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# A NEW SPECIES OF GLASS FROG (CENTROLENIDAE: *COCHRANELLA*) FROM THE LOWLANDS OF NORTHWESTERN ECUADOR, WITH COMMENTS ON THE *COCHRANELLA GRANULOSA* GROUP

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ABSTRACT: We describe a new species of *Cochranella* from the Montañas de Mache in the Chocó Ecoregion of the lowlands of northwestern Ecuador. The new species is placed in the *Cochranella granulosa* group and can be distinguished from all other species of *Cochranella* by having: (1) white parietal and visceral peritonea; (2) a snout that is gradually inclined in lateral aspect; (3) conspicuous dermal folds, and large, white tubercles on ventrolateral edges of Finger IV, forearms, elbows, tarsi, Toe V, and heels; (4) fleshy, tuberculate, ∩-shaped cloacal fold; and (5) dorsum green with small yellow dots in life. The new species shares several characters with *C. daidalea*, *C. resplendens*, *C. savagei* and *C. solitaria*, including dermal folds with white tubercles on the arms and legs, snout gradually inclined in profile, and cloacal ornaments. Finally, we briefly discuss the characters that define the *Cochranella granulosa* group.

*Key words:* Centrolenidae; Chocó Ecoregion; *Cochranella granulosa*; Ecuador; Esmeraldas; Lowlands; Montañas de Mache; New species

The anuran family Centrolenidae currently contains 136 recognized species distributed throughout the neotropics (southern Mexico to Bolivia, northeastern Argentina, and southeastern Brazil; Frost, 2002). The monophyly of the family is supported by the following synapomorphies: (1) fusion of tibiale and fibulare (but see Sanchiz and de la Riva, 1993); (2) T-shaped terminal phalanges; (3) dilated medial process on Metacarpal III; and (4) eggs deposited on vegetation or rock faces above water (Ruiz-Carranza and Lynch, 1991*a*). Three genera are recognized in Centrolenidae: *Centrolene*, *Cochranella*, and *Hyalinobatrachium* (Ruiz-Carranza and Lynch, 1991*a*). *Centrolene* is diagnosed by the presence of humeral spines in adult males and *Hyalinobatrachium* has a bulbous liver (Ruiz-Carranza and Lynch, 1991*a*). *Cochranella* lacks diagnostic synapomorphies and is defined by two plesiomorphic characteristics, liver trilobate and adult males without humeral spines (Ruiz-Carranza and Lynch, 1991*a*).

The genus *Cochranella* contains 60 described species (Frost, 2002) placed in three phenetic groups—viz., the *Cochranella granulosa*, *ocellata*, and *spinosa* groups (Ruiz-Carranza and Lynch, 1991*a*,*b*, 1995). The *C. granulosa* group is defined by the following characters: (1) vomerine teeth present, (2) green bones in life, (3) a snout that is gradually inclined in lateral aspect, (4) white pericardial, parietal, and visceral peritonea, and (5) protruding upper lip (Ruiz-Carranza and Lynch, 1991*a*,*b*). Additionally, several species in the *C. granulosa* group have dermal folds on the arms and legs (Ruiz-Carranza and Lynch, 1991*b*); these folds may have undulated margins or series of tubercles along their ventrolateral edges.

At present, the *Cochranella granulosa* group contains eight species: *C. castroviejoi* Ayarzagüena and Señaris (1997 "1996"), *C. daidalea* Ruiz-Carranza and Lynch (1991*b*), *C. euknemos* (Savage and Starrett, 1967), *C. granulosa* (Taylor, 1949), *C. ramirezi* Ruiz-Carranza and Lynch (1991*b*), *C. resplendens* (Lynch and Duellman, 1973), *C. savagei* Ruiz-Carranza and Lynch (1991*b*), and *C. solitaria* Ruiz-Carranza and Lynch (1991*b*).

Herein, we describe a new species of *Cochranella* that exhibits the defining characteristics of the *C. granulosa* group. It inhabits the lowlands of northwestern Ecuador, in the Montañas de Mache of the Chocó Ecoregion.

## MATERIALS AND METHODS

We examined alcohol-preserved specimens from the herpetological collections at Museo

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de Zoología of the Universidad Católica del Ecuador (QCAZ), Natural History Museum of The University of Kansas (KU), Natural History Museum of Los Angeles County (LACM), and Museo de Historia Natural La Salle (MHNLS). In addition to the type series of the new species, specimens examined are listed in Appendix I; when specimens were not available for direct comparison, we relied on literature. Measurements were taken as described by Guayasamin (2004), except for foot length and disc of Finger III (described below), and are as follow: (1) snout–vent length (SVL); (2) tibia length; (3) foot length = distance from proximal margin of inner metatarsal tubercle to tip of Toe IV; (4) head length; (5) head width; (6) interorbital distance; (7) upper eyelid width; (8) internarial distance; (9) eye-to-nostril distance; (10) snout-to-eye distance; (11) eye diameter; (12) tympanum diameter; (13) eye-to-tympanum distance; (14) radioulna length; (15) hand length; (16) Finger I length; (17) disc of Finger III = greatest width of disc of Finger III. Sexual maturity was determined by the presence of vocal slits in males. For ease of comparison, the numerical diagnosis parallels that of Lynch and Duellman (1973) as modified by Ruiz-Carranza and Lynch (1991*a*) and Noonan and Bonett (2003). Terminology for webbing is that described by Savage and Heyer (1967). For the generic placement of the new species, we follow the classification proposed by Ruiz-Carranza and Lynch (1991*a*).

## Systematics

### *Cochranella* ***mache*** sp. nov.

*Holotype.*—QCAZ 22412, adult male, from Riachuelo La Ducha (0° 20′ 41″ N, 79° 42′ 36″ W; 510 m), tributary of Río Aguacatal, Reserva Biológica Bilsa, 27.4 km W (airline distance) of the town of Quinindé, Montañas de Mache, Provincia Esmeraldas, Ecuador; obtained on 8 January 2003 by Juan M. Guayasamin and Elisa Bonaccorso.

*Paratypes.*—QCAZ 22413, same data as holotype; KU 291176, Río Aguacatal, Reserva Biológica Bilsa, Montañas de Mache, Provincia Esmeraldas, Ecuador; obtained on 3 July 2000 by Greg Vigle.

*Diagnosis.*—The new species is placed in the genus *Cochranella* because it lacks bulbous liver (present in *Hyalinobatrachium*) and lacks a humeral spine in males (present in *Centrolene*). *Cochranella mache* (Figs. 1, 2) differs from other species in the genus by the following combination of characters: (1) each vomer having 3 or 4 teeth on dentigerous process; (2) bones green in life; (3) in life, parietal peritoneum white, covering anterior third of abdomen (heart not visible); pericardial and stomach peritonea white; hepatic peritoneum clear; (4) in life, dorsum green with numerous small yellow spots, Fingers I and II and Toes I and II white; iris white with fine black reticulation and narrow golden ring around pupil; in preservative, dorsum lavender with small white or cream spots; (5) webbing formula between outer fingers usually $II1^{+}$–$3^{+}III2^{-}$–1IV; (6) webbing formula on foot usually I1–$2^{-}$II1–2 III1–$2^{-}$IV2–1V; (7) snout round in dorsal view and gradually inclined in lateral view; (8) dorsal skin shagreen, usually with numerous minute spinules and warts with protruding spicules; (9) dermal folds present, conspicuous, with large white tubercles on ventrolateral edges of Finger IV, forearms, elbows, Toe V, tarsi, and heels; cloacal fold present, ∩-shaped, fleshy, tuberculate; (10) humeral spine absent; (11) posterodorsal portion of tympanum covered by low tympanic fold, tympanum oriented dorsolaterally; (12) snout–vent length in males 23.5–24.0 mm; females unknown; (13) prepollical spine not protruding externally; nuptial pad large (Type I of Flores, 1985); nuptial excrescences cream, finely granular; (14) cloacal ornamentation present in the form of white warts (= enameled warts sensu Lynch and Duellman, 1973:6); (15) when adpressed, Fingers I and II about same length; (16) liver trilobate; (17) eye diameter about double width of disc of Finger III.

*Cochranella mache* is distinguished from most other species in the genus by having a snout gradually inclined in profile (Fig. 3) and dermal folds with a series of tubercles on the ventrolateral edges of the Finger IV, forearms, elbows, Toe V, tarsi, and heels (Fig. 4a,b). In *Cochranella*, only the following species share the aforementioned characteristics: *Cochranella daidalea*, *C. resplendens*, *C. savagei*, and *C. solitaria*. The only other species that can be confused with *C. mache* is *C. euknemos*.

The primary characters distinguishing *Cochranella mache* from *C. daidalea* are as

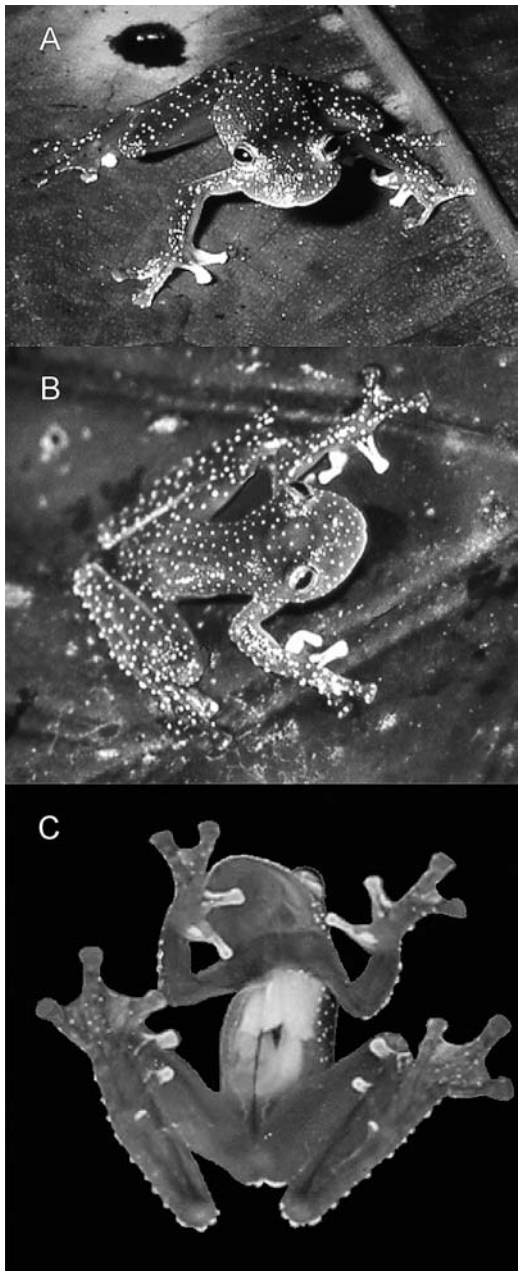


FIG. 1.—Dorsal (A, B) and ventral (C) views of *Cochranella mache* in life. Specimen shown in (A) not collected, photo by Andrew J. Crawford; specimen in (B) and (C) paratype QCAZ 22413, SVL = 24.0 mm, adult male. Color photographs will be available at AmphibiaWeb (http://elib.cs.berkeley.edu/aw/).

FIG. 2.—Dorsal view of holotype of *Cochranella mache* in preservative, QCAZ 22412; SVL = 24.0 mm, adult male.

follow: (1) males have conspicuous nuptial pads (absent in males of *C. daidalea*; Ruiz-Carranza and Lynch, 1991*b*), and (2) in life, the dorsum is green with numerous, small yellow spots (dorsum pale green with small cream to white spots and large dark blue to black spots in *C. daidalea*; Ruiz-Carranza and Lynch, 1991*b*). *Cochranella mache* is distinguished from *C. resplendens* by (1) usually having spinules and spicules on the dorsum (absent in *C. resplendens*), (2) in life, having a green dorsum bearing numerous small, yellow spots (dorsum dark green with white to bluish green spots in *C. resplendens*; Lynch and Duellman, 1973), (3) being smaller (Table 1), and (4) having a distribution in lowlands west of the Andes (lowlands east of the Andes in *C. resplendens*; Table 2). *Cochranella mache* differs from *C. savagei* and *C. solitaria* by (1) possessing dermal folds with series of large tubercles on forearms, Finger IV, tarsi, and Toe V (dermal folds with series of relatively low tubercles in *C. savagei* and *C. solitaria*; Fig. 3 of Ruiz-Carranza and Lynch, 1991*b*), (2) having males with conspicuous nuptial excrescences (nuptial excrescences absent in males of *C. savagei* and *C. solitaria*; Ruiz-Carranza and Lynch, 1991*b*), and (3) in life, having a green dorsum bearing numerous small, yellow spots (dorsum green with dark green and white spots in *C. savagei* and *C. solitaria*; Ruiz-Carranza and Lynch,

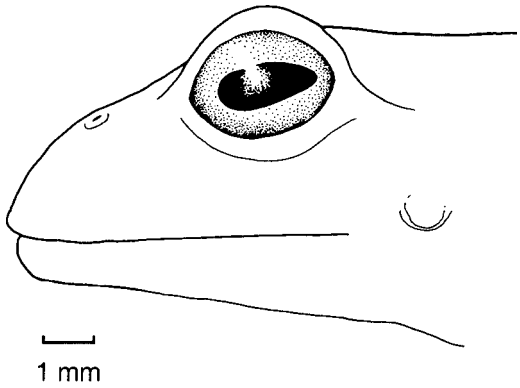


FIG. 3.—Lateral view of head of paratype of *Cochranella mache*, KU 291176; SVL = 23.5 mm.

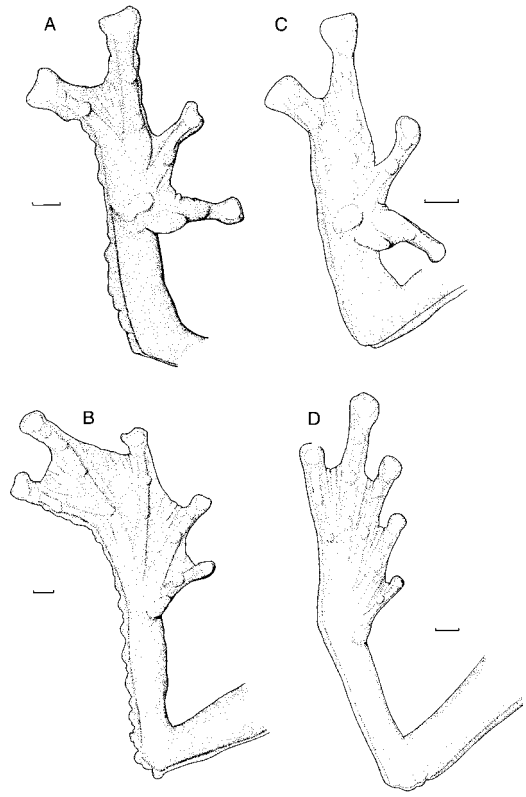


FIG. 4.—Hand and foot of male paratype (KU 291176, SVL = 23.5 mm) of *Cochranella mache* (A, B), and of male holotype (LACM 26764, SVL = 24.5 mm) of *Cochranella euknemos* (C, D).

1991*b*). *Cochranella mache* differs from *C. euknemos* by (1) having dermal folds on the forearms, Finger IV, tarsi, and Toe V with lateral tubercles, resembling a series of separate flaps (dermal fold continuous and slightly undulate in *C. euknemos*; Fig. 4), and (2) in life, having dermal folds with white coloration only on lateral tubercles (dermal folds with continuous white border; Savage and Starrett, 1967). The distribution of some characters among species in the *C. granulosa* group is presented in Table 3.

*Description of holotype.*—Adult male, SVL 24.0 mm. Head slightly wider than body, longer than wide; head width 93.3% of head length, 35% of SVL; snout rounded in dorsal view, gradually sloping from nostrils to tip in lateral profile; canthus rounded; loreal region slightly concave; lips slightly flared; nostril about one half the distance from eye to tip of snout, not protuberant, directed dorsolaterally; internarinal area barely depressed. Eye large, directed anterolaterally; transverse diameter of disc of Finger III 53% of eye diameter. Supratympanic fold low, obscuring posterodorsal portion of tympanic annulus; tympanum directed dorsolaterally, with slight posterior inclination; tympanic membrane translucent, pigmented as surrounding skin. Dentigerous processes of vomer low, situated transversely between choanae, each bearing four teeth; choanae large, longitudinally rectangular; tongue ovoid, with ventral posterior sixth not attached to mouth floor and posterior margin notched; vocal slits long, extending posterolaterally from the posterolateral base of tongue to angle of jaws.

Humeral spine absent; conspicuous dermal fold around elbow, along ventrolateral edge of forearm and outer edge of Finger IV; dermal folds with lateral, large, white tubercles (Fig. 4); relative length of fingers: III > IV > I ≈ II; webbing between Fingers I and II absent, webbing formula for outer fingers $III1^{+}$–$3^{+}III2^{-}$–1IV; discs expanded, nearly round; disc pads triangular; subarticular tubercles small, round, simple; supernumerary tubercles absent; palmar tubercle elliptical, simple; nuptial pad large, ovoid, granular, extending from ventrolateral base to dorsal surface of Finger I (Fig. 5), covering the proximal one-half of the length of Finger I (Type I of Flores, 1985).

Length of tibia 62.9% of SVL; conspicuous dermal fold around heel, along ventrolateral

TABLE 1.—Measurements (in mm) of species of the *Cochranella granulosa* group.

| Character | *C. castroviejoi* | *C. croceopodes* | *C. daidalea* | *C. euknemos* | | *C. granulosa* | | *C. mache* | *C. ramirezi* | *C. savagei* | *C. resplendens* | *C. solitaria* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Source | This work | This work | Ruiz-Carranza and Lynch 1991*b* | This work | | This work | | This work | Ruiz-Carranza and Lynch 1991*b* | Ruiz-Carranza and Lynch 1991*b* | This work | Ruiz-Carranza and Lynch 1991*b* |
| Specimens referred | MHNLS 16429, 16432, 16446, 16452 | KU 211804, 211799 | ICN 18008 (holotype) | LACM 26764 (holotype), 47066, KU 77534, 116436, 116441 | KU 116437, 116439 | KU 65236, 23802, 96362, 85474 | KU 32808, 166457 | QCAZ 22412 (holotype), 22413, KU 291176 | ICN 19684 (holotype) | ICN 9769 (holotype) | KU 118053 (holotype) | ICN 24298 (holotype) |
| Sex | Males | Females | Female | Males | Females | Males | Females | Males | Male | Female | Male | Male |
| SVL | 21.3–22.6 | 24.4–25.2 | 25.5 | 22.2–26.7 | 29.1–31.1 | 25.9–28.2 | 28.6–29.6 | 23.5–24.0 | 25.6 | 23.3 | 26.6 | 19.3 |
| Tibia | 12.3–13.5 | 13.8–15.2 | 13.6 | 12.8–15.5 | 16.7–18.1 | 13.3–15.5 | 16.3–17.7 | 13.8–15.1 | — | 12.9 | 15.0 | 11.8 |
| Foot | 9.1–10.0 | 11.4–12.4 | — | 11.3–12.6 | 13.6–13.9 | 11.6–12.5 | 13.2–14.5 | 10.8–12.2 | — | — | 12.8 | — |
| Head length | 7.4–8.0 | 9.1 | 8.1 | 8.0–9.7 | 10.5–11.5 | 8.6–9.1 | 9.5–10.1 | 8.1–9.0 | 7.9 | 7.9 | 9.7 | 5.4 |
| Head width | 7.7–8.0 | 9.8–10.0 | 9.0 | 7.5–10.0 | 10.8–11.3 | 8.5–9.5 | 10.0 | 7.7–8.4 | 8.8 | 8.3 | 9.5 | 6.9 |
| Interorbital distance | 2.5–2.7 | 2.8–3.0 | 3.0 | 2.6–3.2 | 3.3 | 2.7–3.5 | 3.5–3.8 | 2.8–3.0 | 3.5 | 3.3 | 3.2 | 2.55 |
| Upper eyelid width | 1.6–2.0 | 2.4 | 1.4 | 1.4–1.6 | 1.5–1.8 | 2.1–2.5 | 2.2 | 1.4–1.6 | — | 1.1 | 1.6 | — |
| Internarinal distance | 1.4–1.6 | 2.0 | — | 1.8–2.0 | 2.2–2.5 | 1.9–2.2 | 2.1–2.3 | 1.8–2.0 | — | — | 2.3 | — |
| Eye-to-nostril distance | 1.9–2.0 | 2.3 | — | 2.1–2.3 | 2.6–3.1 | 2.2–2.3 | 2.4 | 2.1–2.2 | — | — | 2.6 | — |
| Snout-to-eye-distance | 3.1–3.3 | 4.4 | 1.3 | 4.1–4.5 | 5.3–5.6 | 3.8–4.3 | 4.0–5.0 | 3.9–4.2 | 2.3 | 1.4 | 5.0 | 1.45 |
| Eye diameter | 3.3–3.6 | 3.4–3.5 | 2.7 | 2.5–2.8 | 2.9–3.0 | 2.9–3.5 | 3.2–3.3 | 2.8–3.0 | 2.8 | 2.1 | 2.9 | 2.1 |
| Tympanum diameter | 0.8 | 1.2 | — | Not evident | Not evident | 0.8–1.1 | 1.1 | 1.0–1.1 | 0.9 | 1.6 | 1.1 | 1.10 |
| Eye-to-tympanum distance | 1.1–1.2 | 1.2–1.4 | — | Not evident | Not evident | 1.1–1.3 | 1.3 | 0.6–0.8 | — | — | 0.9 | — |
| Radioulna length | 4.6–5.2 | 5.2–6.0 | — | 4.8–5.5 | 5.8–6.3 | 5.3–5.8 | 5.8–6.3 | 4.7–4.9 | — | — | 6.0 | — |
| Hand length | 6.5–6.9 | 7.8–8.3 | — | 7.4–8.1 | 8.8–8.9 | 7.4–7.9 | 8.2–8.9 | 7.6–8.3 | — | — | 8.3 | — |
| Finger I length | 4.4–4.6 | 5.2–5.7 | — | 4.1–5.1 | 5.8–6.0 | 4.8–5.2 | 5.4–6.3 | 4.6–5.1 | — | — | 5.5 | — |
| Disc of Finger III | 1.0–1.2 | 1.5–1.6 | 1.5 | 1.2–1.5 | 1.4–1.5 | 1.3–1.6 | 1.7–1.8 | 1.3–1.6 | 1.4 | 1.3 | 1.6 | 1.2 |

TABLE 2.—Geographic distribution of species of the *Cochranella granulosa* group.

| *Species* | Distribution | Source |
|---|---|---|
| *C. mache* | Montañas de Mache, 510 m, Reserva Biológica Bilsa, Provincia de Esmeraldas, Pacific lowlands of northwestern Ecuador | This work |
| *C. castroviejoi* | Península de Paria, Ramal oriental Cordillera de La Costa, 580–750 m, Estado Sucre, Venezuela | Ayarzagüena and Señaris ("1997" 1996); this work |
| *C. croceopodes* | Northwest-southeast ridge north of Tarapoto, 730–800 m, Provincia de San Martín, eastern slopes of the Cordillera Central de los Andes, northern Peru | Duellman and Schulte (1993) |
| *C. daidalea* | Western slope of the Cordillera Oriental, 1630–2060 m, Departamentos Cundinamarca and Santander, Andean Mountains, Colombia | Ruiz-Carranza and Lynch (1991*b*) |
| *C. euknemos* | Costa Rica (840–1500 m), and Panama (90–1270) to the pacific slope of the Western Andes (south to Departamento de Chocó) of Colombia (100–1650 m) | Ruiz-Carranza and Lynch (1991*b*), Savage (2002) |
| *C. granulosa* | From Atlantic slope eastern Honduras to central Panama and on the Pacific versant from northern Costa Rica to southwestern Panama (40–1500 m) | Savage (2002) |
| *C. ramirezi* | Western slopes of the Cordillera Occidental, 20–830 m, Departamentos Antioquia and Chocó, Andean Mountains, Colombia | Ruiz-Carranza and Lynch (1991*b*) |
| *C. resplendens* | Amazon Basin in Ecuador, Provincia de Sucumbíos, and southwestern Colombia (Departamento de Putumayo), below 340 m | Lynch and Duellman (1973) |
| *C. savagei* | Western slope of the Cordillera Central, 1980-2410 m, Departamentos de Quindío and Risaralda, and western slopes of the Cordillera Occidental, 1800 m, Departamento del Valle del Cauca, Andean Mountains, Colombia | Ruiz-Carranza and Lynch (1991*b*) |
| *C. solitaria* | Eastern slope of the Cordillera Oriental, 1410 m, Departamento de Caquetá, Andean Mountains, Colombia | Ruiz-Carranza and Lynch (1991*b*) |

edge of tarsus and outer edge of Toe V; dermal folds with large, white tubercles laterally (Figs. 1, 2); feet about fully webbed; webbing formula on foot I1–2⁻II1⁻–2 III1–2IV2–1⁻V; discs on toes round; disc on Toe IV narrower that disc on Finger III; disc pads triangular; inner metatarsal tubercle large, ovoid; outer metatarsal tubercle absent; subarticular tubercles small, round; supernumerary tubercles absent.

Skin on dorsal surfaces of head, body, and lateral surface of head and flanks shagreen with numerous minute spinules and warts with protruding spicules; warts usually associated with white spots; throat smooth, cream; belly and lower flanks areolate; cloacal opening directed posteriorly at upper level of thighs, bordered laterally by fleshy tuberculate ∩-shaped fold; cloacal tubercles small, fleshy, located immediately posterior to cloacal slit (Fig. 6), but different from those illustrated by Lynch and Duellman (1973; their Fig. 2A).

*Color in life.*—Dorsum green with small yellow spots (Figs. 1, 2); upper lip with thin white margin; iris white with fine black reticulation; narrow golden ring around pupil; lateral tubercles on dermal folds of hind- and forelimbs white (Figs. 1, 2); Fingers I and II and Toes I and II white; throat and ventral surfaces of limbs blue-green; parietal peritoneum white, covering anterior part of abdomen (heart not visible); stomach peritoneum white; bones green (Fig. 1); some cloacal tubercles white.

*Color in preservative.*—Dorsum of head, body, and limbs green-lavender with small white or cream spots; upper lip with thin white or cream margin; lateral tubercles on dermal folds of forearm, Finger IV, tarsus, and Toe IV cream-white; dorsally, spots on hind limbs form a barred pattern (Fig. 2); nuptial pad on Finger I cream; dorsally, Fingers I and II and Toes I–III unpigmented; some cloacal tubercles creamy white; venter creamy white.

*Measurements.*—The morphometric data (in mm) for the holotype is as follows: SVL = 24.0; tibia length = 15.1; foot length = 12.2; head length = 9.0; head width = 8.4; interorbital distance = 3.0; upper eyelid width = 1.6; internarial distance = 2.0; eye-to-nostril

TABLE 3.—Character states of species in the *Cochranella granulosa* group. Nuptial pad, spinules, and spicules are as described by Flores (1985). Cloacal ornaments refer to structures (e.g., folds and tubercles) located immediately around the cloacal opening (Fig. 6) and not to the pair of enlarged tubercles located below the cloaca (see Fig. 2A of Lynch and Duellman, 1973).

| | Snout in profile | Dermal folds on arms and legs | Tubercles on dermal folds | Cloacal ornamentation | Nuptial pad | Spinules and spicules in dorsum of males | Dorsal coloration in life | Source |
|---|---|---|---|---|---|---|---|---|
| *C. mache* | Gradually inclined | Present | Present | Present | Type I | Usually present | Green with yellow spots | This work |
| *C. castroviejoi* | Truncate | Absent | Absent | Absent | Type I | Present, but few and minute | Dark green with yellow spots | Ayarzagüena and Señaris ("1997" 1996); this work |
| *C. croceopodes* | Nearly truncate | Absent | Absent | Absent | ? | ? | Dosum dull green with diffuse yellow line on flanks; no dots | Duellman and Schulte (1993) |
| *C. daidalea* | Gradually inclined | Present | Present | Present | Absent | ? | Pale green with cream to white and dark blue to black spots | Ruiz-Carranza and Lynch (1991*b*) |
| *C. euknemos* | Gradually inclined | Present | Absent | Present | Type I | Present | Deep bluish-green with yellowish-white to bright yellow spots | Savage and Starrett (1967); this work |
| *C. granulosa* | Gradually inclined | Absent | Absent | Absent | Type I | Present | Dark green, usually with scattered large black spots | Savage (2002); Taylor (1949); this work |
| *C. ramirezi* | Round | Absent | Absent | Absent | Type I | ? | Green to yellow-green forming a reticular pattern, which surrounds cream spots | Ruiz-Carranza and Lynch (1991*b*) |
| *C. resplendens* | Gradually inclined | Present | Present | Present | Type I | Absent | Dark green with white to bluish green spots | Lynch and Duellman (1973); this work |
| *C. savagei* | Gradually inclined | Present | Present | Present | Absent | ? | Green with white and dark green spots | Ruiz-Carranza and Lynch (1991*b*) |
| *C. solitaria* | Gradually inclined | Present | Present | Fold present; no tubercles | Absent | ? | Pale green with white and dark green spots | Ruiz-Carranza and Lynch (1991*b*) |

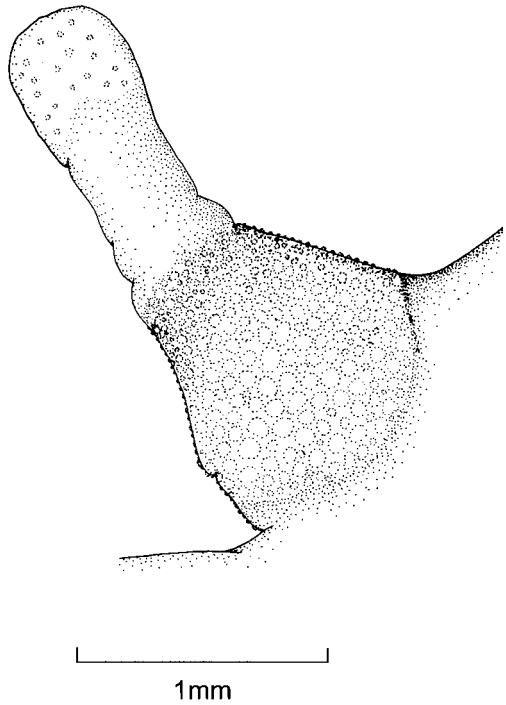


FIG. 5.—Dorsal view of nuptial excrescences on Finger I of paratype of *Cochranella mache*, QCAZ 22413; SVL = 24.0 mm, adult male.

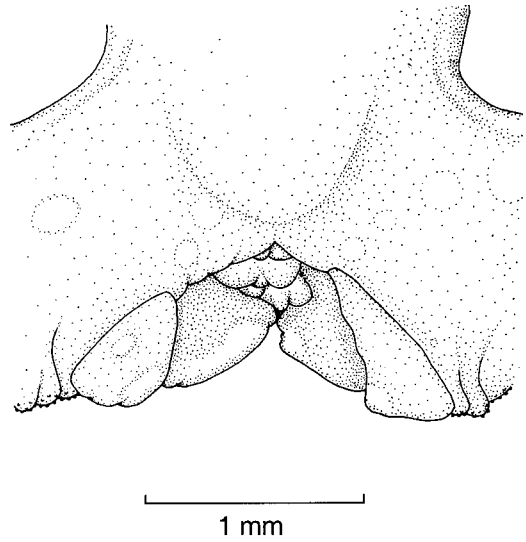


FIG. 6.—Dorsal view of cloacal ornamentation of holotype of *Cochranella mache*, QCAZ 22412; SVL = 24.0 mm, adult male.

distance = 2.2; snout-to-eye distance = 4.2; eye diameter = 3.0; tympanum diameter = 1.0; eye-to-tympanum distance = 0.8; radio–ulna length = 4.9; hand length = 8.3; Finger-I length = 5.1; and disc of Finger III = 1.6.

*Variation.*—Variation in measurements is given in Table 1. Other variation is as follows: dorsum with no visible spicules and spinules (KU 291176); dentigerous process of each vomer with three teeth (KU 291176); webbing formula for outer fingers II1$^{+}$–3$^{+}$III2–1$^{+}$IV (KU 291176); webbing formula on foot I1$^{-}$–2$^{-}$II1–2III1–2$^{-}$IV2$^{-}$–1V (KU 291176) or I1–2$^{-}$II1–2III1–2$^{-}$IV2–1V (QCAZ 22413); discs on Fingers II–IV truncate (KU 291176); discs on Toes III–V (KU 291176) or on Toes III and IV (QCAZ 22413) truncate.

*Etymology.*—The specific name is a noun in apposition and refers to the Montañas de Mache, the type locality of the species.

*Distribution and ecology.*—*Cochranella mache* is known only from the Riachuelo La Ducha (0° 20′ 41″ N, 79° 42′ 36″ W; 510 m), a tributary of the Río Aguacatal, and the Río Aguacatal, Provincia Esmeraldas, Ecuador (Fig. 7). The type locality is in the Montañas de Mache within the Reserva Biológica Bilsa, a reserve managed by the Fundación Jatun Sacha. The Reserva Biológica Bilsa occupies 2500 ha ranging from 300–700 m and is located within the Reserva Ecológica Mache-Chindul in the last relatively extensive block of forest in the northern coastal hills. This region is included in the Evergreen Foothill Forest (*Bosque Siempreverde Piemontano*) Formation as defined by Cerón et al. (1999) and is seasonally rainy; July–September are the dryest months. Two individuals (QCAZ 22412–13) of *C. mache* were encountered at night on vegetation (100–150 cm above ground) in the immediate vicinity of streams. *Cochranella mache* seems to be rare in the area. In our visit to the type locality, we conducted nocturnal searches along streams for five consecutive nights (7–11 January, 2003), searching approximately four hours per night, and found only two individuals (QCAZ 22412–13). Other nocturnal amphibians found at the type locality were *Centrolene prosoblepon*, *Hyla picturata*, and *Eleutherodactylus achatinus*.

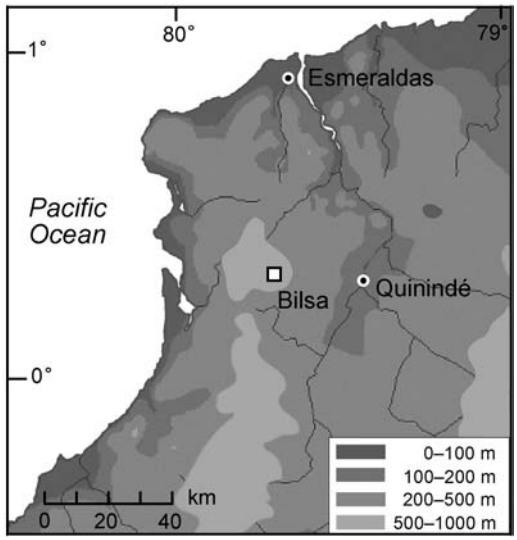


FIG. 7.—Location of type locality of *Cochranella mache* (square) in northwestern Ecuador.

## DISCUSSION

The *Cochranella granulosa* group is distributed in lowland and cloud forests of Central America and northern South America at elevations of 20–2410 m, and has its highest diversity in the Colombian Andes (Table 2). Ruiz-Carranza and Lynch (1991*b*) listed several diagnostic characters for the group (described in Introduction), but only one is unambiguous in separating *C. granulosa* from the two other species groups recognized in *Cochranella* (*C. ocellata* and *C. spinosa* groups). All species in the *C. granulosa* group have a white visceral peritoneum; in contrast, species in the *C. ocellata* and *C. spinosa* groups have a transparent visceral peritoneum. Based on this character, the *C. granulosa* group contains the following species: *C. castroviejoi*, *C. croceopodes*, *C. daidalea*, *C. euknemos*, *C. granulosa*, *C. mache*, *C. ramirezi*, *C. resplendens*, *C. savagei*, and *C. solitaria*.

Ruiz-Carranza and Lynch (1995:3) removed *Cochranella croceopodes* from the *C. granulosa* group without explanation. However, according to the original description (Duellman and Schulte, 1993), *C. croceopodes* has a white visceral peritoneum; this characteristic justifies the inclusion of *C. croceopodes* in the *C. granulosa* group.

Based on the presence of dermal folds with white tubercles on the arms and legs, the snout being gradually inclined in profile, and cloacal ornaments (Table 3), we suggest that *Cochranella mache*, *C. daidalea*, *C. resplendens*, *C. savagei.* and *C. solitaria* might be closely related. Nevertheless, rigorous cladistic analyses are necessary to test this hypothesis.

## RESUMEN

Describimos una nueva especie de *Cochranella* de las montañas Mache en las tierras bajas del noroccidente del Ecuador, en la región del Chocó. La nueva especie pertenece al grupo de especies *Cochranella granulosa* y se distingue principalemente por tener: (1) periotoneo parietal y viceral color blanco; (2) hocico gradulamente inclinado en vista lateral; (3) pliegues dermales con conspicuos tubérculos blancos en el margen ventrolateral de la mano, brazo, codo, pie y tobillo; (4) región cloacal con pliegue en forma de ∩ y tubérculos blancos; y (5) en vida, dorso verde con pequeños puntos amarillos. La nueva especie comparte muchas características con *C. daidalea*, *C. resplendens*, *C. savagei* y *C. solitaria*. Brevemente, discutimos los caracteres que diagnostican al grupo de especies *Cochranella granulosa*.

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## Appendix I

### *Specimens Examined*

*Cochranella euknemos*: Costa Rica: *Provincia San José:* Cantón Coronado: 1.5 km S Alto La Palma, 1500 m (LACM 26764, holotype). Panama: *Provincia Darién:* Serranía de Darién, Laguna, 08° 00′ N, 77° 20′ W, 820 m (KU 77534); S slope Cerro La Campana, 850 m (KU 116436); Río Jaque, 1.5 km above Río Imamado, 50 m (KU 116439–41); *Comarca San Blas*: Camp Summit, 400 m (KU 116437–38).

*Cochranella castroviejoi*: Venezuela: *Estado Sucre*: Península de Paria, Cerro El Humo, ca. 1 km NW Las Melenas, 10° 42′ S, 61° 37′ W, ca. 750 m (MHNLS 16429, 16432); Península de Paria, 2.5 km W and 3.2 km N of Macuro, 10° 41′ 32″ S, 61° 57′ 44″ W, 580 m (MHNLS 16446, 16452).

*Cochranella croceopodes*: Perú: *Departamento San Martín*: Provincia San Martín: 23.2 km (by road) NE of Tarapoto, 06° 27′ S, 76° 48′ W, 800 m (KU 211804, holotype); Cataratas Ahuashiyacu, 14 km NE, Tapapoto, 730 m (KU 211799, paratype).

*Cochranella granulosa*: Costa Rica: *Provincia Limón*: Los Diamantes, 1 mi. S Guapiles (KU 23802, paratype); Moravia de Chirripo (KU 32808). *Provincia Cartago*: Río Chitaria, 3 km NNE Pavones, 775 m (KU 65236). Panama: *Provincia Darien:* Reserva de Pava, Río Tuira, 30 m (KU 96362); *Provincia Bocas del Toro:* ca. 4.8 km W Almirante, 40 m (KU 116457). Nicaragua: *Matagalpa Province:* Finca Tepeyac, 10.5 km N, 9 km E Matagalpa, 960 m (KU 85474).

*Cochranella resplendens*: Ecuador: *Provincia Sucumbíos*: Santa Cecilia, 340 m (KU 118053, holotype).