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# A NEW SPECIES OF GLASSFROG (CENTROLENIDAE) FROM THE SOUTHERN ANDEAN FOOTHILLS ON THE WEST ECUADORIAN REGION

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ABSTRACT: *Cochranella buenaventura* sp. nov. is described from the southern foothills of the Cordillera Occidental, Andes of Ecuador. The new species inhabits the Seasonal Foothill Evergreen forests of the province of El Oro, in the West Ecuadorian biogeographic region. This species is distinguished from other species of glassfrogs by having a truncate snout in dorsal and lateral views, reduced webbing between fingers, absence of guanophores on the digestive visceral peritonea, but present on the renal capsule, absence of humeral spine, green dorsum in life with scattered pale yellow spots, bright yellow hands and feet discs, and moderate body size (20.9-22.4 mm snout-vent length in adult males).

KEYWORDS: Amphibia, Anura, Centrolenidae, *Cochranella,* new species, West Ecuadorian region, Province of El Oro, Ecuador.

## INTRODUCTION

The West Ecuadorian region is a biogeographic zone recently defined for the highly Seasonal Evergreen forests that extend along the Pacific lowlands and foothills of Cordillera Occidental in western Ecuador. Previously conceived just as a transition zone between the Chocoan and Tumbesian regions, recent studies have revealed that several unique, endemic, and highly endangered species are restricted to this region. As such, it has been recognized, for biogeographic and conservation reasons, as an independent Endemic Area (Cisneros-Heredia 2006).

The monophyletic family Centrolenidae at present includes ca. 135 species of arboreal anurans, commonly called glassfrogs. They are widely distributed and diverse along the Neotropics, but only four described species have been reported from the seasonal forests of the West Ecuadorian region, *Cochranella mache, Cochranella spinosa, Hyalinobatrachium fleischmanni, Centrolene prosoblepon,* only the latter from foothill forests (Duellman and Burrowes 1989, Guayasamin and Bonnacorso 2004, Cisneros-Heredia and McDiarmid 2005). Recent fieldwork carried out by the Museo Ecuatoriano de Ciencias Naturales in the Seasonal Foothill Evergreen forests of the province of El Oro, West Ecuadorian region, resulted in the collection of a series of specimens of an undescribed Centrolenid species, which we describe herein.

## MATERIAL AND METHODS

General characters and terminology used herein follow definitions by Ruiz-Carranza and Lynch (1991), and Cisneros-Heredia and McDiarmid (2006a). Webbing formulae follow the method of Savage and Heyer (1967), as modified by Guayasamin *et al.* (2006). Eye direction angle was calculated as proposed by Wild (1994). Sex was determined by direct examination of the gonads and by noting the presence of secondary sexual characters (vocal slits, nuptial pads). Relative digit lengths were determined by adpressing adjacent digits to each other. The following measurements and their abbreviations are cited in the text and, they were taken with electronic digital calipers (0.05 mm accuracy) at least three times each as described by Cisneros-Heredia and McDiarmid (2006a): 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).

Geographic placement and elevation at collection localities were determined using collector's field notes and museum records, and revised in accordance with the 2000 physical map of the Republic of Ecuador (IGM, 2000), and NGA (2006). Classifications of zoogeographic divisions and vegetation formations from Ecuador follow the proposals by Albuja *et al.* (1980) and Sierra (1999), as modified by Cisneros-

Heredia (2006). Museum abbreviations are as follow: DHMECN – División de Herpetología, Museo Ecuatoriano de Ciencias Naturales, Quito; DFCH-USFQ – Universidad San Francisco de Quito, Quito; ICN – Instituto de Ciencias Natural, Universidad Nacional de Colombia, Bogotá; USNM – Nacional Museum of Natural History, Smithsonian Institution, Washington, D.C.

## Results

### *Cochranella buenaventura* sp. nov.
(Figs. 1-3)

*Holotype* – DHMECN 3563, an adult male collected at Reserva Buenaventura (03°38'S, 79°45'W, 1200 m elevation), canton Piñas, Provincia de El Oro, República del Ecuador, on 5 June 2006 by Mario Yánez-Muñoz, Paul Meza-Ramos, Marco Reyes-Puig, and Juan Pablo Reyez-Puig.

*Paratopotypes* – DHMECN 3561-62, adult males collected with the holotype; DHMECN 2524, adult male collected on 23 December 2003.

*Diagnosis – Cochranella buenaventura* is diagnosed from all other glassfrogs by the combination of the following characters: (1) vomerine teeth absent; (2) snout truncate in dorsal view and in profile; nostrils elevated with a deep depression in the internarial area; (3) lower half of the tympanic annulus evident, oriented dorsolaterally with dorsoventral inclination; supratympanic fold absent or very weak; (4) dorsal skin slightly shagreen with scattered flat tubercles corresponding to light spots and extensive microgranulations (= microspiculations, see Flores and McDiarmid 1989, Cisneros-Heredia and McDiarmid 2006b); (5) ventral skin areolate, pair of large, round, flat tubercles on ventral surfaces of thighs below vent; subanal skin granular and enameled; (6) upper half of parietal peritoneum covered by guanophores (= white), all other peritonea clear except for the renal capsules covered by guanophores; (7) liver tetralobed; (8) humeral spine absent in adult males; (9) webbing absent between fingers I and II, basal between fingers II and III, outer fingers III 2⅔-2½ IV; (10) webbing on feet I 2-2$^{+}$ II 1$^{+}$-2½ III 1-2½ IV 2½-1⅔ V; (11) low enameled dermal folds on outer edges of forearms and tarsus, other dermal folds absent; (12) unpigmented nuptial pad Type I, concealed prepollex; (13) first finger shorter than second, (14) eye diameter larger than width of disc on finger III; (15) color in life, green dorsum with scattered pale yellow spots; green bones; (16) color in preservative, dorsal surfaces pale lavender with scattered cream spots; (17) iris yellowish-silver with fine dark maroon reticulations; (18) yellow-green hands with bright yellow discs, melanophores present on outer fingers and outer toes; (19) males call from upper side of leaves around streams; (20) advertisement call consists on a simple "tic" note; (21) fighting behavior unknown; (22) egg clutches placed on the upper side of leaves next to streams; (23) tadpoles unknown; (24) SVL in adult males 20.9-22.4 mm; adult females unknown.

*Comparisons* – Twenty-six described species of Centrolenid frogs share with *Cochranella buenaventura* the following combination of characters: reduced webbing between fingers, absence of guanophores on the digestive visceral peritonea, and absence of humeral spine. Twenty-three of them differ from *C. buenaventura* as follows: *Cochranella armata* has dark dorsal spots and dark spiny nuptial excrescences in adult males. *Cochranella bejaranoi* has white dorsal spots, round snout in dorsal view, and large spicules in adult males in reproductive condition (no large spicules in adult males *C. buenaventura* even though they were collected during the reproductive season). *Cochranella chami* has vomerine teeth and larger SVL in adult males (30.5-34.6 mm). *Cochranella chancas* has a dull gray dorsum with cream spots in preservative (spots larger than those present in *C. buenaventura*), and finger I and II of equal size. *Cochranella cristinae* has a round snout in dorsal view, dark dorsal spots, and larger SVL in adult males (26.5-32.1 mm). *Cochranella garciae* has a snout rounded in dorsal view and sloping in profile, dark dorsal spots, light dorsal tubercles, and larger SVL in adult males (25.5-28.1 mm). *Cochranella luminosa* has a round snout in dorsal view, vomerine teeth, and larger SVL in adult males (28.1-31.5 mm). *Cochranella luteopunctata* has a round snout in dorsal view, large light spots in adult ma325.5-28.1 mm).
spots, and larger SVL in adult ma8es .5-32.1 mm).

Figure 1: Holotype of *Cochranella buenaventura* sp. nov. (DH-MECN 3563) in life. SVL 21.5 mm.

tubercules and spicules in life. *Cochranella prasina* has a uniform green dorsum in life, and larger SVL in adult males (33.0-34.1 mm). *Cochranella posadae* has a uniform green dorsum with diffuse white warts in life, round snout in dorsal view, and larger SVL in adult males (30.7-34.1 mm). *Cochranella rosada* has a rose-brown dorsum with cream yellow spots in life. *Cochranella ruizi* has a brown dorsum with dark spots in life. *Cochranella siren* has well defined yellow-orange rounded dorsal spots in life, and the iris yellowish gray without reticulations. *Cochranella spilota* has larger SVL in adult males (25.3-26.4 mm), and vomerine teeth. *Cochranella truebae* has dark and light dorsal marks. *Cochranella vozmedianoi* has green-emerald dorsal marks in life, and larger SVL in adult males (26.2-28.4 mm). All these 23 species inhabit areas far-away from *C. buenaventura;* usually on the Amazonian versant of the tropical Andes, or on the northernmost parts of Cordillera Occidental of Colombia. Only four species *(Cochranella armata, C. luteopunctata, C. prasina,* and *C. ruizi)* occur on the Pacific lowlands and western Andean slopes of central and southern Colombia to northern Ecuador; yet none is known from southwestern Ecuador where *C. buenaventura* occurs. All 23 species lack guanophores over the renal capsules (kidneys); a character that *Cochranella buenaventura* shares only with three other species, *C. cariticommata, C. griffithsi,* and *C. wileyi.* These four allopatric species are very similar phenetically; but *Cochranella buenaventura* differs from *C. cariticommata, C. griffithsi,* and *C. wileyi* by having pale yellow spots on the dorsum, maroon reticulations in the iris, yellowish-green hands with yellow discs, and slightly more webbing between fingers III and IV, and between toes III, IV, and V. Characters used to distinguish among these four species are summarized in Table 1.

*Description of the holotype* – Adult male, moderate body size SVL = 21.5 mm (Fig. 1). Body slender. Head distinct, slightly wider than long, and wider than body; HW/HL = 1.07, HW/SVL = 0.35, HL/SVL = 0.33. Snout short, truncate in dorsal view and in profile (Fig. 2), EN/HL = 0.24; nostrils elevated, deep depression in the internarial area; loreal region

Table 1: Character states and geographic distribution of species of the *Cochranella griffithsi* clade. Abbreviations: CIL: coloration in life; CIP: coloration in preservative.

| *Cochranella* | Snout dorsal/ lateral view | Dorsal CIL | Dorsal CIP | Iris CIL | Hands CIL | SVL (mm) adult males | Distribution |
|---|---|---|---|---|---|---|---|
| *Co. buenaventura* | Truncate/ truncate | Green with pale yellow spots | Pale lavender with cream spots | Yellowish-silver with maroon reticulations | Lemon green hands, yellow discs | 20.9-22.4 | SW Ecuador, Andean foothills, 1200 m elev. |
| *Co. cariticommata* | Round/ truncate | Green with yellow spots | Lavender with cream spots | White with black reticulations | Yellow hands and discs | 22.2-23.6 | SE Ecuador, Andean slopes, 2350-2500 m elev. |
| *Co. griffithsi* | Truncate/ truncate to protruding | Green with or without dark spots and flecks | Pale to dark lavender with or without dark spots and flecks | White with dark reticulations | Dark to light green hands and discs | 19.8-26.7 | NW Ecuador and SW Colombia, Andean slopes, 1460-2600 m elev. |
| *Co. wileyi* | Truncate/ truncate to protruding | Green | Pale lavender | White-copper with dark reticulation | Light green hands and discs | 23.3-26.1 | NE Ecuador, Andean slopes, 2100 m elev. |

FIGURE 2: Dorsal and lateral views of the head of the holotype of *Cochranella buenaventura* sp. nov. (DHMECN 3563).

FIGURE 3: Hand and feet of the holotype of *Cochranella buenaventura* sp. nov. (DHMECN 3563).

concave; canthus rostralis indistinct; lips slightly flared. Large eyes, ED/HL = 0.54, directed anterolaterally at about 45° from midline, eyes can be seen when viewed from below, interorbital area less wide than eye diameter, IOD/ED = 0.63, EN/ED = 0.45, EN/IOD = 0.71. Lower half of tympanic annulus evident, oriented dorsolaterally with dorsoventral inclination; supratympanic fold absent but area behind the eye to the insertion of the arm slightly swallowed, tympanum separated from orbit by distance less than the tympanum diameter. Dentigerous processes of vomers absent, choanae moderately sized, rounded, near margin of mouth. Long vocal slits, extending posterolaterally from the posterolateral base of tongue to angle of jaws. Skin of dorsal surfaces of head, body, and limbs shagreened with extensive microgranulations and scattered flat tubercles corresponding to light flecks. Cloacal opening directed posteriorly at upper level of thighs; ventral skin granular and enameled; other anal ornamentation absent, no distinct cloacal sheath. Upper arm thin, forearm moderately robust, breadth of upper arm about half that of forearm. Humeral spine absent; ulnar fold present. Relative lengths of fingers III > IV > II > I; webbing absent

Table 2: Variation of measurements (in mm) of holotype and paratypes of *Cochranella buenaventura* sp. nov.

| | DHMECN 3563 | DHMECN 2524 | DHMECN 3562 | DHMECN 3561 |
|---|---|---|---|---|
| | Holotype | Paratype | Paratype | Paratype |
| Sex | Male | Male | Male | Male |
| Snout-vent length | 21,50 | 22,40 | 22,30 | 20,90 |
| Head width | 7,50 | 7,90 | 7,50 | 7,10 |
| Head length | 7,00 | 7,10 | 7,70 | 6,70 |
| Horizontal eye diameter | 3,80 | 3,60 | 3,30 | 3,50 |
| Interorbital distance | 2,40 | 3,00 | 2,70 | 2,70 |
| Eye-nostril distance | 1,70 | 1,85 | 1,92 | 1,64 |
| Internarial distance | 1,64 | 1,44 | 1,48 | 1,62 |
| Width disc on third finger | 1,70 | 1,90 | 1,10 | 1,50 |
| Tibia length | 12,60 | 12,70 | 13,30 | 11,30 |
| Foot length | 10,40 | 10,70 | 10,20 | 9,90 |

between fingers I and II, basal between fingers II and III, outer fingers III 2⅔-2½ IV (Fig. 3); finger discs wide, truncate; disc on third finger slightly larger than those on toes, and equivalent to more than half of eye diameter, 3DW/ED = 0.45; subarticular tubercles rounded and those of the four finger of larger size, supernumerary tubercles absent; palmar tubercle flat, indistict. Concealed prepollex; unpigmented nuptial pad Type I. Hind limbs slender, TL/SVL = 0.59, FL/SVL = 0.48. Inner tarsal fold absent, outer tarsal present; inner metatarsal tubercle large and elliptical (left foot) or bifurcated (right foot); outer metatarsal tubercle indistinct. Subarticular tubercles rounded and low; supernumerary tubercles absent. Webbing on feet I 2-2$^{+}$ II 1$^{+}$-2½ III 1-2½ IV 2½-1⅔ V (Fig. 3); disc on toe I round not expanded, all other discs bluntly truncate, two pointed projections on all discs.

Table 3: Variation of proportions of adult males of the type series of *Cochranella buenaventura* sp. nov. Abbreviations: SVL= snout-vent length; HW = head width; HL = head length; ED = horizontal eye diameter; IOD = inter-orbital distance; EN = eye-nostril distance; IN = internarial distance; TD = tympanum diameter; 3DW = width of disc on the third finger; TL = tibia length; FL = foot length.

| Proportion | Range (n = 4) |
|---|---|
| HW/HL | 0,97–1,11 |
| HW/SVL | 0,34–0,35 |
| HL/SVL | 0,32–0,35 |
| EN/HL | 0,24–0,26 |
| ED/HL | 0,43–0,54 |
| IOD/ED | 0,63–0,83 |
| EN/ED | 0,45–0,58 |
| EN/IOD | 0,62–0,71 |
| 3DW/ED | 0,33–0,53 |
| TL/SVL | 0,54–0,60 |
| FL/SVL | 0,46–0,48 |

*Coloration of holotype* – In life, light green dorsum with pale yellow spots dispersed across dorsal surfaces including arms and legs (Fig. 1). Hands and feet yellowish-green with light yellow discs. Venter cream, yellowish towards the ventro-lateral region. Iris yellowish silver with fine maroon reticulations. In preservative, lavender dorsum with cream spots; eyelids dark lavender. Parietal peritoneum white, most visceral peritonea clear except for peritoneum covering the renal capsules white.

Figure 4: Egg clutch of *Cochranella buenaventura* sp. nov. Note that it is on the upper side of the leaf but appears to glide towards the tip.

Table 4: Altitudinal distribution of the Glassfrogs from the foothills, slopes, and highlands of Cordillera Occidental, Ecuador. Abbreviations: *Ce = Centrolene; Co = Cochranella; H = Hyalinobatrachium;* N = North; S = South.

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3300 | | | | | | | | | | | | | | | |
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| 2700 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 2500 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 2300 | | | | | | | | | | | | | | | |
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| 2100 | | | | | | | | | | | | | | | |
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| 1900 | | | | | | | | | | | | | | | |
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| 1700 | | | | | | | | | | | | | | | |
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| 1500 | | | | | | | | | | | | | | | |
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| 1300 | | | | | | | | | | | | | | | |
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| 1100 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 900 | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 700 | | | | | | | | | | | | | | | |
| | | | | NS | S | N | N | N | N | N | N | N | N | N | N |
| | | | | *Ce. prosoblepon* [1] ... | *Co. buenaventura*... | *H. sp. A* [2] ... | *Ce. balionotum*... | *Ce. lynchi* [3] ... | *Ce. peristictum* [4] ... | *Ce. ballux*... | *Ce. geckoideum*... | *Ce. helioderma*... | *Co. griffithsi*... | *Ce. grandisonae*... | *Ce. buckleyi*... |

[1] We consider *Cochranella ocellifera* (= *Hyla ocellifera* Boulenger, 1899) as a synonym of *Centrolene prosoblepon.* The dorsal pattern of *ocellifera* falls within the color pattern variation found in *C. prosoblepon*. All other characters used to differentiate *ocellifera* from *prosoblepon* are either part of intraspecific (i.e., vomerine teeth) or ontogenic variation (i.e., expression of humeral spines in juvenile males) (details in Cisneros-Heredia and McDiarmid in prep.). The record of *ocellifera = prosoblepon* from Pilalo cited by Lynch and Duellman (1973) is a specimen of an undescribed species from the foothills of Cordillera Oriental whose locality data was erroneous reported.

[2] *Hyalinobatrachium* sp. A corresponds to the species referred by Ruiz-Carranza and Lynch (1998) to *H. petersi*, yet it is an undescribed species from the foothill and low montane forests of SW Colombia and NW Ecuador, contrary to *H. petersi* from the lowlands of NW Ecuador (Cisneros-Heredia and McDiarmid in press).

[3] *Centrolenella scirtetes* Duellman and Burrowes, 1989 and *Centrolenella gemmatum* Flores, 1985 are excluded from this list since we consider they are not valid taxa; yet precise details on their taxonomical situation and relationship with *C. lynchi* will be published elsewhere (Guayasamin, Cisneros-Heredia, *et al.* in prep.).

[4] *Centrolene peristictum* is almost indistinguishable from *C. lynchi* based on published descriptions, differing just in their SVLs (*C. lynchi* 23.0-26.9 mm SVL in males, n = 23; 23.8-24.9 mm SVL in females, n = 8; *C. peristictum* 18.7-20.6 mm SVL in males, n = 2; 20.5 mm SVL in female, n = 1), and their altitudinal distributions. Both species could be synonyms (with *peristictum* having priority over *lynchi*), but further studies are needed to solve their taxonomic status.

*Measurements* – Snout-vent length, 21.5 mm; head width, 7.5 mm; head length, 7.0 mm; horizontal eye diameter, 3.8 mm; inter-orbital distance, 2.4 mm; eye-nostril distance, 1.7 mm; internarial distance between the nostrils, 1.6 mm; width of disc on the third finger, 1.7 mm; tibia length, 12.6 mm; foot length, 10.4 mm.

*Variation* – Variation of measurements and body proportions is given in Tables 2 and 3. Gross morphological features are invariant; with the exception of DHMECN 2525, which has a short almost indistinct ulnar fold visible only near the elbow and towards the hand, and DHMECN 3562, which has a snout shorter and more truncate. The supratympanic fold is either absent or indistinct. Background dorsal coloration in preservative varies from pale lavender (DHMECN 3563, 3561), dark lavender (DHMECN 3562), or reddish lavender (DHMECN 2524). In life, the coloration varies from light lemon green to dark green. The light dorsal spots are always scattered along the dorsum but more aggregated behind the head. All specimens are adult males, and all have the dorsal skin slightly shagreen with extensive microgranulations. All specimens have two pointed projections on all toe discs.

*Etymology* – The specific name of this new taxon is a noun in apposition in reference to its type locality, Reserva Biológica Buenaventura, a private natural reserve managed by Fundación Jocotoco. This reserve protects several highly endangered animals and plants, including two birds endemic to the West Ecuadorian region: El Oro Parakeet *(Pyrrhura orcesi)* and El Oro Tapaculo *(Scytalopus robbinsi)*. Buenaventura also means "good fortune", alluding to our feelings on finding and describing this beautiful new species of glassfrog.

*Distribution and natural history* – *Cochranella buenaventura* is known only from its type-locality on the foothills of Cordillera de Chilla, a small mountain range which is part of Cordillera Occidental in southwestern Ecuador. The area is covered by Seasonal Evergreen forest, and it is part of the West Ecuadorian region. All specimens were found on leaves of shrubs and low trees, 1-3 m above streams. Males were calling on December 2003 and July 2006. On July 2006, one male was found next to an egg clutch with 38 embryos. The male was on the upper left side of the egg clutch, suggesting parental care. The egg clutch was placed on the upper side of an epiphyte leave, c. 1 m above a small rivulet (Fig. 4). *Cochranella buenaventura* was found in sympatry with *Centrolene prosoblepon, Hyloscirtus alytolylax* and two undescribed species of *Eleutherodactylus.*

*Remarks* – *Cochranella buenaventura, C. cariticommata, C. griffithsi,* and *C. wileyi* are very similar taxa, and we suspect they are closely related. All four species share a very similar morphology in terms of their general appearance, snouts, webbing on hands and feet, presence of low ulnar fold, and guanophores on the renal capsules. The last character is almost unique to these four species; otherwise known only in one member of the *C. granulosa* clade (*C. mache,* pers. obs.). Guayasamin *et al.* (2006) reported the absence of guanophores on the renal capsule of *C. cariticommata;* but examination of recently collected specimens showed that guanophores are present (its absence on the renal capsule of the type-series of *C. cariticommata* is certainly a preservation artifact). The high similarity between *C. wileyi* and *C. cariticommata* would suggest its synonymy, but characters detailed on Table 1 justify its current separation, particularly the differences in the coloration of their dorsum and hands. The apparently monophyletic clade formed by *Cochranella buenaventura, C. cariticommata, C. griffithsi,* and *C. wileyi* – herein called the *C. griffithsi* clade – inhabits the forests on the foothills, slopes, and highland regions of Ecuador (Pacific and Amazonian versant of the Andes) and Colombia (Pacific versant) at elevations between 1200 and 2600 m. All four species are allopatric, *C. griffithsi* occur on southwestern Colombia and northwestern Ecuador, *C. buenaventura* on southwestern Ecuador, *C. wileyi* on northeastern Ecuador, and *C. cariticommata* on southeastern Ecuador [the report of *C. cariticommata* by Coloma *et al.* (2004a) from Yanayacu corresponds to *C. wileyi*]. Only *Cochranella buenaventura* is distributed in Seasonal Evergreen Foothill forests, while all other occur in Montane Cloud forests. The egg clutches of *C. griffithsi* and *C. wileyi* were described as been deposited on the tip of leaves, as hanging egg masses (Guayasamin *et al.* 2006). The egg clutch of *C. buenaventura* was found on the upper side of leaves, not hanging. However, hanging egg clutches are produced in some species of Centrolenid frogs (e.g., *Centrolene grandisonae, Cochranella spinosa*) after deposition; due to the hydration of egg masses that induce them to increase their size and to glide towards the tip of the leaves (especially on thin leaves like ferns) (R. W. McDiarmid pers. comm., D. F. Cisneros-Heredia pers. obs.).

## Discussion

Eleven described species of glassfrogs, including new *Cochranella buenaventura,* are currently known to inhabit the foothills, slopes, and highlands of Cordillera Occidental (Table 4) (Goin 1961, Lynch and Duellman 1973, Duellman 1980, Duellman 1981, Flores 1985, Duellman and Burrowes 1989, Cisneros-Heredia and McDiarmid 2005, Guayasamin *et al.* 2006, Cisneros-Heredia and McDiarmid in press, Cisneros-Heredia and Yánez-Muñoz 2007). The distribution of these species across Cordillera Occidental is uneven, with ten species occurring towards the northern areas (above 1°S latitude) and just two species from the central-southern areas (below 1°S latitude) (Table 4). The northern areas of the Cordillera are heavily influenced by the highly humid, non-seasonal, and rainy Choco region, while the central-southern areas are influenced by the highly seasonal West Ecuadorian region and the xeric Tumbesian region. Thus, since glassfrogs are closely linked to moist situations near riverine areas, they are expected to be more diverse in the northern areas of the Cordillera. However, the disparity between the northern and central-southern areas of Cordillera Occidental may be also a result of the scarce knowledge available for the glassfrogs of western Ecuador, with vast areas unexplored, many survey results unpublished, and some species undescribed. Most glassfrog species of the northern section are known from a very limited area in the provinces of Pichincha and Cotopaxi, in the surroundings of the towns of Tandayapa, Mindo, Chiriboga, Tandapi, and Las Pampas, an area less than 5000 km$^2$. Some information is known from the northern province of Carchi, but practically nothing is available for the foothills, slopes, and highlands of the provinces of Imbabura or Esmeraldas. In the central-southern section, some short-termed expeditions have surveyed small areas of the provinces of El Oro, Bolivar, and Loja (R. W. McDiarmid unpubl. data, F. Nogales unpubl. data, M. Yánez-Muñoz *et al.* unpubl. data), but basically nothing is known from the province of Chimborazo, Cañar, and Azuay, and from the southern areas of Cotopaxi. We are certain also that some species must have wider distributions than currently recognized; and at least one species of glassfrog, herein called *Hyalinobatrachium* sp. A, remains undescribed from the foothills of western Ecuador (Cisneros-Heredia and McDiarmid in press). Furthermore, *Cochranella griffithsi* shows extensive dorsal color variation (pers. obs.), and preliminary analyses of calls recorded at different altitudes along the Saloya River basin showed strong differences, suggesting that at least two sympatric taxa are included under that name, with altitudinal segregation, but overlapping around 1900 m elevation (R.W. McDiarmid, unpubl. data).

## Resumen

*Cochranella buenaventura* sp. nov. es descrita de las áreas piemontanas sureñas de la Cordillera Occidental, Andes de Ecuador. La nueva especie habita los bosques Siempreverdes Piemontanos Estacionales de la provincia de El Oro, en la región biogeográfica del Oeste Ecuatoriano. La nueva especie se distingue de otras Ranas de Cristal por la presencia de un hocico truncado en vista dorsal y lateral, membranas reducidas entre los dedos anteriores, ausencia de guanóforos sobre el peritoneo visceral digestivo pero presente sobre las cápsulas renales, ausencia de espina humeral, dorso verde en vida con puntos amarillo pálido dispersos, discos de manos y pies amarillo brillante y un tamaño corporal medio (20.9-22.4 mm longitud hocico-ano en machos adultos).

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## Appendix I

Examined comparative material

*Cochranella armata:* COLOMBIA: Valle del Cauca: ICN 25000 (H), ICN 28037-49. *Cochranella caritocommata:* ECUADOR: Morona-Santiago: USNM 288435-6: El Cruzado. Zamora-Chinchipe: DHMECN 1974, 2429: Reserva Tapichalaca. *Cochranella chami:* COLOMBIA: Risaralda: ICN 32079. Antioquia: ICN 8666, ICN 10640. *Cochranella cristinae:* COLOMBIA: Antioquia: ICN 18645, ICN 18643-4, 18646-9. *Cochranella garciae:* COLOMBIA: Cauca: ICN 11752, ICN 11715-20. *Cochranella griffithsi:* ECUADOR: Pichincha: USNM 286659: Quebrada La Plata; USNM 286662-64, 286667-77: 1.0 km SW of Tandayapa; DHMECN0903: Estación Experimental La Favorita; DHMECN (field series) MYM01106-01107: Reserva Orquideológica Pahuma. *Cochranella luminosa:* COLOMBIA: Antioquia: ICN 15930, ICN 15931-6, ICN 15918-23. *Cochranella luteopunctata:* COLOMBIA: Cauca: ICN 20747. *Cochranella megacheira:* ECUADOR: Napo: USNM 286700: Rio Azuela; USNM 286701: Río Salado. *Cochranella nephelophila:* COLOMBIA: Caquetá: ICN 24297. *Cochranella oreonympha:* COLOMBIA: Caquetá: ICN 20765, ICN 20766-75. *Cochranella pluvialis:* PERU: Cuzco: USNM 298950-52. *Cochranella posadae:* COLOMBIA: Cauca: ICN 11307, ICN 7447-50. ECUADOR: Sucumbíos: USNM 288464-5: La Bonita. *Cochranella rosada:* COLOMBIA: Caldas: ICN 34761, ICN 34764-5. *Cochranella ruizi:* COLOMBIA: Cauca: ICN 7469, ICN 7470-71. *Cochranella siren:* ECUADOR: Napo: USNM 286740. Orellana: DFCH-USFQ D292-295: Cordillera de Galeras. *Cochranella spilota:* COLOMBIA: Caldas: ICN 35155. *Cochranella truebae:* PERU: Cuzco: USNM 298178-80, USNM 346056-59, USNM 346310-13.