



Taxonomic identity of *Cochranella petersi* Goin, 1961 and *Centrolenella ametarsia* Flores, 1987

JUAN M. GUAYASAMIN¹, DIEGO F. CISNEROS-HEREDIA² & SANTIAGO CASTROVIEJO-FISHER³

¹Museo de Zoología, Centro de Biodiversidad y Ambiente, Escuela de Biología, Pontificia Universidad Católica del Ecuador, Av. 12 de Octubre y Roca, Aptdo. 17012184, Quito, Ecuador. E-mail: jmguyasamin@gmail.com ²King's College London, Department of Geography, Strand, London WC2R 2LS, UK. E-mail: diegofrancisco_cisneros@yahoo.com ³Evolutionary Biology Centre, Department of Evolutionary Biology, Uppsala University, SE-752 36 Uppsala, Sweden. E-mail: santiago.castroviejo@ebc.uu.se

Abstract

We assess the taxonomic status of *Hyalinobatrachium petersi* and *Cochranella ametarsia* based on the examination of type material and recently collected specimens. We conclude that the material assigned to them is morphologically undistinguishable from two previously described species (*Cochranella pulverata* and *Cochranella oyampiensis*, respectively) and, therefore, are junior synonyms.

Key words: Centrolenidae, *ametarsia*, *Cochranella*, *Hyalinobatrachium*, *oyampiensis*, *petersi*, *pulverata*, Synonymy

Resumen

Evaluamos el estatus taxonómico de *Hyalinobatrachium petersi* y *Cochranella ametarsia* basándonos en el examen de material tipo y de especímenes recientemente colectados. Concluimos que el material asignado a dichas especies es morfológicamente indistinguible de dos especies previamente descritas (*Cochranella pulverata* y *Cochranella oyampiensis*, respectivamente) y por lo tanto son sinónimos de éstas.

Palabras claves: Centrolenidae, *ametarsia*, *Cochranella*, *Hyalinobatrachium*, *oyampiensis*, *petersi*, *pulverata*, Sinonimia

Introduction

Species identity is often times confused because descriptions are based on few individuals that may present atypical characteristics and/or are inadequately preserved. In the family Centrolenidae Taylor, 1951, several of such cases have been reported (e.g., Cisneros-Heredia & McDiarmid 2007b; Kok & Castroviejo-Fisher 2008). Herein we focus on two such cases. Goin (1961) described *Cochranella petersi*, currently placed in the genus *Hyalinobatrachium* (Ruiz-Carranza & Lynch 1998), based on a single adult female (B.M.1902.5.27.24) collected at Río Durango, northwestern Ecuador. He differentiated *H. petersi* from all species known at the time by its extensive webbing between the outer fingers and absence of vomerine teeth. We also address the status of *Centrolenella ametarsia*, currently in the genus *Cochranella* (Ruiz-Carranza & Lynch 1991), described by Flores (1987) based on a single adult male (MCZ 96522) collected in the Amazonian lowlands of Colombia. Flores (1987) differentiated *C. ametarsia* from *C. oyampiensis* (Lescure, 1975) by several characters including webbing between Fingers III and IV, color of visceral and ventral parietal peritonea, exposure of tympan-

num, and condition of the prepollex. In this paper, we assess the taxonomic status of *Hyalinobatrachium petersi* and *Cochranella ametarsia* based on morphological characters. We argue that they represent two previously described species.

Material and methods

Taxonomy follows the cladistic proposal of Ruiz-Carranza and Lynch (1991, 1998), with the modifications proposed by Cisneros-Heredia and McDiarmid (2006, 2007b). We examined alcohol-preserved specimens (Appendix 1) from the herpetological collections at BMNH, DHMECN, DFCH-USFQ, ICN, KU, MCZ, MHNLS, MNHNP, QCAZ, RMNH, UCR, and USNM; museum abbreviations are as in Frost (2007). Characters and terminology follow proposals by Cisneros-Heredia and McDiarmid (2007b). Terminology for webbing is that of Savage and Heyer (1967, 1997) as modified by Guayasamin *et al.* (2006). Sexual maturity was determined by the presence of vocal slits in males and by the presence of eggs and/or convoluted oviducts in females. Fingers are numbered preaxially to postaxially from I–IV to facilitate comparison with previous literature dealing with anurans, but we stress that in an evolutionary perspective anuran fingers correspond to Digits II–V in consistency with the hypothesis that Digit I was lost in anurans (Shubin & Alberch 1986; Fabrezi & Alberch 1996).

Results

Status of *Cochranella petersi*.

Goin (1961) differentiated *Hyalinobatrachium petersi* from other centrolenid frogs mainly by the absence of vomerine teeth and the presence of extensive webbing between Fingers II–IV. Since its description, the recognition of *H. petersi* has been debated in various papers. Lynch and Duellman (1973) synonymized *H. petersi* with *H. fleischmanni* Boettger, arguing that the extensive webbing observed in *H. petersi* falls within the variation of *H. fleischmanni*. Later, Ruiz-Carranza and Lynch (1998) revalidated *H. petersi* based on specimens from southwestern Colombia and differentiated it from *H. fleischmanni* by the color of the pericardium (transparent in *H. petersi*, white in *H. fleischmanni*). Cisneros-Heredia and McDiarmid (2007a) considered that Ruiz-Carranza and Lynch (1998) misidentified the Colombian specimens, and later assigned those specimens to *H. valerioi* (Cisneros-Heredia & McDiarmid 2007b), who mentioned that the holotype of *H. petersi* was conspecific with *H. fleischmanni* but did not take further taxonomic actions. Recent expeditions to the Río Durango area have collected specimens of *Centrolene callistommum* Guayasamin and Trueb, *C. ilex* (Savage), *C. litorale* Ruiz-Carranza & Lynch, *C. prosoblepon* (Boettger), *Cochranella albomaculata* (Taylor), *C. pulverata* (Peters), *C. spinosa* (Taylor), *H. aureoguttatum* (Barrera-Rodríguez & Ruiz-Carranza), and *H. fleischmanni*, but not a single specimen that could be confidently assigned to *H. petersi* (Bustamante *et al.* 2007, QCAZ catalogue, DHMECN catalogue, pers. obs.).

We examined the holotype of *Hyalinobatrachium petersi* (Fig. 1), which is in a good state of preservation (except for a careless ventral dissection). Although iridophore layers over the visceral peritonea are well preserved, the general color of the specimen (including bones) is olive green. This green coloration, which is also present in several other centrolenid species housed at the BMNH (DFCH and SCF pers. obs.), seems to be a preservation artifact caused by the fluid used at the time by the BMNH.

Morphological traits of the holotype include a slightly sloping snout in lateral profile, traces of cloacal ornamentations, completely transparent parietal peritoneum, white pericardium, white hepatic and gastrointestinal peritonea, an externally bulbous liver (no dissection was done to confirm this character state),

extensive webbing between Fingers II–IV, traces of low enameled ulnar and tarsal folds, warts on the upper lip, white (enameled) warts between the tympanum and the arm, and lack of humeral spine and vomerine teeth. The traces of cloacal ornamentations, warts behind the tympanum, and the ulnar and tarsal folds are subtle and were overlooked the first two times the specimen was examined (SCF and DFCH). This led Cisneros-Heredia and McDiarmid (2007b) to suggest it was conspecific with *H. fleischmanni*. Re-examination of the specimen by DFCH in September 2007 revealed the presence of the mentioned traits. Three male specimens of *Cochranella pulverata* were found in the BMNH, one of them collected with the holotype of *Hyalinobatrachium petersi* (BMNH 1902.5.27.25) and the others at a nearby locality (1902.7.29.36–37). They present the same morphological patterns and most preservation effects showed by type of *H. petersi*, except that the enameled warts and folds are better preserved, they bear vomerine teeth, and they show the normal coloration in preservative of the species. All but one of these characteristics (i.e., absence of vomerine teeth) is present in all *Cochranella pulverata* examined (Appendix 1). We hypothesize that the absence of vomerine teeth in the holotype of *H. petersi* can be the result of accidental removal during examination by researchers or previously unnoticed intraspecific variation within *C. pulverata*. The former option is favored by the condition of another type in the BMNH; the holotype of *Hylella parabambae* Boulenger (= *Centrolene prosoblepon*) that shows no teeth on the right side and two teeth on the left side, but close examination under a dissecting microscope (x40) shows that the areas are strongly damaged and several teeth were broken. Particularly important in associating the holotype of *H. petersi* with *Cochranella pulverata* is the presence of enameled warts on the upper lip and below the tympanum, extensive hand webbing, and ulnar and tarsal folds. This combination of traits is absent in all species of *Hyalinobatrachium*, including those sympatric or from surrounding areas, i.e. *H. aureoguttatum*, *H. chirripoi* (Taylor), *H. fleischmanni*, and *H. valerioi* (Dunn). Based on these observations, we place the name *Cochranella petersi* Goin, 1961 as a junior synonym of *Cochranella pulverata* (Peters, 1873). Below, we provide a synonymy, diagnosis, and characterization of *Cochranella pulverata*.

***Cochranella pulverata* (Peters, 1873)**

Hyla pulverata Peters, 1873:614. Holotype: ZMB 7842, according to Duellman, 1977:194. Type locality: "Chiriqui", Panama; at the time of the description "Chiriqui" included both Atlantic and Pacific versants of extreme western Panama according to Myers, 1982:5.

Centrolene pulveratum—Dunn, 1931:393.

Centrolenella pulveratum—Taylor, 1949:258.

Cochranella pulverata—Taylor, 1951:35. Cisneros-Heredia and McDiarmid, 2006, Zootaxa, 1244:1.

Centrolenella pulverata—Savage 1967:328.

Hyalinobatrachium pulveratum—Ruiz-Carranza and Lynch, 1991:24.

Cochranella petersi—Goin, 1961:96. Holotype: BM 1902.5.27.24. Type locality: "Rio Durango, [Province of Esmeraldas] N. W. Ecuador". **New synonymy.**

Centrolenella petersi—Goin, 1964:1.

Hyalinobatrachium petersi—Ruiz-Carranza and Lynch, 1998:573.

Diagnosis. *Cochranella pulverata* differs from all other Glassfrogs by having a dorsum green with small white spots, completely transparent ventral parietal peritoneum, white hepatic and gastrointestinal peritonea, a sloping snout in lateral profile, and by lacking humeral spines (Fig. 2).

Characterization. (1) dentigerous process of the vomer with 2–4 teeth; (2) snout rounded in dorsal aspect, sloping in lateral profile; (3) tympanum visible, relatively small, its diameter 20.2–23.3% of eye diameter; tympanic annulus visible except for dorsal border covered by supratympanic fold; tympanic membrane differentiated and translucent, pigmented as surrounding skin; (4) dorsal surfaces shagreen; males with small spicules visible under magnification; (5) ventral surfaces granular, thighs below vent lacking pair of enlarged tubercles; (6) ventral parietal peritoneum completely transparent; pericardium and gastrointestinal peritoneum

white; (7) bulbous liver covered by white peritoneum; (8) humeral spines absent; (9) webbing between Fingers I and II absent or basal; webbing formula for outer fingers: II ($1^+ - 1^{1/3}$) — ($2^{4/5} - 3^-$) III ($1^{1/3} - 1^{2/3}$) — ($1^+ - 2^-$) IV; (10) feet about two-thirds webbed; webbing formula: I ($1^- - 1$) — ($1^{2/3} - 2^-$) II ($1^- - 1$) — ($1^{3/4} - 2^-$) III ($1 - 1^+$) — ($1^{2/3} - 2^+$) IV ($2^- - 2^+$) — ($1^- - 1^+$) V; (11) metacarpal, ulnar, metatarsal, and tarsal enameled folds present, having low tubercles that give them an undulated shape; (12) nuptial pad Type-I in adult males; concealed prepollex; (13) Fingers I and II about equal in length (FII/FI = 0.980–1.025); (14) disc of Finger III small, its width 20.1–23.5% of eye diameter; (15) in life, dorsum green with small white flecks and dots; bones green; (16) in preservative, dorsum cream to light lavender with small un-pigmented or white flecks and dots; (17) iris gray-white with thin dark gray reticulations and minute yellow flecks; a thin yellow to cream circumpupillary ring borders the pupil; (18) melanophores partially covering dorsal surface of Finger IV, absent from Fingers I–III; (19) males call from the upper side of leaves; call usually emitted as a series of three notes (each note = 0.05 s), with a short pause between them (internode pause = 0.5–0.8 s), dominant frequency of 5600–6200 Hz (Savage & Starrett 1967; Ibañez *et al.* 1999; Kubicki 2007); (20) fighting behavior unknown; (21) egg masses deposited on the upper side of leaves; no parental care provided (Kubicki 2007); (22) in tadpoles, tooth row formula 2/3; A2 tooth row is broadly separated in the center (Hoffmann 2004); (23) in adult males, SVL 22.0–24.5 mm ($n = 13$); in adult females, SVL 25.3–28.3 mm ($n = 5$; McCranie & Wilson, 2002; this work).

Status of *Centrolenella ametarsia*.

In the description of *Centrolenella ametarsia* (now in the genus *Cochranella*), Flores (1987) noted its close morphological similarity to *Cochranella oyampiensis*. To differentiate the two species, he listed the following traits: fully webbed outer fingers in *C. oyampiensis* (III $2^{1/3}$ — 2^- IV in *C. ametarsia*), white ventral parietal peritoneum (transparent in *C. ametarsia*), transparent visceral peritoneum (white in *C. ametarsia*), concealed tympanum (lower two-thirds exposed in *C. ametarsia*), and concealed prepollex (distinct in *C. ametarsia*). Cisneros-Heredia and McDiarmid (2007b) and Kok and Castroviejo-Fisher (2008) suggested that *C. ametarsia* could be a junior synonym of *C. oyampiensis*. After examination of the holotypes of *C. oyampiensis* and *C. ametarsia*, as well as recently collected specimens from the surroundings of their type localities and additional areas (Appendix 1), we found that the differences listed for *C. ametarsia* and *C. oyampiensis* by Flores (1987) are the product of a limited sample size and preservation artifacts. Individuals found in Leticia, near the type locality of *Cochranella ametarsia*, and in Amazonian Ecuador have a webbing formula of the hand that contains the variation observed in both holotypes [i.e., *ametarsia* and *oyampiensis*; III ($2^- - 2^{1/3}$) — ($1^+ - 2^-$) IV]. Flores (1987) mentioned that *C. ametarsia* has a completely transparent ventral parietal peritoneum. This interpretation is erroneous given that in the types of *C. ametarsia* and *C. oyampiensis* all iridophores responsible for its white coloration are dissolved in the preservation liquid. In the newly collected material (except ICN 50847 where iridophores are also lost), the anterior 1/4–1/3 of the ventral parietal peritoneum is white, being the posterior portion transparent. In all the examined specimens of *C. ametarsia* and *C. oyampiensis*, most of the tympanum (lower three-fourths) is exposed, and a distinct prepollex is present. Additionally, *Cochranella oyampiensis* does not have a white hepatic peritoneum as reported by Señaris and Ayarzagüena (2005); the specimens examined by these authors are in fact *C. helenae* (Ayarzagüena, 1992; see Kok & Castroviejo-Fisher 2008).

We conclude that the two species are morphologically indistinguishable and consider *Centrolenella ametarsia* Flores, 1987, a junior synonym of *Centrolenella oyampiensis* Lescure, 1975. Below, we provide a synonymy, diagnosis, and characterization of *Cochranella oyampiensis*.



FIGURE 1. Photographs of preserved specimens of *Cochranella pulverata*. (A, B) Holotype of *Cochranella petersi*, BM 1902.5.27.24; (C) dorsal view of KU 116493.

***Cochranella oyampiensis* (Lescure, 1975)**

Centrolenella oyampiensis Lescure, 1975:100. Holotype: MNHNP 1973.1673. Type locality: "village Zidok (Haut-Oyapock), Guyane Française".

Centrolenella ametarsia—Flores, 1987:185. Holotype: MCZ A96522. Type locality: “the headwaters of Río Caiwima, a tributary of the Río Amaca-Yacu, ca. 70 km NNE Puerto Nariño, Amazonas, Colombia (approximately 3°20' S, 70°20' W)”. **New synonymy.**

Cochranella ametarsia—Ruiz-Carranza and Lynch 1991:21.

Cochranella oyampiensis—Ruiz-Carranza and Lynch 1991:22.

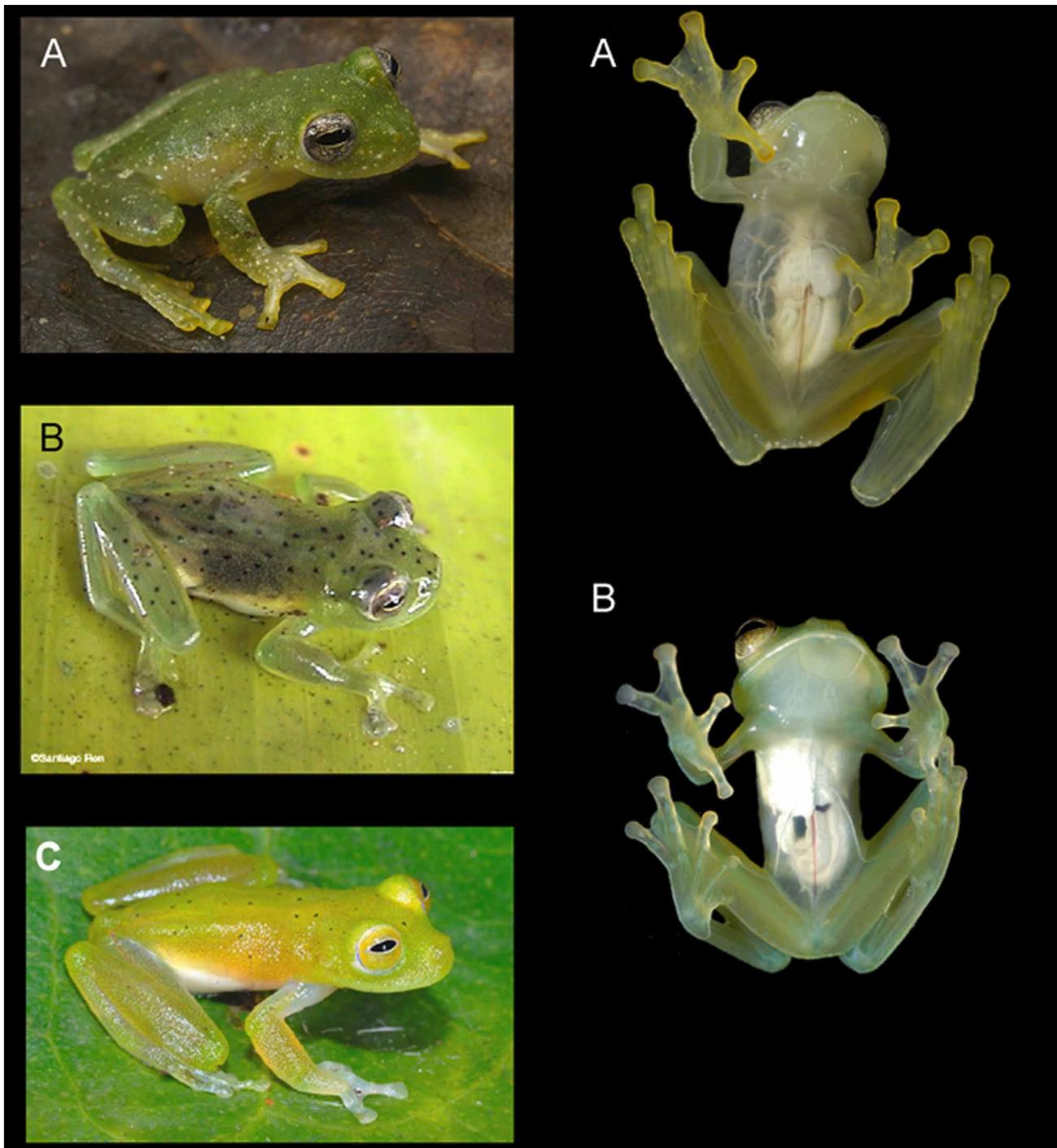


FIGURE 2. Color photographs of *Cochranella pulverata* (A: QCAZ 32066, photo by Martín Bustamante), *Cochranella oyampiensis* (B left: QCAZ 16652, photo by Santiago Ron; B right: MB 202, photo by Michel Blanc), and *Cochranella helena* (C: IRSNB 13980, photo by Philippe Kok).

Diagnosis. Among Glassfrogs, *Cochranella oyampiensis* is unique by having a green dorsum with small black spots, a small size (adults = 20 mm), transparent hepatic peritoneum, white gastrointestinal peritoneum, anterior third of ventral parietal peritoneum white, and a distinct prepollex. The only Glassfrog that could be confused with *C. oyampiensis* is *C. helena*, which differs by having a yellow iris (grayish white with a fine

dark reticulation in *C. oyampiensis*), dorsum light greenish yellow with dark punctuations (green with dark with dark punctuations in *C. oyampiensis*; Fig. 2), and a mostly white hepatic peritoneum (hepatic peritoneum mostly transparent, showing the brown liver, except for some iridophores on the upper border in *C. oyampiensis*; Fig. 3).

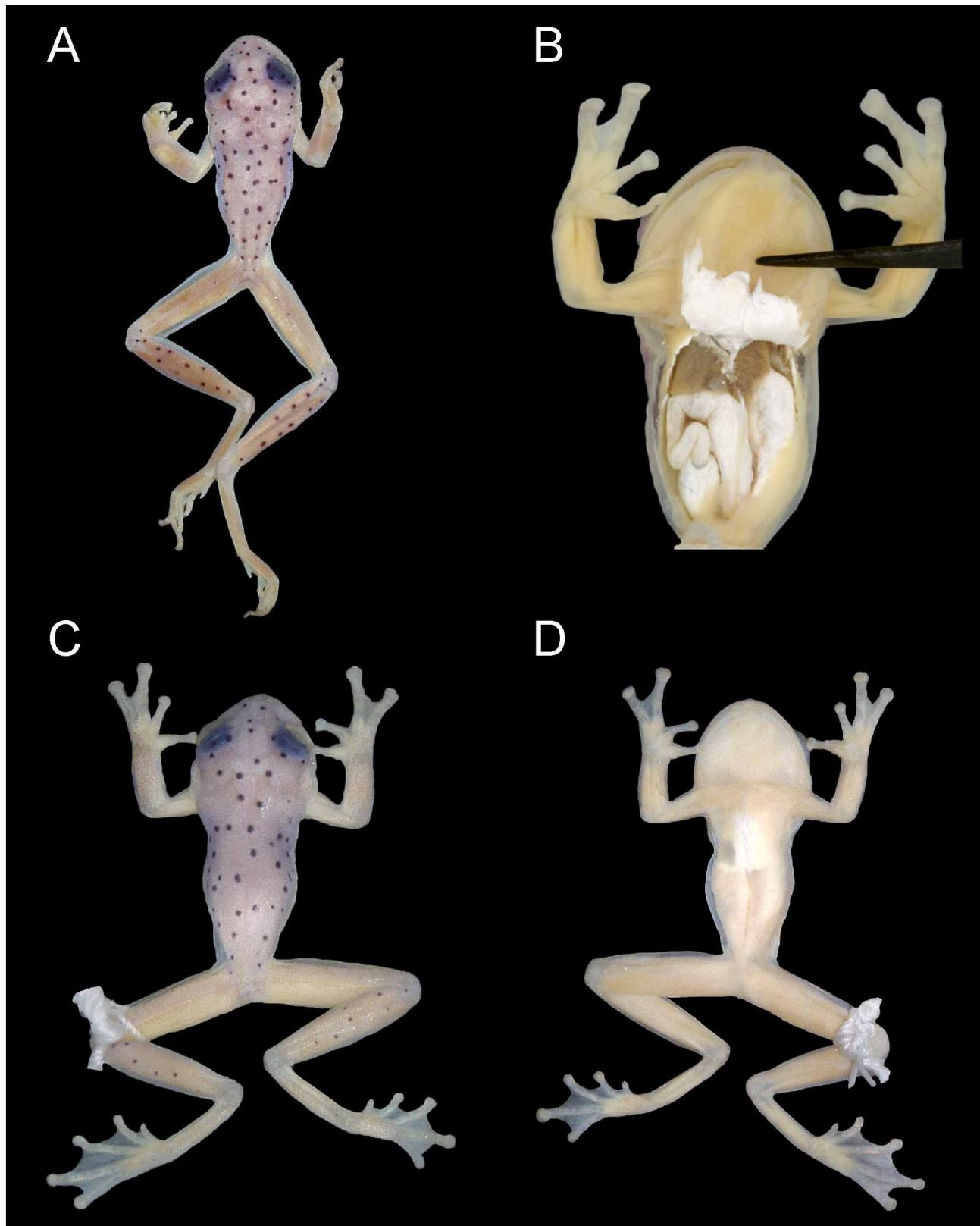


FIGURE 3. Photographs of preserved specimens of *Cochranella oyampiensis*. (A) Holotype of *Centrolenella ametarsia*, MCZ 96522; (B) body cavity, RMNH 37670; (C, D) dorsal and ventral views of ICN 50846.

Characterization. (1) dentigerous process of the vomer with one tooth or lacking teeth; (2) snout rounded in dorsal and lateral views; (3) tympanum visible, moderate in size, its diameter 25.8–35.4% of eye diameter; tympanic annulus visible except for posterodorsal border covered by supratympanic fold; tympanic membrane differentiated and translucent, pigmented as surrounding skin; (4) dorsal surfaces shagreen; males and females lack spinules; (5) ventral surfaces granular, a pair of enlarged tubercles below the vent ; (6) anterior 25–40% of ventral parietal peritoneum white, posterior portion transparent; pericardium and gastrointestinal peritoneum white; (7) lobed liver covered by an almost completely transparent peritoneum except for its anterior part that may be covered by a thin layer of iridophores; (8) humeral spines absent; (9) webbing between Fingers I–III absent, moderate between outer fingers; webbing formula: III ($2^- - 2^{1/3}$) — ($1^+ - 2^-$) IV; (10) webbing between toes moderate; webbing formula: I 1 — ($2^- - 2$) II ($1 - 1^+$) — ($2 - 2^{1/4}$) III ($1^+ - 1^{1/2}$) — 2^+ IV ($2 - 2^{1/3}$) — 1 V; (11) low ulnar fold, lacking iridophores; low inner tarsal fold present, lacking iridophores; outer tarsal fold absent; (12) nuptial pad Type I in males; distinct prepollex (distal portion separated from Finger I); (13) Fingers I slightly longer than Finger II (FII/FI = 0.840–0.921); (14) disc of Finger III moderate, its width 31.0–42.3% of eye diameter; (15) in life, dorsum green with small dark flecks; bones green; (16) in preservative, dorsum lavender with dark flecks; (17) iris grayish white with a fine dark reticulation; (18) melanophores covering dorsal surface of Fingers III and IV, absent from Fingers I and II; (19) males call from the upper side of leaves; single and double note advertisement call of 0.10–0.15 s duration, emphasized frequency of 4640–5160 Hz (Zimmerman & Bogart 1984); (20) fighting behavior unknown; (21) eggs deposited on the upper- or underside of leaves (Lima *et al.*, 2005); parental care unknown; (22) tadpoles unknown; (23) in adult males, SVL 17.1–20.1 mm (= 18.8 ± 1.250 , $n = 6$); in two adult females, SVL 19.8–19.9 mm; Lima *et al.* (2005) provide the following data for the species in central Amazonia: SVL in males 17–21 mm, in females 21–24 mm.

Remarks. Our conclusions are the result of the analysis of morphological traits; however, we cannot rule out the existence of morphologically cryptic species, a possibility that has to be addressed with acoustic and/or molecular data, unavailable now. The wide distribution of the *C. oyampiensis* (from the Guianas across western Amazonia; Lescure 1975; Flores 1987; Lescure & Marty 2001; Lima *et al.* 2005; Guayasamin *et al.* 2006; Cisneros-Heredia & McDiarmid 2007b; Kok & Castroviejo 2008) opens the possibility of testing hypotheses of diversification through phylogeographic studies.

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Appendix 1. Specimens examined

Cochranella pulverata Costa Rica: Puntarenas: Rincón de Osa, UCR 17417, USNM 219379–87. Ecuador: Provincia de Esmeraldas: Río Durango, BM 1902.5.27.24 (holotype of *H. petersi*), BM 1902.5.27.25, QCAZ 32066, DHMECN 2612, 3194–3195; Río Sapayo, BM 1902.7.29.36–37; Río Bogota, DHMECN 3194–95; Reserva Ecológica Cotacachi-Cayapas, Salto del Bravo, 100–150 m, QCAZ 11367; Reserva Ecológica Cotacachi-Cayapas, Charco Vicente, 60 m, QCAZ 11368; Estero Aguacate, Parroquia San Francisco del Cabo, DHMECN 3194–95. Provincia de Pichincha: Silanche, 400 m, QCAZ 32224. Nicaragua: Matagalpa: Finca Tepeyac, 10.5 km N and 9.0 km E of Matagalpa, 960 m, KU 85476. Panamá: Coclé: Quebrada Guabalito, Palmarazo, Parque Nacional Omar Torrijos, CH 5122; Darién: Río Jaque, 1.5 km above Río Imamado, 50 m, KU 116493. Honduras: Olancho, USNM 342214–21.

Hyalinobatrachium fleischmanni Ecuador: Provincia de Esmeraldas: Bosque Protector La Perla, 190 m, QCAZ 12606; La Tola, 250 m, QCAZ 22301–03; Km 2 on San Francisco–Durango road, 60–80 m, QCAZ 32073; Provincia de Los Ríos: Quevedo, USNM 60520; Centro Científico Río Palenque, 150 m, USNM 286639–40; 8 km ESE of Patricia Pilar, 250 m, USNM 286645. Panamá: Darién: Río Tuira at Río Mono, 175 m, KU 96360–61; Río Jaque, 1.5 km above Río Imamado, 50 m, KU 116442–54. Costa Rica: Monteverde, along Río Guacimal, ca. 1350 m, USNM 219250–57; Alto la Palma, 1530 m, USNM 219274–80. Nicaragua: Finca San José de la Montana, near Matagalpa, 975–1100 m, USNM 220013–18. Honduras: confluence of Río Wampu and Río Sausa, 100 m, USNM 342162. México: Salto de Agus, Cerro Ovando, 1 mile NE of La Esperanza, USNM 115499.

Hyalinobatrachium chirripoi Costa Rica: Limón: Suretka, along Cocales Creek, KU 36867–68.

Hyalinobatrachium aureoguttatum Ecuador: Esmeraldas: Km 2 on San Francisco–Durango road, 60–80 m, QCAZ 32069–70, 32101, 32105, 32129, 32132–33.

Cochranella oyampiensis Colombia: Departamento de Amazonas: headwaters of Río Caiwima, tributary of the Río Amayaca-Yacu, MCZ A-96522 (holotype of *C. ametarsia*); Leticia, ICN 50846–47, ICN (JDL 24472). Ecuador: Provincia de Orellana: Río Yasuní, 200 km upstream from Río Napo, KU 175216; Tiputini Biodiversity Station, DFCH-USFQ D162; Estación Científica Yasuní PUCE, 240 m, QCAZ 16652; Yasuní, km 8 on the Pompeya-Iro road, 260 m, QCAZ 22709; Provincia de Sucumbíos: Puerto Bolívar, 260 m, QCAZ 28138. French Guiana: Village Zidock, Haut, Oyapock, MNHN 1973.1673 (holotype of *C. oyampiensis*); Grigel (rivière Ouaqui), MNHN 1973.1674 (paratype of *C. oyampiensis*); Saut Eleupoucing, MNHN 2003.1598. Suriname: Tafelberg, RMNH 37670, 37673–74.

Cochranella helenae Venezuela: Estado Bolívar: Gran Sabana, Quebrada Jaspe (04°55' N, 61°05' W; 800–1000 m), MHNLS 9431 (holotype), 17127–30, IRSNB 13988 (ex MHNLS 17988); Salto Karuay, Karuay river (05°41'27" N, 61°51'40" W; 900 m), MHNLS 17136–40.