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An enigmatic new species of Glassfrog (Amphibia: Anura: Centrolenidae) from the Amazonian Andean slopes of Ecuador

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Abstract

We describe a new species of frog of the family Centrolenidae, *Cochranella amelie* **n. sp.**, from the central Amazonian Andean slopes, collected at the Oglan River, Province of Pastaza, Ecuador. This new species shows a very unusual combination of characters (lavender dorsum in preservative, absence of a humeral spine in adult males, transparent parietal peritoneum, white visceral peritonea, and bulbous liver). The relationships of this new species of Glassfrog are uncertain, and its assignment to *Cochranella* is preliminary.

Key words: *Cochranella amelie*, new species; taxonomy; Oglan River; Pastaza; Ecuador

Resumen

Describimos una nueva especie de rana de la familia Centrolenidae, *Cochranella amelie* **n. sp.**, de los flancos Andinos Amazónicos centrales, colectada en el Río Oglán, Provincia de Pastaza, Ecuador. Esta nueva especie presenta una muy inusual combinación de caracteres (dorso de color lavanda en preservante, ausencia de espina humeral en machos adultos, peritoneo parietal transparente, peritoneos viscerales blancos, e hígado bulboso). Las relaciones de esta nueva especie de Rana de Cristal son inciertas y su asignación a *Cochranella* es preliminar.

Palabras clave: *Cochranella amelie*, nueva especie; taxonomía; Río Oglán; Pastaza; Ecuador

Introduction

The Amazonian Andean slopes of Ecuador hold a remarkably high biological diversity with regard to frogs of the family Centrolenidae. Until 1994, 16 species of Glassfrogs had been reported from that region (Jiménez de la Espada 1872; Goin 1961; Lynch & Duellman 1973; Flores & McDiarmid 1989; Wild 1994). Recent fieldwork and the study of collections have increased the number of species to 22 taxa up to 2006 (Cisneros-Heredia & McDiarmid 2006; Cisneros-Heredia & McDiarmid in press; Guayasamin *et al.* 2006a–b). This number is expected to grow in the near future as some species remain undescribed or unreported (Cisneros-Heredia & McDiarmid 2002–2004, 2006, in press; Cisneros-Heredia *et al.* 2006).

The recently described *Centrolene mariaelenae* was the first Andean non-*Hyalinobatrachium* centrolenid to be reported as having completely transparent parietal peritoneum and white visceral peritonea (Cisneros-

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Heredia & McDiarmid 2006). During recent surveys on the Amazonian central slopes of the Andes of Ecuador, two specimens of an undescribed Glassfrogs were collected. Both specimens belong to a distinctive taxon with a transparent parietal peritoneum and a combination of characters previously unreported in any species of Centrolenidae. We are pleased to describe this enigmatic new species herein.

Materials and methods

General characters and terminology follow definitions by Ruiz-Carranza and Lynch (1991), and Cisneros-Heredia and McDiarmid (2006). Webbing formulae follow the method of Savage and Heyer (1967), as modified by Guayasamin *et al.* (2006b). Eye direction angle was calculated as proposed by Wild (1994). Sex was determined by direct examination of the gonads. Relative digit lengths were determined by adpressing adjacent digits one to another. The following measurements were taken with electronic digital callipers (0.05 mm accuracy) at least three times each as described by Cisneros-Heredia and McDiarmid (2006): snout-vent length (SVL), head width (HW), head length (HL), horizontal eye diameter (ED), inter-orbital distance (IOD), eye-nostril distance (EN), internarial distance (IN), tympanum diameter (TD), width of disc on the third finger (3DW), tibia length (TL), and foot length (FL). The following abbreviations are used along the text: *Ce.* = *Centrolene*, *Co*. = *Cochranella*, *H*. = *Hyalinobatrachium*.

Geographic placement and elevation at collection localities were determined using collector's field notes and museum records, and revised in accord with the 2000 physical map of the Republic of Ecuador (IGM, 2000), and NGA (2006). Classification of vegetation formations from eastern Ecuador follows the proposal by Sierra (1999). Museum abbreviations are those of Leviton *et al.* (1985), with the addition of DHMECN (División de Herpetología, Museo Ecuatoriano de Ciencias Naturales, Quito), DFCH-USFQ (Universidad San Francisco de Quito, Quito), and QCAZ (Museo de Zoología, Pontificia Universidad Católica del Ecuador, Quito).

Species description

***Cochranella amelie* Cisneros-Heredia & Meza-Ramos, new species**
Figure 1

Holotype.—DHMECN 3066 (field number PMR 073), adult male collected at Comunidad de Oglán, Cantón Arajuno, Provincia de Pastaza, República del Ecuador (01°18'65" S, 77°42'41" W, 600 m elevation), 28 July 2004 by Paúl Meza-Ramos and Fabricio Narváez.

Paratype.—DHMECN 3591 (field number PMR 072), adult male collected with the holotype.

Diagnosis. *Cochranella amelie* is a small centrolenid diagnosed from all other Glassfrogs by having: (1) vomerine teeth absent; (2) snout slightly truncate in dorsal view and rounded in lateral view; nostrils slightly elevated producing a depression in the internarial area; loreal region concave; (3) tympanic annulus evident, oriented dorsolaterally with posterior inclination; very weak supratympanic fold above the tympanum; (4) dorsal skin shagreened; (5) ventral and subanal area granular, with two large, rounded, flat subanal tubercles, other anal ornamentations absent; (6) parietal peritoneum completely clear/transparent (without white pigmentation/guanophores), all visceral peritonea covered by white pigmentation; (7) liver bulbous; (8) humeral spine absent in adult males; (9) webbing on hand, basal between finger I and II, outer fingers II 1^{-}–3 III $1^{1}/_{2}$–1 IV; (10) webbing on feet I 1^{-}–$1^{1}/_{2}$ II 1^{-}–2^{-} III 1–2^{-} IV 2^{-}–0^{+} V; (11) low non-enameled ulnar fold; low non-enameled inner tarsal fold; (12) nuptial excrescences present, type-I; concealed prepollex; (13) first finger longer than second, (14) eye diameter larger than width of disc on finger III; (15) colour in life, uniform bluish

green dorsal surfaces; (16) colour in preservative, uniform lavender dorsal surfaces; (17) iris coloration in life between dark to light grey; in preservative, cream background with dense lavender punctuations especially concentrated around the midline; (18) extensive melanophores on finger IV and toes IV and V; (19) males call from the upper surfaces of leaves; advertisement call unrecorded; (20) fighting behaviour unknown; (21) one-layer egg clutches deposited on the upper surfaces of leaves next to streams; (22) tadpoles unknown; (23) snout-vent length in adult males 18.1-18.3 (n = 2); females unknown.

FIGURE 1. Holotype of *Cochranella amelie* in life (DHMECN 3066), adult male, SVL = 18.3 mm.

Comparisons. *Cochranella amelie* differs from all species currently placed in *Centrolene* by lacking humeral spines in adult males. Further, most species of *Centrolene* have the parietal peritoneum totally or partially covered by white pigmentation, with the exception of *Ce. mariaelenae*. *Centrolene mariaelenae* differs from *Cochranella amelie* by having a green dorsum with many small dark punctuations and scattered larger dark spots in life that turns cream lavender with dark punctuations and spots in preservative.

Cochranella amelie differs from most species of *Cochranella* by having a completely transparent parietal peritoneum; only *Co. pulverata* and *Co. antisthenesi* are similar in this character. *Cochranella pulverata* differs by having a sloping snout in lateral view, vomerine teeth, enameled folds or tubercles on arms and tarsus, green dorsum with white spots in life, pale lavender to cream lavender dorsum in preservative, and a larger size (21.4–29.3 mm SVL in adult males *Co. pulverata*; Savage 2002; Cisneros-Heredia *et al.* unpubl. data). *Cochranella antisthenesi* differs by having vomerine teeth, green dorsum with light spots, and a larger size (21.4–26.2 mm SVL in adult males *Co. antisthenesi*; Señaris & Ayarzagüena 2005). Species related to *Cochranella granulosa* (= "*C. granulosa* species-group") resemble to *Co. amelie* in having guanophores over the visceral peritonea, but differ by having sloping snouts, crenulated dermal folds, vomerine teeth, and white parietal peritoneum. Other species of *Cochranella* having white visceral peritonea are *Co. cariticommata*, *Co. wileyi*, *Co. ametarsia*, *Co. midas*, and *Co. oyampiensis*. *Cochranella amelie* differs from all by having transparent parietal peritoneum; *Cochranella cariticommata* further differs by having a green dorsum with yellow dots in life that turns lavender with light dots in preservative, less hand and foot webbing, lacking guanophores on the hepatic and intestinal peritonea, and by its larger body size (22.4–23.5 mm SVL in adult male *Co. cariticommata*; Wild 1994; Cisneros-Heredia & Yánez-Muñoz 2007). *Cochranella wileyi* differs by having less hand and foot webbing, lacking guanophores on the hepatic and intestinal peritonea, and by its larger body size (23.3–26.1 mm SVL in adult male *Co. wileyi*; Guayasamin *et al.* 2006). *Cochranella ametarsia* differs by having a green dorsum with dark spots in life that turns lavender with dark spots in preservative, guanophores covering the anterior $^{1}/_{4}$ parietal peritoneum, and by lacking guanophores on the hepatic peritonea.

Cochranella midas differs by having a green dorsum with yellow spots in life that turns lavender with light spots in preservative, guanophores covering the anterior $^{1}/_{3}$ to $^{1}/_{2}$ parietal peritoneum, and by lacking guanophores on the hepatic peritonea. *Cochranella oyampiensis* differs by having a green dorsum with dark spots in life that turns lavender with dark spots in preservative, and guanophores covering the anterior $^{1}/_{4}$ parietal peritoneum.

Cochranella amelie differs from all species related to *Hyalinobatrachium fleischmanni* (= "*Hyalinobatrachium fleischmanni* species-group") by having a uniform green dorsum in life that turns lavender in preservative, by depositing its egg clutches on the upper surfaces of leaves; and from most species by having a type-I nuptial pad. *Cochranella amelie* differs from all species related to *H. parvulum* (= "*Hyalinobatrachium parvulum* species-group") by having a transparent urinary bladder, and lacking vomerine teeth.

Description of the holotype. Adult male, SVL = 18.3 mm. Body slender. Head distinct, wider than long, and wider than body; HW/HL = 1.14, HW/SVL = 0.36, HL/SVL = 0.32. Snout short, slightly truncate in dorsal view and rounded in lateral view, EN/HL = 0.28; nostrils slightly elevated producing a depression in the internarial area; loreal region concave; canthus rostralis rounded, fairly indistinct, a shallow platform between the canthus rostralis; lips slightly flared. Eyes large, ED/HL = 0.40, directed anterolaterally at about 48° from midline, eyes can be seen when viewed from below, interorbital area wider than eye diameter, IOD/ED = 1.61, EN/ED = 0.70, EN/IOD = 0.43. Tympanic annulus evident, oriented dorsolaterally with slight posterodorsal inclination; very weak supratympanic fold above the tympanum. Dentigerous processes of vomers absent, choanae moderately sized, elliptical, widely separated between them, very close to the margin of mouth; tongue oval, not indented posteriorly; vocal slits paired, extending from anterior base of tongue to angles of jaws.

Skin of dorsal surfaces finely shagreened, without warts, spicules, or tubercles; ventral surfaces granular. Cloacal opening directed posteriorly at upper level of thighs; no distinct cloacal sheath; a pair of large, oval, flat tubercles on ventral surfaces of tights below vent, other anal ornamentation absent, ventral/subanal skin granular but not enameled.

Upper arm thin, forearm robust, breadth of upper arm about half that of forearm. Humeral spine absent; low non-enameled ulnar fold present. Relative lengths of fingers III > IV > I > II; webbing basal between finger I and II, outer fingers II 1^{-}–3 III $1^{1}/_{2}$–1 IV; bulla absent; finger discs wide, between truncate to rounded; disc on third finger slightly larger than those on toes, and shorter than eye diameter, 3DW/ED = 0.52; subarticular tubercles rounded to oval but flat and almost indistinct, palmar surface granular; palmar tubercle large, rounded, flat; tenar tubercle elliptic. Concealed prepollex, unpigmented nuptial excrescences Type I present.

Hind limbs slender; TL/SVL = 0.61, FL/SVL = 0.48. Low non-enameled inner tarsal fold present; inner metatarsal tubercle elliptical, elongated; outer metatarsal tubercle indistinct. Subarticular tubercles rounded and flat; supernumerary tubercles indistinct. Webbing on foot I 1^{-}–$1^{1}/_{2}$ II 1^{-}–2^{-} III 1–2^{-} IV 2^{-}–0^{+} V; disc on toe I oval with a distinct globular point at the end, all other discs bluntly truncate without projections.

Coloration of holotype. In life, all dorsal surfaces bluish green (between cerulean green and viridian green), whitish upper lip, yellowish cream flanks, greenish throat, transparent ventral skin, all visceral peritonea covered by guanophores. Iris between dark to light grey, and black pupil with a yellow pupillary ring. Bones green.

In preservative, all dorsal surfaces uniform lavender, without dark or light flecks, spots, ocelli or other marks. Upper eyelid dark lavender. Venter transparent cream. Parietal peritoneum without guanophores. Guanophores covering the pericardium and most visceral peritonea (esophageal, stomach, intestinal, hepatic, and gallbladder), except for the urinary bladder and the renal capsule that are clear.

Variation. The adult male paratype is similar to the holotype in all diagnostic characters, including coloration. The only pertinent difference is the renal capsule in the paratype covered by guanophores. Variation of measurements is provided below.

Measurements. The measurements of the holotype and paratype (in parentheses) are: snout-vent length, 18.3 (18.1) mm; head width, 6.6 (6.6) mm; head length, 5.8 (5.7) mm; horizontal eye diameter, 2.3 (2,3) mm; inter-orbital distance, 3.7 (3.4) mm; eye-nostril distance, 1.6 (1.6) mm; internarial distance between the nostrils, 1.9 (1.7) mm; tympanum diameter, 0.7 (0.7) mm; width of disc on the third finger, 1.2 (1.1) mm; tibia length, 11.1 (11.1) mm; foot length, 8.7 (9.1) mm.

Etymology. The specific name—a noun in apposition—of this new species of Glassfrog is for Amelie, protagonist of the extraordinary movie "Le Fabuleux Destin d'Amélie Poulain"; a movie where little details play an important role in the achievement of *joie de vivre*; like the important role that Glassfrogs and all amphibians and reptiles play in the health of our planet.

Distribution and natural history. The two known specimens were collected on *Heliconia* leaves (ca. 0.8 m above floor) over a small affluent of the Oglán River, in primary forest. Both specimens were calling on the upper surface of leaves. The paratype (DHMECN 3591) was found next to a single-layer egg clutch deposited on the upper surface of a leaf. Other anurans found along the stream included *Hypsiboas boans* and *Osteocephalus* sp.

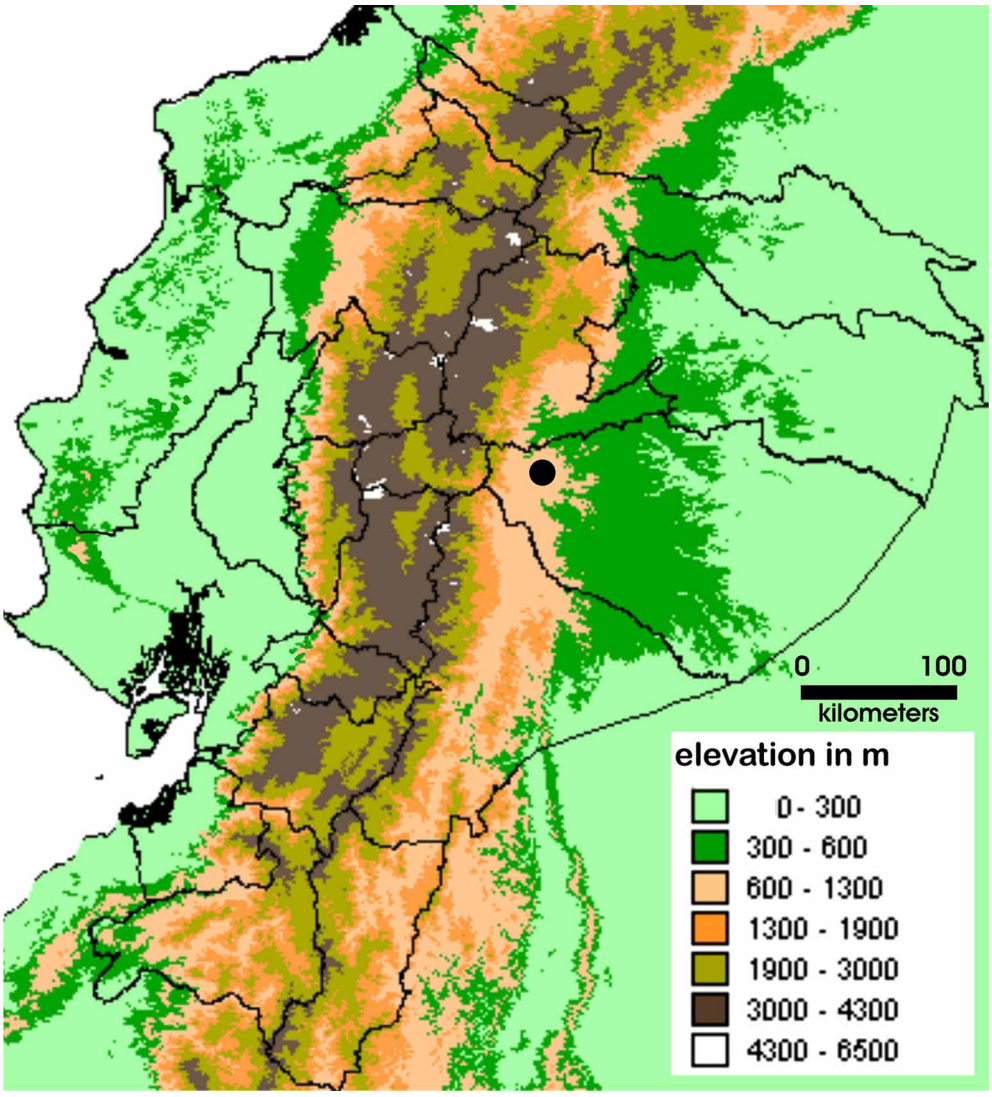

FIGURE 2. Map of Ecuador showing the type locality of *Cochranella amelie*

Discussion

The current generic classification of Centrolenidae is based on the cladistic evaluation of morphological characters developed by Ruiz-Carranza and Lynch (1991). These authors defined two genera delimited by characters conceived as synapomorphies (*Centrolene* and *Hyalinobatrachium*), and a third one for the remaining species that presented the plesiomorphic states (*Cochranella*; Ruiz-Carranza & Lynch 1991). *Centrolene* was diagnosed by having humeral spines in adult males, and *Hyalinobatrachium* by having a bulbous liver covered by guanophores. When Ruiz-Carranza & Lynch (1991) performed their analyses, around 77 species of Glassfrogs were known. Fifteen years later, the species richness of Centrolenidae has almost doubled (Frost 2006), and many more species will be discovered and described in the near future. Recent studies have found that the genera as defined by Ruiz-Carranza & Lynch (1991) are non-monophyletic (Darst & Cannatella 2004; Faivovich *et al.* 2005; Wiens *et al.* 2005; Cisneros-Heredia & McDiarmid 2006, Frost *et al.* 2006; Grant *et al.* 2006, Guayasamin *et al.* 2006b). Several taxa with character-state combinations that enter in conflict with the proposed generic definitions have been discovered. *Centrolene gorzulai*, *Ce. papillahallicum*, *Ce. lema* (the "C. *gorzulai* species-group"), and *Ce. mariaelenae* have both humeral spines and livers covered by guanophores, and sometimes even with a bulbous external appearance (Ayarzagüena 1992; Señaris & Ayarzagüena 1994; Noonan & Harvey 2000; Duellman & Señaris 2003; Cisneros-Heredia & McDiarmid 2006, Cisneros-Heredia & Guayasamin 2006). Señaris and Ayarzagüena (2005) described the livers of *Cochranella oyampiensis*, *Co. castroviejoi*, and *Co. helenae* as covered by guanophores (the "*Co. oyampiensis* species-group"). Señaris and Ayarzagüena (2005) found that *Hyalinobatrachium antisthenesi* (with a white bulbous liver) was apparently more closely related to members of *Centrolene* or *Cochranella* than to *Hyalinobatrachium* based on morphological and behavioral characters. Cisneros-Heredia and McDiarmid (2006) re-evaluated the data of *H. antisthenesi* presented by Señaris and Ayarzagüena (2005), and studied *H. pulveratum* (both members of the former "*H. pulveratum* species-group" *sensu* Ruiz-Carranza & Lynch 1991) and transferred them to the genus *Cochranella*, based on their osteological, behavioral, and internal and external morphological characters. *Hyalinobatrachium sensu lato* (as defined by Ruiz-Carranza & Lynch 1991) is certainly non-monophyletic; but the clade defined as the "*Hyalinobatrachium fleischmanni* species-group" by Ruiz-Carranza & Lynch (1998) is well-supported by several morphological, osteological, and behavioral characters, and is herein referred as *Hyalinobatrachium sensu stricto* (*fleischmanni* Boettger is the type species of *Hyalinobatrachium*; Ruiz-Carranza & Lynch 1998; Barrera-Rodríguez 2000; Señaris & Ayarzagüena 2005; Cisneros-Heredia & McDiarmid 2006; Guayasamin *et al.* 2006b).

We refrain from assigning *amelie* to *Hyalinobatrachium sensu stricto* because it lacks most characters that define this clade, including the egg clutch appearance and location, and the dorsal chromatophore organization, and differs significantly from *H. fleischmanni*, its type species (see Starrett & Savage 1973, Ruiz-Carranza & Lynch 1998, Barrera-Rodríguez 2000, Manzano 2000, Cisneros-Heredia & McDiarmid 2006, Guayasamin *et al.* 2006b). It, *amelie*, also lacks humeral spines and greatly differs from the type species of *Centrolene* (*geckoideum* Jiménez de la Espada) and its synonym *Centrolenella* (*antioquiensis* Noble). The affinities of *amelie* are uncertain, but it shares many morphological and behavioural characters with *Cochranella antisthenesi*, and we consider they are closely related. We use herein *Cochranella* as a convenience group by assigning *amelie* and *antisthenesi* to it. Many species do not fit in any centrolenid genus as currently defined (e.g., *amelie*, *antisthenesi*, *pulverata*, *mariaelenae*), and only an extended phylogenetic analysis will find their true relationships, and probably the formation of new genera will be needed for those clades currently not related to *Centrolene*, *Cochranella*, or *Hyalinobatrachium* as defined by the relationships of their type species, *geckoideum* Jiménez de la Espada, *granulosa* Taylor, and *fleischmanni* Boettger respectively.

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Material examined

Centrolene audax: ECUADOR: NAPO: USNM 286620–22: Cascada de San Rafael; USNM 286623–25, MCZ A97807–8: 14.6 km (by road) NE of Río Salado. *Centrolene bacatum*: ECUADOR: NAPO: QCAZ 16212, 17807, 22386–87: Yanayacu Biological Station. *Centrolene buckleyi*: ECUADOR: BOLÍVAR: DHMECN 0866–67: Guanujo. CARCHI: DHMECN 1246: Los Encinos. COTOPAXI: USNM 288428: Pilaló. Napo: USNM 311113–14: Santa Bárbara. PICHINCHA: USNM 288423: Quito; USNM 286626–27: 8.5 km (by road) NW of Nono; 286628–29: Machachi; 286630–31: 21.2 km (by road) ESE of Chiriboga; USNM 288424: 8 km to Chiriboga. SUCUMBÍOS: DHMECN 0868–93: La Alegría, Santa Barbara. *Centrolene geckoideum*: COLOMBIA: BOYACÁ: ICN 5559, 5560–63, 5598 (C&S). QUINDÍO: ICN 8694–97. ECUADOR: CARCHI: DHMECN 0900: Río La Plata, Maldonado-Tulcán road. PICHINCHA: USNM 167018: 45 km SWS of Quito, at km 45 on Chillogallo–Santo Domingo de los Colorados road. *Centrolene mariaelenae*: ECUADOR: ZAMORA-CHINCHIPE: DFCH-USFQ D125 (H): Río Jambue, Cordillera de Tzunantza. NAPO: QCAZ 18618–19: Río Hollín. *Centrolene medemi*: COLOMBIA: PUTUMAYO: USNM 15227 (H). *Centrolene pipilatum*: ECUADOR: NAPO: ICN 23756 [formerly KU 143283] (P); USNM 286717, MCZ A-97803: 14.7 km NE Rio Salado.

Cochranella ametarsia: COLOMBIA: LETICIA: ICN (JDL 24472). ECUADOR: ORELLANA: DFCH-USFQ D162: Tiputini Biodiversity Station; QCAZ 16652, QCAZ 22709: Estación Científica Yasuní. SUCUMBÍOS: QCAZ 28138: Cuyabeno. *Cochranella antisthenesi*: VENEZUELA: ARAGUA: ICN 36589. *Cochranella cariticommata*: ECUADOR: MORONA-SANTIAGO: USNM 288435-6: El Cruzado. ZAMORA-CHINCHIPE: DHMECN 1974, 2429: Reserva Tapichalaca. *Cochranella cochranae*: ECUADOR: NAPO: USNM 284304–6, 286632–36: Cascada de San Rafael; USNM 286638: Río Salado. ORELLANA: USNM 288452: “Loreto”. Zamora-Chinchipe: DFCH D100-1: Contrafuerte de Tzunantza. *Cochranella megacheira*: ECUADOR:

NAPO: USNM 286700: Río Azuela; USNM 286701: Río Salado. *Cochranella midas*: ECUADOR: SUCUMBÍOS: ICN 23755 [formerly KU 150623] (P): Santa Cecilia. ORELLANA: DFCH-D102: Tiputini Biodiversity Station; QCAZ 22876: Yasuni, Orellana. NAPO: QCAZ 20001-2: Puerto Misahualli; USNM 286702–05, USNM 286707: trail between Tambo Unión and Rosario Yacu. PASTAZA: USNM 288437: Río Oglán, Curaray. PERU: MADRE DE DIOS: USNM 342716. *Cochranella posadae*: COLOMBIA: CAUCA: ICN 11307 (H), ICN 7447–50 (P). ECUADOR: SUCUMBÍOS: USNM 288464–5: La Bonita. *Cochranella pulverata*: HONDURAS: OLANCHO: USNM 342214–21. COSTA RICA: PUNTARENAS: USNM 219379–87. ECUADOR: ESMERALDAS: DHMECN 2612, 3195, 3194: Cabo San Francisco. *Cochranella puyoensis*: ECUADOR: PASTAZA: MCZ 91187 (H): 1 km W Puyo; USNM 291298: Río Pucayacu. NAPO: DFCH-USFQ D285: ca. 45 km E of Narupa. ORELLANA: QCAZ 7104, 7499: Río Huataracu. *Cochranella resplendens*: ECUADOR: ORELLANA: DFCH D103-4: Tiputini Biodiversity Station; USNM 288460: San José Viejo de Sumaco. *Cochranella siren*: ECUADOR: NAPO: USNM 286740: Río Azuela. KU 146611–23. MCZ A97809: 6.5 km S Baeza. ORELLANA: DFCH-USFQ D292-295: Cordillera de Galeras.

Hyalinobatrachium eurygnathum: BRAZIL: SAO PAULO: USNM 96558, 96560–3, 207734, 217662–69. MINAS GERAIS: 207762–74. RIO DE JANEIRO: USNM 208388–95, USNM 232360–64. *Hyalinobatrachium munozorum*: COLOMBIA: META: ICN 5031-34, ICN 39503. ECUADOR: ORELLANA: DFCH-USFQ D105: Tiputini Biodiversity Station. *Hyalinobatrachium pellucidum*: ECUADOR: NAPO: USNM 286708-10: Río Azuela; USNM 286711-12: Río Reventador. MORONA-SANTIAGO: QCAZ 25950: 6 Km N of Limón. *Hyalinobatrachium ruedai*: COLOMBIA: CAQUETÁ: ICN 40409 (H), ICN 40410-11 (P). ECUADOR: NAPO: DFCH-USFQ 0735: Tena. *Hyalinobatrachium uranoscopum*: BRAZIL: RIO DE JANEIRO: USNM 232353–59, USNM 243722. *Hyalinobatrachium* sp. "Leticia" (cf. *munozorum*): COLOMBIA: AMAZONAS: ICN (JMR) 4119.

References

Ayarzagüena, J. (1992) Los Centrolenidos de la Guayana Venezolana. *Publicaciones de la Asociación de Amigos de Doñana*, 1, 1–48.

Barrera-Rodríguez, M. (2000 "1999") Estudio Anatómico de cuatro especies de ranitas de cristal del género *Hyalinobatrachium* Ruíz and Lynch 1991 grupo *fleischmanni* (Amphibia: Anura: Centrolenidae). *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 23 (suplemento especial), 245–260.

Cisneros-Heredia, D. F. & Guayasamin, J. M. (2006) Amphibia, Anura, Centrolenidae, *Centrolene mariaelenae*: Distribution extension, Ecuador. *Check List*, 2 (3), 93–95.

Cisneros-Heredia, D.F. & McDiarmid, R.W. (2002) *Notes on some Glass Frogs (Anura: Centrolenidae) from Western Ecuador: Taxonomy, natural history and conservation status, with the description of a new species*. Research Training Program, Virtual Poster Session, National Museum of Natural History, Smithsonian Institution. Available from http://www.nmnh.si.edu/rtp/students/2002/virtualposterinfo/poster_2002_cisneros_heredia.htm (accessed August 2006).

Cisneros-Heredia, D.F. & McDiarmid, R.W. (2003) *Ecuadorian Glass Frogs: Current state of knowledge, new research trends and conservation*. Abstracts 2003 Joint Meeting of Ichthyologists and Herpetologists. Manaus. Brasil.

Cisneros-Heredia, D.F. & McDiarmid, R.W. (2004) *Observations on the taxonomy, distribution, and conservation status of the centrolenids from Ecuador (Anura: Centrolenidae)*. Abstracts 2004 Joint Meeting of Ichthyologists and Herpetologists. Oklahoma, USA.

Cisneros-Heredia, D.F. & McDiarmid, R.W. (2006) A new species of the genus *Centrolene* (Amphibia: Anura: Centrolenidae) from Ecuador with comments on the taxonomy and biogeography of Glassfrogs. *Zootaxa*, 1244, 1–32.

Cisneros-Heredia, D.F. & McDiarmid, R.W. (In press) Primer registro de *Hyalinobatrachium ruedai* (Amphibia: Centrolenidae) en Ecuador, con notas sobre otras especies congenéricas. *Herpetotrópicos*.

Cisneros-Heredia, D.F. & Yánez-Muñoz, M. (2007) Amphibia, Anura, Centrolenidae, *Centrolene balionotum*, *Centrolene geckoideum*, and *Cochranella cariticommata*: Distribution extension, new provincial records, Ecuador. *Check List*, 3 (1), 39–42.

Cisneros-Heredia, D.F., Guayasamin, J.M. & McDiarmid, RW. (2006) *Population declines in Ecuadorian Glassfrogs (Centrolenidae)*. Abstracts 2006 Joint Meeting of Ichthyologists and Herpetologists. New Orleans, USA.

Darst, C.R. & Cannatella, D.C. (2004) Novel relationships among hyloid frogs inferred from 12S and 16S mitochondrial DNA sequences. *Molecular Phylogenetics and Evolution*, 31, 462–475.

Duellman, W.E. & Señaris, J.C. (2003) A new species of glass frog (Anura: Centrolenidae) from the Venezuelan Guayana. *Herpetologica*, 59 (2), 247–252.
Faivovich, J., Haddad, C.F.B., Garcia, P.C.A., Frost, D.R., Campbell, J.A. & Wheeler, W.C. (2005) Systematic review of the frog family Hylidae, with special reference to Hylinae: a phylogenetic analysis and taxonomic revision. *Bulletin of the American Museum of Natural History*, 294: 1–240.
Flores, G. & McDiarmid, R.W. (1989) Two new species of South American *Centrolenella* (Anura: Centrolenidae) related to *C. mariae*. *Herpetologica*, 45(4), 401–411.
Frost, D.R. (2006) Amphibian Species of the World. Version 4. Americ*an Museum of Natural History*, New York. Available from http://research.amnh.org/herpetology/amphibia/index.html (accessed August 2006).
Frost, D.R., Grant, T., Faivovich, J., Bain, R.H., Haas, A., Haddad, C.F.B., de Sa, R.O., Channing, A., Wilkinson, M., Donnellan, S.C., Raxworthy, C.J., Campbell, J.A., Blotto, B.L., Moler, P., Drewes, R.C., Nussbaum, R.A., Lynch, J.D., Green, D.M. & Wheeler, W.C. (2006) The Amphibian Tree of Life. *Bulletin of the American Museum of Natural History*, 297, 1–370.
Goin, C.J. (1961) Three new centrolenid frogs from Ecuador. *Zoologischer Anzeiger*, 166, 95–104.
Grant, T., Frost, D.R., Caldwell, J.P., Gagliardo, R., Haddad, C.F.B., Kok, P.J.R., Means, B.D., Noonan, B.P., Schargel, W. & Wheeler, W.C. (2006) Phylogenetic systematics of dart-poison frogs and their relatives (Amphibia: Athesphatanura: Dendrobatoidea). *Bulletin of the American Museum of Natural History*, 299, 1–262.
Guayasamin, J.M., Cisneros-Heredia, D.F., Yanez-Muñoz, M. & Bustamante, M. (2006a) Amphibia, Centrolenidae, *Centrolene ilex*, *Centrolene litorale*, *Centrolene medemi*, *Cochranella albomaculata*, *Cochranella ametarsia*: Range extensions and new country records. *Check List*, 2 (1), 24–26.
Guayasamin, J.M., Bustamante, M.R., Almeida-Reinoso, D. & Funk, W. C. (2006b) Glass frogs (Centrolenidae) of Yanayacu Biological Station, Ecuador, with the description of a new species and comments on centrolenid systematics. *Zoological Journal of the Linnaean Society*, 147, 489–513.
IGM (2000) *República del Ecuador: Mapa Físico, escala 1: 100 000*. Quito, Instituto Geográfico Militar.
Jiménez de la Espada, M. (1872) Nuevos batracios americanos. *Anales de la Sociedad Española de Historia Natural*, 1, 85–88.
Leviton, A.E., Gibbs, R.H. Jr., Heal, E. & Dawson, C.E. (1985) Standards in herpetology and ichthyology. Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia*, 1985, 802–832.
Lynch, J.D. & Duellman, W.E. (1973) A review of the Centrolenid frogs of Ecuador, with descriptions of new species. *Occasional Papers University of Kansas Museum of Natural History*, 16, 1–66.
Manzano, A.S. (2000) Miología pectoral de algunos Centrolenidae (Amphibia: Anura). *Cuadernos de Herpetología*, 14(1), 27–45.
NGA (2006) *Geonet Names Server GNS: official standard names approved by the United States Board on Geographic Names*. National Geospatial-Intelligence Agency's (NGA) and U.S. Board on Geographic Names. http://earth-info.nga.mil/gns/html/ (accessed on September 2006).
Noonan, B.P. & Harvey, M.B. (2000) A new species of Glassfrog (Anura: Centrolenidae) from the highlands of Guyana. *Herpetologica*, 56 (3), 294–302.
Ruiz-Carranza, P.M. & Lynch, J.D. (1991) Ranas Centrolenidae de Colombia I. Propuesta de una nueva clasificación genérica. *Lozania*, 57, 1–30.
Ruiz-Carranza, P.M. & Lynch, J.D. (1998) Ranas Centrolenidae de Colombia XI. Nuevas especies de ranas cristal del genero *Hyalinobatrachium*. *Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 22 (85), 571–586.
Savage, J.M. & Heyer, W.R. (1967) Variation and distribution in the tree-frog genus Phyllomedusa in Costa Rica, Central America. *Beitrage zur Neotropischen Fauna*, 5, 111–131.
Señaris, J.C. & Ayarzagüena, J. (1994 “1993”) Una nueva especie de Centrolenella (Anura: Centrolenidae) del Auyan-Tepui, Edo. Bolivar, Venezuela. *Memoria de la Fundación La Salle de Ciencias Naturales*, LII (139), 121–126.
Señaris, J.C. & Ayarzagüena, J. (2005) *Revisión taxonómica de la Familia Centrolenidae (Amphibia; Anura) de Venezuela*. Publicaciones del Comité Español del Programa Hombre y Biosfera – Red IberoMaB de la UNESCO. Sevilla, España, 337 pp.
Sierra, R. (1999) *Propuesta Preliminar de un Sistema de Clasificación de Vegetación para el Ecuador Continental*. Proyecto INEFAN/GEF-BIRF EcoCiencia, Quito, Ecuador, 194 pp.
Wiens, J.J., Fetzner, Jr., J.W., Parkinson, C.L. & Reeder, T.W. (2005) Hylid Frog phylogeny and sampling strategies for speciose clades. *Systematic Biology*, 54 (5), 719–748.
Wild, E. R. (1994) Two new species of Centrolenid Frogs from the Amazonian slope of the Cordillera Oriental, Ecuador. *Journal of Herpetology*, 28 (3), 299–310.