge "cave" at N 05º 27.480'W 62º 27.588' on the northwestern slope of the Aprada tepui.

Natural history—This species is a fast-moving frog that lives along creeks and in quiet pools along small streams on the slopes of Aprada-tepui. An undescribed species of *Eleutherodactylus* and the lizard *Neusticurus rudis* (Gymnophtalmidae) were found syntopically. Tadpoles and call of the new species are unknown.

Etymology—I dedicate this frog to the indefatigable explorer of the Venezuelan Guayana, Charles Brewer-Carías, in recognition for his endless support of biological research in the Guiana highlands.

Discussion—Currently, knowledge of Guayanan *Colostethus* is increasing, and several characters have been observed recurrently for most of the species. The most apparent is the presence of a MLP (Grant et al. 1997); although it is not exclusive of Guayanan *Colostethus*, it seems most of the species share it. Furthermore, all species known to have a MLP (*Colostethus breweri C. parkerae, C. praderioi, C. roraima, C. shrevei, C. tamacuarensis, C. tepuyensis, C. triunfo, C. wothuja and C. sp.* from Sarisariñama (Barrio-Amorós and Brewer-Carías, *in press*), also share other characters, such as a short oblique lateral stripe, absence of dorsolateral and ventrolateral stripes, moderate to scant webbing, and in at least two species, *C. triunfo* and *C. wothuja*, absence of palatine bones. I assume that most of the species of the Venezuelan Guayana (and probably the rest of the Guiana Shield) that do not belong to the *C. trilineatus* group (*sensu* Morales 2002), will have a MLP (which can be larger in males) and absence of palatine bones, which suggest they might form a monophyletic group.

The remaining species are not known to have the MLP, but it is probable to occur in *C. ayarzaguenai, C. guanayensis, C. murisipanensis, C. parimae*, and *C. sanmartini* (unpublished data).

The geography of the MLP is of interest. Grant *et al.* (1997) recognized eight species (only four named at that time) of *Colostethus* having a MLP. I mentioned above Venezuelan species currently known to have a MLP, which are 11 (plus two more without proper name). Of all species with the MLP, only three (*C. atopoglossus*, *C. lacrimosus* and *C.* aff. *chocoensis* from Ecuador) are known from the Chocoan bioregion (Pacific versant of Panama, Colombia and Ecuador), and the rest (13) occur at the Guiana Shield. The distance between the closest Guayanan and Chocoan species, respectively *C. shrevei* from Venezuelan Amazonas state and *C. lacrimosus* from Valle del Cauca in Colombia, is of about 1200 km, separated by Los Llanos, the Cordillera Oriental and Central de Colombia. No relationship can be inferred between the Chocoan and Guayanan groups of *Colostethus* having MLP. Grant *et al.* (1997) considered the MLP to be a dendrobatid plesiomorphy. I

consider here the presence of the MLP in both biogeographically separated groups, as a convergence.

Due to its restricted distribution to a single tepui of 4.37 km^2, I consider the species to be potentially endangered and sensitive to natural or artificial catastrophes, as was predicted by Barrio-Amorós (2001) for other tepui endemics. I should locate the species in the category VU D2 of the IUCN, following Young et al (2004).

Acknowledgements

I could have never described this new species without the support of the celebrated Venezuelan explorer Charles brewer-Carías, who collected the type series, along with the explorers Alberto Tovar and Francisco Tamayo. La Cueva del Fantasma was discovered thanks to Patricia Cisneros, who hired the helicopter in February 2001 to help ongoing explorations of the Venezuelan tepuis.

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References

Barrio-Amorós, C.L. (2001) State of knowledge on the declination of amphibians in Venezuela. *FROGLOG*, 47, 2–4.

Barrio-Amorós, C.L. & C. Brewer-Carías (*in press*) Herpetological report of the Sarisariñama—2002 Expedition in the Venezuelan Guayana, with description of five new taxa. *Herpetological Natural History*

Barrio-Amorós, C.L., Fuentes O., & Rivas, G. (2004) Two new species of *Colostethus* (Anura: Dendrobatidae) from the Venezuelan Guayana. *Salamandra, Rheinbach*, 40 (3/4), 1–18.

Caldwell, J. P., Lima, A. P. & Keller, C. (2002) Redescription of *Colostethus marchesianus* (Melin, 1941) from its type locality. *Copeia*, 2002, 157–165.

Dunsterville, G.C.K. & Dunsterville, N. (1979) Tepui Top hopping by helicopter. *American Orchid Society Bulletin*, 48 (3), 222–228.

Gorzula, S. & Señaris, J. C. (1998) Contribution to the herpetofauna of the Venezuelan Guayana. I. A data base. *Scientia Guaianae* 8, 1–267 pp.

Grant, T., & F. Castro. (1998) The cloud forest *Colostethus* (Anura, Dendrobatidae) of a region of Cordillera Occidental of Colombia. *Journal of Herpetology*, 32 (3), 378–392.

Grant, T. & L. Rodriguez. (2001) Two new species of frogs of the genus *Colostethus* (Dendrobatidae) from Peru and a redescription of *C. trilineatus* (Boulenger, 1883). *American Museum Novitates*, 3355, 1–24.

Huber, O. (1995) Vegetation, 97–160 pp. In: Flora of the Venezuelan Guayana. Vol I: Introduction. (P.E.Berry. B.K. Holst & K.Yatskievych (Eds.), Missouri Botanical Gardens, St. Louis. Timber Press.

Huber, O. & Alarcón, C. (1988) Mapa de Vegetación de Venezuela, 1:2.000.000. Ministerio del Ambiente y de los Recursos Naturales Renovables and The Nature Conservancy, Caracas, Venezuela.

La Marca, E. (1992) Catálogo taxonómico, biogeográfico y bibliográfico de las ranas de Venezuela. *Cuadernos Geográficos U. L.A., Mérida*, 9, 197pp.

La Marca, E. (1996 "1997") Ranas del género *Colostethus* (Amphibia: Anura: Dendrobatidae) de la Guayana Venezolana con la descripción de siete especies nuevas. *Publicaciones Asociación Amigos de Doñana*, 9, 1–64.

Lescure, J. & Marty, C. (2000) *Atlas des Amphibiens de Guyane.* Muséum National d'Histoire Naturelle. Patrimoines Naturels, 45, 388 p. Paris.

Meinhardt, D. J. & Parmelee, J. R. (1996) A new species of *Colostethus* (Anura: Dendrobatidae) from Venezuela. *Herpetologica*, 52 (1), 70–77.

Morales, V. R. (1994) Taxonomía de algunos *Colostethus* (Anura: Dendrobatidae) de Sudamérica, con descripción de dos especies nuevas. *Revista Española Herpetología*, 8, 95–103.

Morales, V. R. (2000) Sistemática y biogeografía del grupo *trilineatus* (Amphibia, Anura, Dendrobatidae, Colostethus) con descripción de once nuevas especies. *Publicaciones de la Asociación de amigos de Doñana*, 13, 5–59.

Myers, C.W. & Donnelly, M.A. (1997) A Tepui herpetofauna on a granitic mountain (Tamacuari) in the borderland between Venezuela and Brazil: Report from the Phelps Tapirapecó Expedition. *American Museum Novitates,* 3213, 1–71.

Myers, C.W. & Donnelly, M.A. (2001) Herpetofauna of the Yutajé-Corocoro Massif, Venezuela: Second report from the Robert G. Goelet American Museum-Terramar Expedition to the Northwestern tepuis. *Bulletin of the American Museum of Natural History*, 261, 1–85.

Myers, C.W. & Duellman, W.E. (1982) A new species of *Hyla* from Cerro Colorado, and other tree frog records and geographical notes from western Panama. *American Museum Novitates*, 2752: 1–32.

Rivero, J.A. (1961) Salientia of Venezuela. *Bulletin of the Museum of Comparative Zoology Harvard*, 126 (1), 1–207.

Rivero, J.A., Langone. J. & Prigioni, C.M. (1986) Anfibios Anuros colectados por la Expedición del Museo Nacional de Historia Natural de Montevideo al Río Caura, Estado Bolívar, Venezuela; con la descripción de una nueva especie de *Colostethus* (Dendrobatidae). *Comunicaciones Zoológicas Museo Historia Natural de Montevideo*, 11 (157), 1–15.

Señaris, J.C., Ayarzagüena, J. & Gorzula, S. (1996) Revisión taxonómica del género *Stefania* (Anura; Hylidae) en Venezuela, con la descripción de cinco nuevas especies. *Publicaciones Asociación Amigos Doñana*, 7, 1–55.

Young, B.E., Stuart, S.N., Chanson, J.S., Cox, N.A. & Boucher, T.M. (2004) Dissapearing jewels: The status of New World Amphibians. NatureServe, Arlington, Virginia.

Appendix I: Specimens Examined

Colostethus breweri: See type series. *Colostethus parkerae* MBUCV 6642 (3 specimens) (Salto El Danto, La Escalera, Sierra de Lema, estado Bolívar, Venezuela). *Colostethus shrevei*: MBUCV 6687–8 (Cerro Duida, 1000 m, estado Amazonas, Venezuela); MHNLS 13910–11 (Cuerpo Circular, Alto Orinoco, estado Amazonas, Venezuela). *Colostethus tepuyensis*: EBRG 2694, EBRG 2701–2 (Auyan tepuy, camp 4., 5º58'N–62º33'W, 1600 m., estado Bolívar, Venezuela). *Colostethus triunfo*: EBRG 4756–4759; CVULA 6521–26; MBUCV 6585, 6667 (Cerro Santa Rosa, Serranía del Supamo, estado Bolívar, Venezuela). *Colostethus undulatus*: EBRG 3040–2 (paratypes) (Cerro Yutajé, 1750 m., 5º 46'N–66º 08'W, estado Amazonas, Venezuela). *Colostethus wothuja*: MBUCV 6689–90; EBRG 4760–61 (Base of Cerro Sipapo, Tobogán del Cuao, estado Amazonas, Venezuela).

