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A new species of glassfrog of the genus *Centrolene* from the foothills of Cordillera Oriental of Ecuador
(Anura: Centrolenidae)

Eine neue Glasfroschart der Gattung *Centrolene* von den Ausläufern der Cordillera Oriental in Ecuador
(Anura: Centrolenidae)

DIEGO F. CISNEROS-HEREDIA

KURZFASSUNG

Aus Ecuador wird eine neue Froschart aus der Familie Centrolenidae beschrieben. Das neue Taxon ist die erste Art der Gattung *Centrolene*, die man aus den zentralen und südlichen Ausläufern der Cordillera Oriental Ecuadors kennt. Die neue Art unterscheidet sich von anderen Glasfröschen durch die mäßige Körpergröße (25,7–26,1 mm bei adulten Männchen), die einheitliche Färbung (grün im Leben, blaß lavendelfarben im Konservierungsmittel), die in Rücken- wie in Seitenansicht runde Schnauze, das Vorhandensein mittelgroßer, gerader Oberarmdornen, die bei adulten Männchen ziemlich spitz zulaufen, und das Fehlen von Guanophoren auf dem Peritoneum der Eingeweide.

ABSTRACT

A new species of frog of the family Centrolenidae is described from Ecuador. This new taxon is the first species of the genus *Centrolene* known to inhabit the central and southern foothills of the Cordillera Oriental of Ecuador. The new species is diagnosed from other centrolenid taxa by its moderate body size (25.7–26.1 mm adult males), uniform coloration (green in life, pale lavender in preservative), rounded snout in dorsal and lateral views, presence of medium-sized straight humeral spines with a moderate spiny point in adult males and absence of guanophores on the visceral peritonea.

KEY WORDS

Amphibia: Anura: Centrolenidae; *Centrolene durrellorum* n. sp., new species; systematics, Amazonian Andean foothills; Ecuador

INTRODUCTION

The family Centrolenidae is a diverse clade of arboreal anurans that inhabits Neotropical America. The family currently includes three genera: *Centrolene*, *Cochranella*, and *Hyalinobatrachium* (RUIZ-CARRANZA & LYNCH 1991a). The genus *Centrolene* contains 42 described species with 18 of these recorded for Ecuador, including 11 taxa distributed on the western versant of the Andes, five on the eastern versant, and two on both versants (LYNCH & DUELLMAN 1973; WILD 1994; SEÑARIS & AYARZAGÜENA 2005; CISNEROS-HEREDIA & MCDIARMID 2006a, 2006b; GUAYASAMIN et al. 2006). In western Ecuador, species of *Centrolene* are distributed from 0 up to 3300 m elevation across the lowlands, foothills, slopes and highlands of the Cordillera Occidental. In eastern Ecuador, all *Centrolene* species occur above 1300 m elevation, and no species have been reported at lower ranges of the eastern foothills of the Cordillera Oriental or from the Amazonian lowlands. Herein, I describe the first species of *Centrolene* from the foothills of the Ecuadorian Cordillera Oriental.

MATERIALS AND METHODS

General characters and terminology used herein follow definitions by RUIZ-CARRANZA & LYNCH (1991a) and CISNEROS-HEREDIA & MCDIARMID (2006a). Webbing formulae follow the method of SAVAGE & HEYER (1967) as modified by GUAYASAMIN

et al. (2006). Sex was determined by direct examination of the gonads and by noting the presence of secondary sexual characters (vocal slits, nuptial pads). The following measurements were taken with electronic digital callipers (0.05 mm accuracy) at least three times each: 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); horizontal tympanum diameter (TD); width of disc on the third finger (3DW); tibia length (TL), and foot length (FL). Classification of vegetation formations follows SIERRA (1999). Institutional abbreviations are as follows: División de Herpetología, Museo Ecuatoriano de Ciencias Naturales, Quito (DHMECN); Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá (ICN); Natural History Museum, The University of Kansas, Lawrence (KU); Museo de Zoología, Pontificia Universidad Católica del Ecuador, Quito (QCAZ); Museum of Comparative Zoology, Harvard University, Cambridge (MCZ); National Museum of Natural History, Washington, D.C. (USNM); Universidad San Francisco de Quito, Quito (DFCH-USFQ).

SPECIES DESCRIPTION

Centrolene durrellorum sp. nov.

Holotype.— DFCH-USFQ D131, adult male found along a small rivulet tributary of the Jambue River, ca. 6 km S from Zamora (ca. 04º03'S, 78º56'W, 1150 m a.s.l.), on the western slope of Contrafuerte de Tzunantza, Cordillera Oriental, eastern slopes of the Andes, Provincia de Zamora-Chinchipe, República del Ecuador, on 27 March 2002 by F. SMITH and L. WESCH.

Referred material.— DFCH-USFQ D291, adult male, ca. 45 km E of Narupa, on the Hollín–Loreto road (ca. 800 m a.s.l.), Cordillera Oriental, eastern slopes of the Andes, Provincia de Napo, República del Ecuador, collected on 06 November 1999 by J. FABARA.

Diagnosis.— *Centrolene durrellorum* is diagnosed from all other Centrolenidae by the combination of the following characters: (1) vomerine teeth present; (2) snout fairly rounded in dorsal and lateral views; nostrils slightly elevated producing a deep depression in the internarial area; (3) tympanic annulus evident, oriented dorsolaterally; very weak supratympanic fold above the tympanum; (4) dorsal skin shagreened; (5) ventral skin granular; cloacal area granular, with two large, rounded, flat subcloacal tubercles, and two folds on the sides of the cloacal opening; distinct cloacal sheath; (6) upper $^2/_3$ of the parietal peritoneum covered by guanophores, pericardium white, all other peritonea clear; (7) liver lobed; (8) medium-sized straight humeral spine with a moderate spiny point in adult males; (9) webbing absent between fingers I and II, basal between II and III, outer fingers III 2^-–2^- IV; (10) webbing on feet I 2–2^- II 1–2 III 1^+–2^- IV $2^1/_3$–1^+ V; (11) no dermal folds on hands, forearms, feet or tarsus; (12) nuptial excrescences present, type-I; concealed prepollex; (13) first finger slightly longer than second, (14) eye diameter larger than width of disc on finger III; (15) color in life uniform green; (16) color in preservative (ethanol 70%), dorsal surfaces pale lavender, without light or dark flecks or dots; (17) iris coloration unknown in life, light lavender with fine darker reticulation in preservative; (18) melanophores widespread on outer fingers and outer toes, and on all discs of toes; (19) males call from upper surfaces of leaves, (20, 21, 22) fighting behavior, egg clutches, and tadpoles unknown; (23) snout-vent length 25.7 – 26.1 mm in adult males (n = 2); females unknown.

Comparisons.— The combination of a uniform dorsal coloration (green in life, pale lavender in preservative), presence of humeral spines, moderate body size (25.7–26.1 mm adult males) and absence of guanophores on the visceral peritonea distinguish *Centrolene durrellorum* from all other described species of glassfrogs (Fig. 1). Eight species currently assigned to the

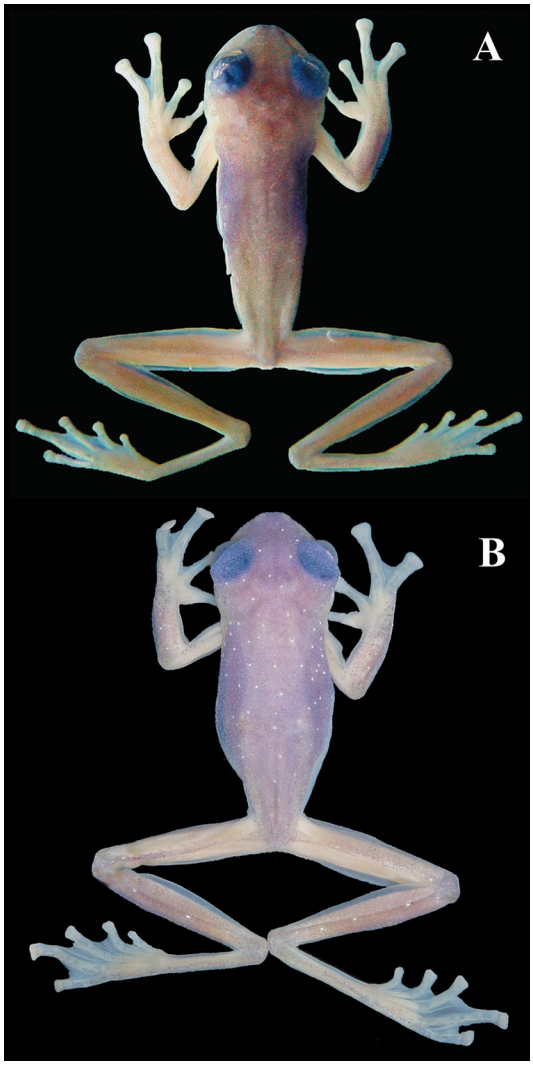

Fig. 1: A – Dorsal view of the holotype of *Centrolene durrellorum* sp. nov. (DFCH-USFQ D131, 25.7 mm SVL), adult male. B – Dorsal view of *Centrolene audax* LYNCH & DUELLMAN (KU 178018, 22.7 mm SVL), adult male.

Abb. 1: A – Holotypus von *Centrolene durrellorum* sp. nov. (DFCH-USFQ D131, KRL 25,7 mm), adultes Männchen von dorsal. B – *Centrolene audax* LYNCH & DUELLMAN (KU 178018, KRL 22,7 mm), adultes Männchen von dorsal.

genus *Centrolene* have uniform coloration on the dorsum; all differ from *C. durrellorum* as follows: *Centrolene heloderma* (DUELLMAN, 1981) has a sloping snout in lateral view, pustular dorsal skin, lacks vomerine teeth, and inhabits the western Andean slopes of northern Ecuador. *Centrolene hesperium* (CADLE & MCDIARMID, 1990) has sloping snout in lateral view, spicules covering the dorsum in adult males, lacks vomerine teeth, and inhabits the western Andean slopes of northern Peru. *Centrolene hybrida* RUIZ-CARRANZA & LYNCH, 1991 has guanophores over the visceral

peritonea, and a smaller SVL in adult males (19.6–22.0 mm). *Centrolene ilex* (SAVAGE, 1967) has a truncate snout in lateral view, dark black thick iris reticulation, and inhabits its southern Central America and the Pacific lowlands of Colombia and Ecuador. *Centrolene lemniscatum* DUELLMAN & SCHULTE, 1993 has the dorsum covered by unpigmented spinules, lacks vomerine teeth, and has more extensive webbing between outer fingers (III $1^{1}/_{2}$–$1^{1}/_{3}$ IV). *Centrolene tayrona* RUIZ-CARRANZA & LYNCH, 1991 has sloping snout in lateral profile, larger SVL in adult males (28.5–31.2 mm), and inhabits the Sierra de Nevada de Santa Marta in northern Colombia. Some specimens of *C. buckleyi* (BOULENGER, 1882) and *C. venezuelense* (RIVERO, 1968) have uniform dorsums; however *C. buckleyi* and *C. venezuelense* differ from *C. durrellorum* by having sloping snouts in lateral profile, white lips, white lines along the flanks, larger SVL in adult males (26.0–32.1 mm), and higher altitudinal range (2100 to 3300 m elevation). *Centrolene audax* (LYNCH & DUELLMAN, 1973) (Fig. 1) is similar to *C. durrellorum* in some general features but clearly differs by having abundant golden dorsal flecks (white in preservative, present in all known specimens without variation), truncate snout in profile, cream-green hands without melanophores, and smaller SVL in adult males (22.0–23.6 mm); in addition *C. audax* has the cloacal region without folds on the sides of the cloacal opening and without a cloacal sheath, its humeral spine is shorter (35–39% of the humerus, n = 4) and distally curved towards the humerus, and it inhabits higher altitudes (1350 to 1700 m elevation) in montane and cloud forests.

Description of the holotype.— Adult male moderate-sized, SVL = 25.7 mm (Fig. 1). Body slender, head distinct, slightly wider than long, and wider than body; HW/HL = 1.05, HW/SVL = 0.34, HL/SVL = 0.32. Snout fairly large, rounded in dorsal view and in profile, EN/HL = 0.24, EN/ED = 0.66; nostrils slightly elevated producing a deep depression in the internarial area; loreal region concave; canthus rostralis pronounced, distinct, rounded, with concave platform between right and left canthus rostralis; concave loreal region; lips slightly flared. Small eyes, ED/HL = 0.34, directed anterolaterally at about 40° from midline, eyes can be seen when viewed from below, interorbital area wider than eye diameter, IOD/ED = 1.25, EN/IOD = 0.53. Tympanic annulus evident, oriented dorsolaterally; very weak supratympanic fold above the eye, tympanum separated from orbit by distance slightly larger than tympanum diameter (TD/ED = 0.25). Dentigerous processes of vomers present, short, slightly separated; choanae medium-sized, acute, elongated, much closer to the distal margin of the vomerine teeth than to the margin of mouth; tongue cordate, with slight indentation posteriorly; vocal slits paired, extending from the posterior border of the tongue to the angles of the jaws.

Skin of dorsal surfaces shagreened; ventral surfaces granular. Cloacal opening directed posteriorly at upper level of thighs; distinct cloacal sheath; cloacal area granular, with two large, rounded, flat subcloacal tubercles and two folds on the sides of the anal opening. Upper arm relatively robust, forearm robust, diameter of upper arm about $^{2}/_{3}$ that of forearm. Medium-sized humeral spine present (crista ventralis and spine ≈45% of the humerus), directed at a narrow angle (≈20° to the humerus), straight spine with a moderate spiny point (not curved towards the humerus), and concave axilla; ulnar fold or tubercles absent. Relative lengths of fingers: III > IV > I > II; webbing absent between fingers I and II, basal between II and III, outer fingers III 2^{-}–2^{-} IV; bulla absent; finger discs fairly wide, slightly round; disc on third finger larger than those on toes, and shorter than eye diameter, 3DW/ED = 0.41; subarticular tubercles rounded, and elevated except for the distal subarticular tubercle of forth finger that is bifurcated, supernumerary tubercles absent; palmar tubercle large, rounded; tenar tubercle large, elliptic, rather indistinct. Concealed prepollex, white nuptial excrescences type-I. Hind limbs slender; heels of limbs adpressed perpendicular to body slightly overlap; TL/SVL = 0.57, FL/SVL = 0.46. Fringes and tarsal folds absent; inner metatarsal tubercle elliptic, indistinct; outer metatarsal tubercle indistinct. Subarticular tubercles rounded and fairly low; few small, supernumerary tubercles absent. Webbing on feet I 2–2^{-} II 1–2

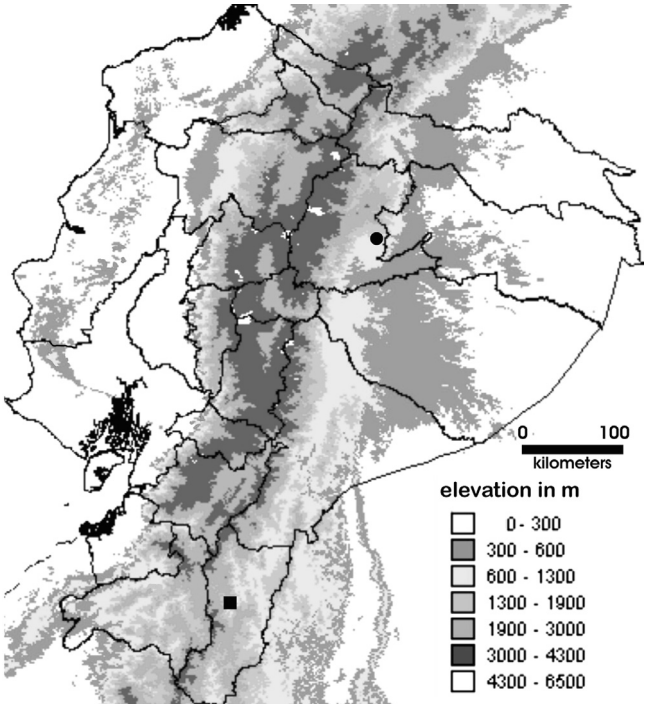

Fig. 2: Map of Ecuador showing the known localities of *Centrolene durrellorum* sp. nov.
■ – type-locality; ● – additional locality.

Abb. 2: Karte von Ecuador mit den bekannten Fundorten von *Centrolene durrellorum* sp. nov.
■ – Typuslokalität; ● – weiterer Fundort.

III 1^{+}–2^{-} IV $2^{1}/_{3}$–1^{+} V; disc on toe I round slightly expanded, all other discs rounded to fairly truncate, pointed projections on discs absent.

Coloration.— In life, uniform green dorsum. In preservative (Fig. 1), all dorsal surfaces pale lavender, paler towards the arms and legs, and darker towards the flanks and eyelids (no light or dark spots). Ventral surfaces cream, without melanophores. Bones white in preservative. Parietal peritoneum covered by guanophores to the level of the lower stomach; pericardium white, all other peritonea clear (including gastric, visceral, and hepatic peritonea).

Variation and measurements.— The referred specimen is similar in all morphological features to the holotype, except for showing a slightly smaller nuptial pad, and more developed cloacal ornaments. Measurements of the holotype are followed by those of the referred specimen in parentheses: Snout-vent length, 25.7 (26.1) mm; head width, 8.7 (8.9) mm; head length, 8.3 (8.5) mm; horizontal eye diameter, 3.2 (3.5) mm; inter-orbital distance, 4.0 (4.2) mm; eye-nostril distance, 2.1 (2.3) mm; internarial distance, 2.0 (2.0) mm; horizontal tympanum diameter 0.8 (1.0) mm; tibia length, 14.6 (14.9) mm; foot length, 11.9 (11.8) mm; width of disc on the third finger, 1.3 (1.3) mm.

Etymology.— This new species of glassfrog is named in honour of Gerald DURRELL and Lee DURRELL (Jersey Wildlife Preservation Trust now Durrell Wildlife Conservation Trust) for their contributions to the conservation of global biodiversity. Their books "A Practical Guide for the Amateur Naturalist" and "My Family and Other Animals" had a profound impact on me, and led me to work on the research and conservation of wildlife.

Distribution and natural history.— *Centrolene durrellorum* is known from two

localities in primary Foothill Evergreen forests on the lower slopes of Cordillera Oriental of Ecuador, provinces of Zamora-Chinchipe and Napo (Fig. 2). The locality of the referred specimen is about 400 km away from the type locality. Many other species from the Cordillera Oriental show similar distribution patterns, with widely separated localities (e.g., *Centrolene mariaelenae*, *Centrolene bacatum*, *Hyalinobatrachium pellucidum*, *Phyllonastes lochites*; CISNEROS-HEREDIA & MCDIARMID 2006a; CISNEROS-HEREDIA & GUAYASAMIN 2006; GUAYASAMIN et al. 2006; CISNEROS-HEREDIA & REYNOLDS 2007). However, the wide separation of localities most likely represents sampling problems rather that disjunct populations. CISNEROS-HEREDIA & MCDIARMID (2006a) described the distributional patterns of the centrolenids along the eastern Andes of Ecuador (= Cordillera Oriental), and remarked about the little information available for most species in the region and the large unexplored areas. Using IUCN criteria (IUCN 2001), I recommend to classify *C. durrellorum* as "Data Deficient" because of the paucity of information to evaluate its extinction risk.

The holotype and the referred specimen are adult males (both in reproductive condition, with developed vocal slits and nuptial pads) collected at night on the upper surface of leaves of small trees, between 3–4 m above small rivulets. The holotype was found in sympatry with an undescribed *Cochranella* species (sp. N4 in CISNEROS-HEREDIA & MCDIARMID 2006a). The referred specimen was found in sympatry with *Cochranella puyoensis* (FLORES & MCDIARMID, 1989).

Remarks.— The phylogeny of centrolenids remains poorly understood, the relationships among species are largely unresolved, and most genera currently in use are non-monophyletic (DARST & CANNATELLA 2004; FROST et al. 2006; GUAYASAMIN et al. 2006). The genus *Centrolene*, defined for all species with humeral spines, was found to be paraphyletic towards *Cochranella* by FROST et al. (2006). Until a new phylogenetic hypothesis is available, I follow RUÍZ-CARRANZA & LYNCH's (1991a) system, and assigned the species herein described to *Centrolene* based on the presence of a humeral spine in adult males. *Centrolene durrellorum* corresponds to the species cited as "*Cochranella* sp. N3" by CISNEROS-HEREDIA & MCDIARMID (2006a), whose altitudinal distribution was erroneously reported as being about 1800 m a.s.l.

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RESUMEN

Una nueva especie de rana de la familia Centrolenidae es descrita para Ecuador. Este nuevo taxón es la primera especie del género *Centrolene* conocida para las áreas piemontanas del centro y sur de la Cordillera Oriental de Ecuador. La nueva especie es diagnosticada de otros taxones centrolénidos por su tamaño corporal moderado (25,7–26,1 mm machos adultos), coloración uniforme (verde en vida, lavanda pálido en preservante), hocico redondeado en vistas dorsal y lateral, presencia de espinas humerales rectas de mediano tamaño con una punta moderadamente espinosa en machos adultos y ausencia de guanóforos en los peritoneos viscerales.

APPENDIX 1 – Specimens examined
H – holotype, P – paratype.

Institutional abbreviations: DFCH-USFQ - Universidad San Francisco de Quito, Quito; DHMECN - División de Herpetología, Museo Ecuatoriano de Ciencias Naturales, Quito; ICN - Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá; MCZ - Museum of Comparative Zoology, Harvard University, Cambridge; QCAZ - Museo de Zoología, Pontificia Universidad Católica del Ecuador, Quito; USNM - National Museum of Natural History, Washington, D.C.

Centrolene acanthidiocephalum (Ruiz-Carranza & Lynch, 1989): ICN 5285 (H), ICN 5431 (P), ICN 60007 (P), ICN 5429, ICN 5274, ICN 5283–4. *Centrolene altitudinale* (Rivero, 1968): USNM 166841 (P). *Centrolene andinum* (Rivero, 1968): USNM

166842 (P), USNM 291061 (P). ICN 5432, 6014–6020, 5535–5537. *Centrolene antioquiense* (NOBLE, 1920): ICN 9773, ICN 35194. *Centrolene audax* (LYNCH & DUELLMAN, 1973): USNM 286620–25, MCZ A97807–8. *Centrolene azulae* (FLORES & MCDIARMID, 1989): USNM 195988 (H). *Centrolene bacatum* WILD, 1994: QCAZ 16212, 17807, 22386–87. *Centrolene balionotum* (DUELLMAN, 1981): DHMECN 0865, ICN 23479 (P). *Centrolene buckleyi* (BOULENGER, 1882): DHMECN 0866–67, DHMECN 1246, USNM 288428, USNM 311113–14, USNM 288423, USNM 286626–31, USNM 288424, DHMECN 0868–93. *Centrolene geckoideum* JIMÉNEZ DE LA ESPADA, 1872: ICN 5559, 5560–63, 5598, ICN 8694–97. DHMECN 0900, USNM 167018. *Centrolene grandisonae* (COCHRAN & GOIN, 1970): USNM 286647–52, DFCH-USFQ fs111, DFCH-USFQ fs117, DFCH-USFQ fs150, DFCH-USFQ fs152, DFCH-USFQ fs160–1, DFCH-USFQ fs175, USNM 211211–15, MCZ A-106952–56. *Centrolene guanacarum* RUIZ-CARRANZA & LYNCH, 1995: ICN 11686 (H), ICN 11685 (P). *Centrolene heloderma* (DUELLMAN, 1981): USNM 211219–21 (P), USNM 211216–8. *Centrolene hesperium* (CADLE & MCDIARMID, 1990): USNM 292582–84 (P). *Centrolene huilense* RUIZ-CARRANZA & LYNCH, 1995: ICN 7462 (H), 7461, 7463 (P). *Centrolene hybrida* RUIZ-CARRANZA & LYNCH, 1991: ICN 17897 (H), ICN 17898 (P), ICN 9614 (P), ICN 10197 (P). *Centrolene ilex* (SAVAGE, 1967): DHMECN 2620–26; DHMECN 3199–03; DHMECN 3204; DHMECN 3217-3220, 3232, 3283, DFCH-USFQ D260–1. *Centrolene litorale* RUIZ-CARRANZA & LYNCH, 1996: DHMECN 3198. ICN 13821 (H). *Centrolene lynchi* (DUELLMAN, 1980): ICN 23753 (P), USNM 284345–48, USNM 286687–95, MCZ A105463–64, QCAZ 106–109, QCAZ 506, QCAZ 468–72. *Centrolene mariaelenae* CISNEROS-HEREDIA & MCDIARMID, 2006: DFCH-USFQ D125 (H), QCAZ 18618–19. *Centrolene medemi* (COCHRAN & GOIN, 1970): USNM 15227 (H). *Centrolene notostictum* RUIZ-CARRANZA & LYNCH, 1991: ICN 12632 (H). *Centrolene paezorum* RUIZ-CARRANZA, HERNÁNDEZ-CAMACHO & ARDILA-ROBAYO, 1986: ICN 11866 (H). *Centrolene peristictum* (LYNCH & DUELLMAN, 1973): USNM 286714, QCAZ 6446. *Centrolene petrophilum* RUIZ-CARRANZA & LYNCH, 1991: ICN 9567 (H). *Centrolene pipilatum* (LYNCH & DUELLMAN, 1973): ICN 23756 (P), USNM 286717, MCZ A-97803. *Centrolene prosoblepon* (BOETTGER, 1892): QCAZ 10925, USNM 288441, USNM 541904-541915, USNM 288438, USNM 286718–27, MCZ A-88573, 89878; USNM 286734–35, QCAZ 4318, 4893; QCAZ 20704, DFCH-USFQ 293-295, USNM 285830, MCZ A-88434–35, MCZ A-89877, MCZ A-91189, MCZ A-91191, MCZ A-91460, USNM 219314–378. *Centrolene quindianum* RUIZ-CARRANZA & LYNCH, 1995: ICN 24886 (H), ICN 24910-20 (P). *Centrolene robledoi* RUIZ-CARRANZA & LYNCH, 1995: ICN 17936–7 (P), ICN 17939–41 (P). *Centrolene sanchezi* RUIZ-CARRANZA & LYNCH, 1991: ICN 24293 (H). *Centrolene tayrona* RUIZ-CARRANZA & LYNCH, 1991: ICN 12997 (H), ICN 12998 (P), ICN 12867 (P), ICN 12869–72 (P).

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AUTHOR: DIEGO F. CISNEROS-HEREDIA, College of Biological and Environmental Sciences, Universidad San Francisco de Quito, Quito, Ecuador; and, 2002 Research Training Program, National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA. Present address: Department of Geography, King's College London, Strand, London WC2R 2LS, UK. < diegofrancisco_cisneros@yahoo.com > or < diegofrancisco.cisneros@gmail.com >