



# A new species and country record of threadsnakes (Serpentes: Leptotyphlopidae: Epictinae) from northern Ecuador

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**Abstract.**—We describe a new species of *Trilepida* Hedges 2011 from cloud forests of the extreme northern Ecuadorian Andes, Carchi province. Among other characters, the new species is distinguished from all congeners by having a subhexagonal ocular with its anterior border barely rounded at eye level, rostral reaching the anterior border of ocular scales in dorsal view, three supralabials, four or five infralabials, thicker body width, 203–214 middorsal scales, 12 scales around middle of tail, uniform gray dorsum, and gray venter with interspaces between scales cream. Morphologically, the new species is most similar to *T. guayaquilensis* and *T. joshuai* from Ecuador and Colombia, respectively. We also report the first records of *T. macrolepis* for the country from the lowland and foothill evergreen forests of northwestern Ecuador.

**Key words.** Andes, Chocó, cloud forest, fossorial, external morphology, osteology, *Trilepida macrolepis*; *Trilepida pastusa*, new species

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## Introduction

Fossorial snakes of the family Leptotyphlopidae are among the least known terrestrial vertebrates (Adalsteinsson et al. 2009). Even though some species in the family may be locally abundant and the group has a wide distribution from sea level to mountaintops in Africa, the Americas, and parts of Asia, their secretive habits make them rarely encountered in the field (Curcio et al. 2002; McDiarmid et al. 1999; Passos et al. 2005; Pinto et al. 2010). Most leptotyphlopids are small (150 to 250 mm snout-vent length), thin, and burrowing animals that feed on social insects (termites are probably the main food source for some species) (Vitt and Caldwell 2013). Recent phylogenetic analyses based on molecular data partitioned the 112 species now recognized in the family in 12 genera (Adalsteinsson et al. 2009; Wallach et al. 2014).

As a combination of limited morphological variation in fossorial squamates and paucity of specimens, morphological synapomorphies for these lineages have not been clearly established yielding differences in researchers' opinions as to which genus some species should be allocated. Especially problematic has been the classification of threadsnakes in the Neotropical genera *Rena*, *Siagonodon*, and *Trilepida* (Pinto and Curcio 2011; Pinto and Fernandes 2012).

In Ecuador, four species of threadsnakes have been confirmed on the basis of voucher specimens: *Epictia signata*, *E. subcrotilla*, *Trilepida anthracina*, and *T. guayaquilensis* (Cisneros-Heredia 2008; Pinto et al. 2010; Salazar-Valenzuela et al. 2010; Torres-Carvajal et al. 2014; Wallach et al. 2014). With the exception of *E. subcrotilla*, which seems to be a common taxon in natural history collections (Cisneros-Heredia 2008; Purtschert

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2007), most of the leptotyphlopoid species reported for the country are known from a few specimens or exclusively from the holotype in the case of *T. guayaquilensis* (Cisneros-Heredia 2008).

Cryptozoic species of snakes are difficult to find and the usefulness of regularly including digging techniques during herpetological surveys has been proposed for fossorial reptiles (Measey 2006). While performing fieldwork on the extreme northern Andes of Ecuador, we found specimens of an undescribed species of *Trilepida* with the help of local people who usually dig for archaeological remains of Los Pastos pre-hispanic culture. Here we recognize this species based on morphological data, increasing the number of species of *Trilepida* to 14 (Uetz and Hosek 2014; Wallach et al. 2014). While reviewing material for this study we came across specimens assignable to *Trilepida macrolepis*, which constitute the first record of this species for Ecuador and are also reported herein.

## Materials and Methods

We examined specimens housed in the Museo de Zoología, Pontificia Universidad Católica del Ecuador (QCAZ) and the Museo Ecuatoriano de Ciencias Naturales (DHMECN), Quito, Ecuador. In addition, we analyzed photographs of specimens deposited in the National Museum of Natural History, Smithsonian Institution (USNM), Washington, D.C., USA, and the Museum für Naturkunde (ZMB) Berlin, Germany. Characters used for description and comparisons were based on internal (skull of a MicroCT Scanned specimen, X-ray plates) and external morphology (meristic and morphometric data, shape of cephalic plates, and color pattern) of examined individuals, as well as published data provided by Rojas-Morales and González-Durán (2011) and those summarized in Pinto and Fernandes (2012). We consider the unique combination of morphological characters present in the new species as delimitation criteria, following the general species concept of de Queiroz (1998, 2007). Terminology for cephalic plates, scale features, cloacal sacs, and measurements follows Broadley and Wallach (2007), Kroll and Reno (1971), Passos et al. (2006), Pinto and Curcio (2011), and Pinto and Fernandes (2012). Color description in life is based on analysis of a series of photographs of the holotype and paratypes. Color terminology and codes follow Köhler (2012). Measurements were taken with a dial caliper to the nearest 0.1 mm, except for total length (TL) and tail length (TL), which were measured with a ruler to the nearest 1.0 mm. Measurements and descriptions of paired cephalic scales are provided for the right side. Sex was determined by the presence or absence of hemipenial muscles through a ventral incision at the base of the tail. Characters recorded are: (1) Total length (TL); (2) tail length (TAL); (3) TL/TAL ratio; (4) middorsal scales (rostral and terminal spine excluded);

(5) midventral scales (mental scale, cloacal shield, and subcaudals excluded); (6) subcaudal scales (terminal spine excluded); (7) dorsal scale rows around the middle of the tail (DSR); (8) midbody diameter (MB); (9) midtail diameter (MT); (10) head length (HL); (11) head width (HW); (12) relative eye diameter (ocular width at eye level/eye diameter); (13) presence of fused caudals; (14) relative rostral width (rostral width/head width) (Pinto and Curcio 2011; Pinto et al. 2010). The head of one preserved specimen (QCAZ 5778) was scanned on a Skyscan 1176 in-vivo high-resolution micro-CT scan at Universidade de São Paulo, Brazil. The specimen was scanned at 40 kV and 533  $\mu$ A, and the dataset was rendered in three dimensions through the use of CTvox for Windows 64 bits version 2.6. Additionally, the skeleton of the holotype and paratypes were examined dorsally and ventrally through X-ray plates. Digital radiographies of QCAZ 5778 were made with a Faxitron X-Ray LLC MX 20 at Departamento de Vertebrados, Museu Nacional, Universidade Rio de Janeiro, Brazil and X-ray scans of QCAZ 8990 and QCAZ 5846 were made with a Thermo KeveX X-ray Imaging System at QCAZ. Terminology for the braincase, mandible, and vertebral column follows Rieppel et al. (2009), Kley (2006), and Holmann (2000), respectively.

## Results

### *Trilepida pastusa* sp. nov.

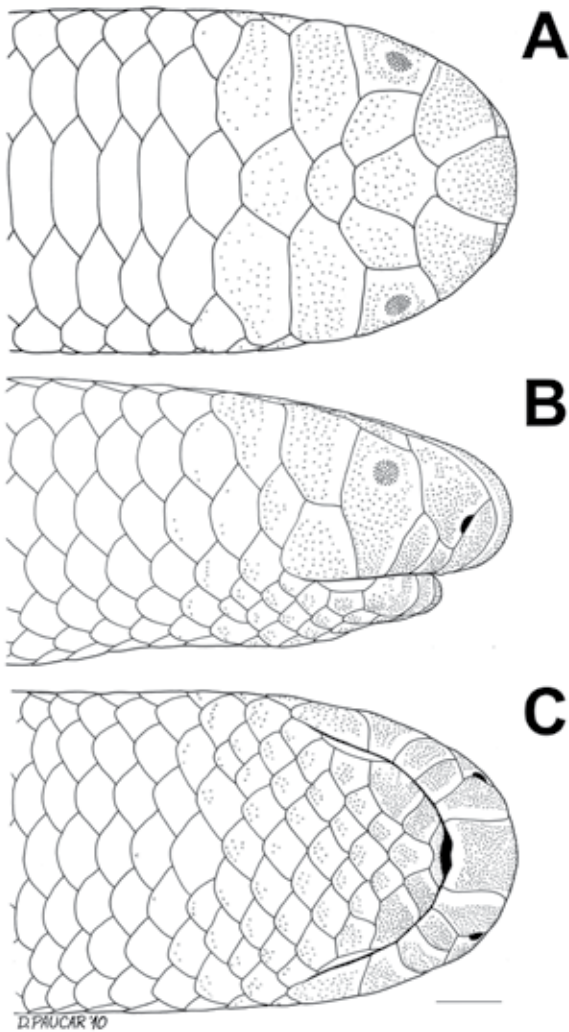
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Figs. 1–3.

*Holotype*.—Adult female, QCAZ 8690, collected on 23 February 2009 by O. Torres-Carvajal, S. Aldás-Alarcón, E. Tapia, A. Pozo and local people, surroundings of Chilmá Bajo on the way to Tres Marías waterfall (0°51'53.82" N, 78°2'59.23" W; 2071 m), Tulcán County, Carchi province, Ecuador.

*Paratypes*.—Two specimens with same locality data as holotype: one juvenile female (QCAZ 5778) collected on 21 February 2013 by D. Salazar-Valenzuela, H. Pozo, A. Chalapud, and D. Males, and one juvenile of undetermined sex (QCAZ 5846) collected on 20 March 2013 by D. Salazar-Valenzuela and A. Loaiza-Lange.

*Diagnosis*.—*Trilepida pastusa* is distinguished from all congeners by the following combination of characters: Snout truncate in dorsal and ventral view, rounded in lateral view; supraocular present; ocular subhexagonal with superior border straight and anterior border barely rounded at eye level; rostral subtriangular in dorsal view, reaching anterior border of ocular scales; frontal as long as supraocular and other middorsal cephalic shields, except for postfrontal which is smaller; temporal distinct; supralabials three (2+1); infralabials four or five; body



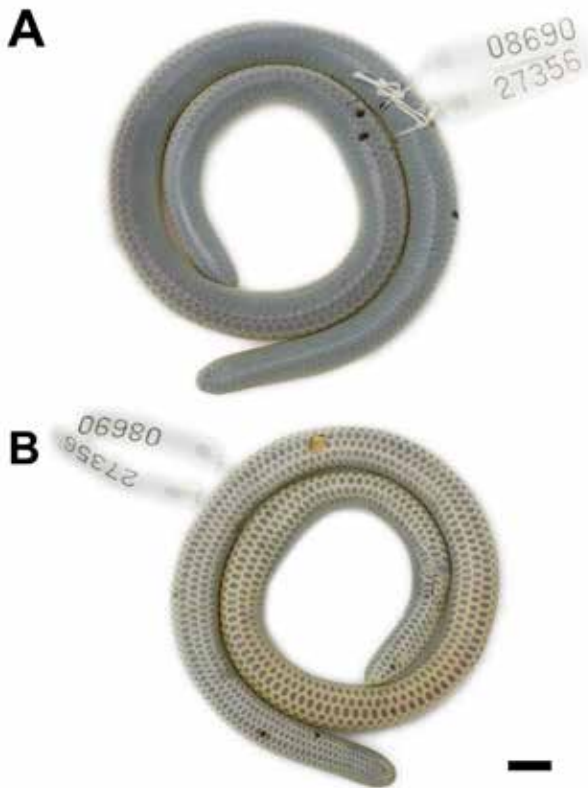
**Fig. 1.** Dorsal (A), lateral (B), and ventral (C) views of the head of the holotype of *Trilepida pastusa* sp. nov. (QCAZ 8690). Scale bar = 1.5 mm. Drawings by D. Pauca.

width relatively thick (TL/MB = 28.6–34.6); middorsal scales 203–214; midventral scales 182–193; subcaudal scales 18–19; fused caudals present; terminal spine conical, slightly longer than wide; scales around middle of tail 12; dorsum uniform gray; venter gray with interspaces between scales cream.

*Comparisons* (Table 1).—Among all congeners, *Trilepida pastusa* is more similar to *T. guayaquilensis* and *T. joshuai* in sharing 12 scales around midtail, three supralabials, and a uniform dark dorsum and pale venter (Pinto and Fernandes 2012). The new species differs from both by having an ocular with an anterior border barely rounded at eye level, a thick body (TL/MB = 28.6–34.6), and a coloration pattern consisting of a uniform gray dorsum and a venter with gray on the center and cream on the outside of each scale (Figs. 3, 4A) (vs ocular with rounded anterior border, thin body [TL/MB = 48.6], and uniform brown color dorsally and pale brown ventrally in *T. guayaquilensis*; ocular with rounded anterior border, moderate to thin body width [TL/MB = 34.0–55.2], and uniform dark brown dorsally and cream ventral scales in *T. joshuai*) (Orejas-Miranda and Peters 1970; Pinto and Fernandes 2012; Pinto et al. 2010; Rojas-Morales and González-Durán 2011). Moreover, *T. pastusa* differs from *T. guayaquilensis* in having a lower number of middorsal (203–214 vs 253, respectively) and midventral (182–193 vs 233, respectively) scales (Orejas-Miranda and Peters 1970; Pinto and Fernandes 2012). The new species also differs from *T. joshuai* by having a higher number of middorsal (203–214 vs 174–199, respectively) and midventral (182–193 vs 165–187, respectively) scales, and a higher number of subcaudals (18–19 vs 13–18, respectively) (Pinto and Fernandes 2012; Pinto et al. 2010; Rojas-Morales and González-Durán 2011). Some specimens of *T. macrolepis* can have 12 scales around

**Table 1.**—Meristic and morphometric variation of the four species of *Trilepida* occurring in Ecuador. Data are from Pinto and Fernandes (2012) and references therein, as well as our own scale counts and measurements. Abbreviations: DO = middorsal scales; VE = midventral scales; SC = subcaudals; TL = total length; TAL = tail length; MB = midbody diameter; MT = midtail diameter; SL = supralabials; IL = infralabials; SO = supraocular. Color pattern adapted from Passos et al. (2006) and Pinto and Fernandes (2012): 1 = uniform violet black dorsally and ventrally; 2 = reticulate dark brown dorsally and reticulate pale brown ventrally; 3 = uniform brown dorsally and pale brown ventrally; 4 = uniform gray dorsally and reticulate gray ventrally.

Character	<i>Trilepida pastusa</i> sp. nov.	<i>Trilepida macrolepis</i>	<i>Trilepida guayaquilensis</i>	<i>Trilepida anthracina</i>
DO	203–214	211–255	253	182–193
VE	182–193	201–237	233	167–176
SC	18–19	16–24	20	15–19
TL/TAL	10.86–13.67	8.2–15.9	13.1	12.2–16.6
TL/MB	28.63–34.55	32.2–68.3	48.6	31.7–43.7
TAL/MT	2.67–3.81	3.8–7.9	–	3.6–10.1
SL	2+1	2+1	2+1	2+1
IL	4–5	4	4	4
SO	present	present	present	present
Midtail scales	12	10	12	10
Color pattern	4	2	3	1

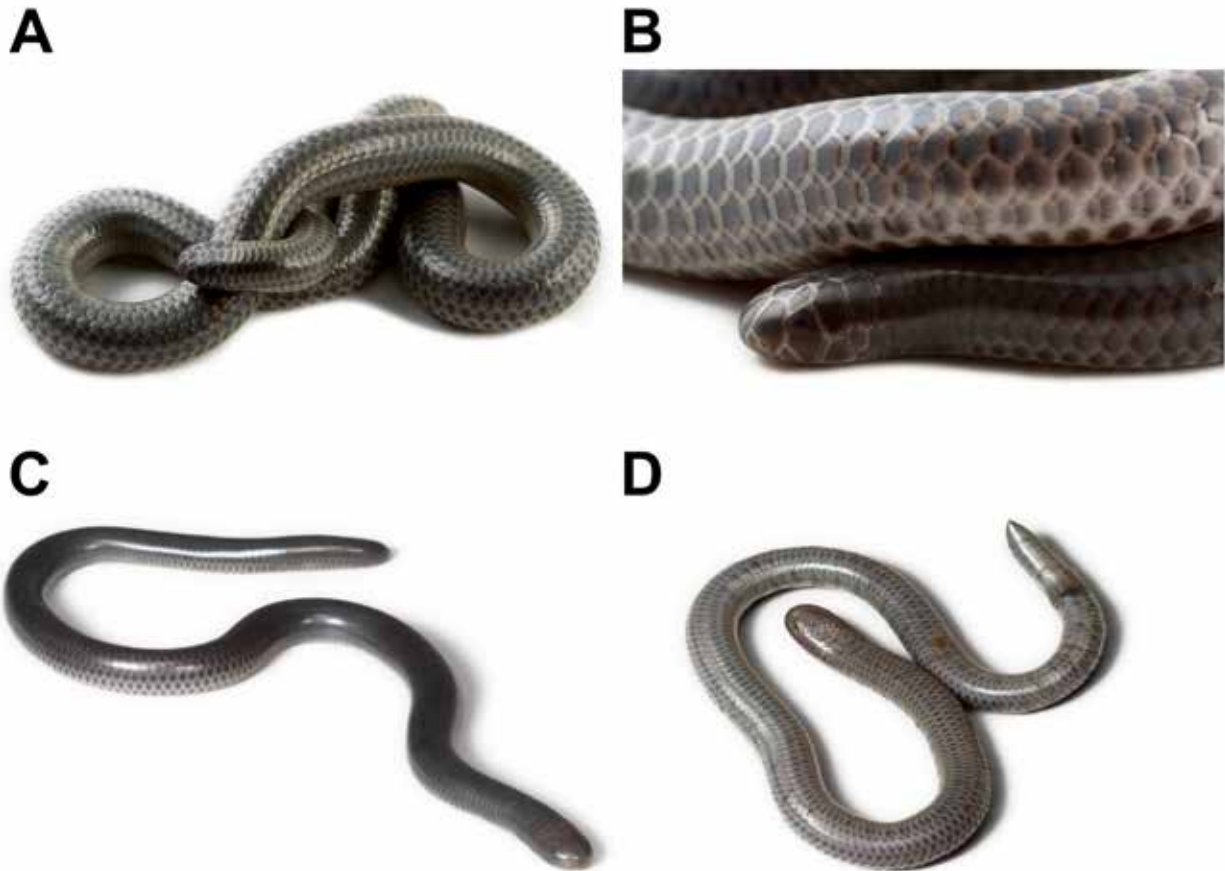


**Fig. 2.** Dorsal (A) and ventral (B) views of the holotype of *Trilepida pastusa* sp. nov. (QCAZ 8690) in preservative. Scale bar = 1 cm.

midtail (see Discussion), but *T. pastusa* differs from this species by having an ocular with barely rounded anterior border, thick body (TL/MB = 28.6–34.6), uniform gray dorsum and venter with gray on the center and cream on the outside of each scale, 203–214 middorsal scales, 182–193 midventral scales, 18–19 subcaudals, non-enlarged eyes, and rostral reaching ocular level in dorsal view (vs ocular with rounded anterior border, moderate to thin body width [TL/MB = 32.2–68.3], reticulate dark brown dorsally and reticulate pale brown ventrally, 211–255 middorsal scales, 201–237 midventral scales, 16–24 subcaudals, enlarged eyes, and rostral not reaching ocular level in *T. macrolepis*) (Fig. 4) (Pinto and Fernandes 2012; Pinto et al. 2010).

*Description of the holotype (Figs. 1, 2).*—Adult female, TL 315 mm, TAL 29 mm; MB 10.2 mm; MT 7.6 mm; TL/TAL 10.9; TL/MB 30.9; TAL/MT 3.8; HL 6.2 mm, HW 6.0 mm; relative eye diameter 3.1; relative rostral width 0.4. Body subcylindrical, robust, head slightly compressed compared to body and slightly tapered caudally near tail. Head subcylindrical, as long as wide and slightly distinguishable from neck. Snout slightly rounded in dorsal and ventral views, rounded in lateral view; rostral straight in frontal and ventral views, subtriangular in dorsal view but with rounded apex, reaching imaginary transverse line between anterior border of oculars; rostral contacting supranasal and infranasal laterally, and

frontal dorsally; nasal completely divided horizontally by oblique suture crossing nostril and descending posteriorly to contact first supralabial; nostril roughly elliptical, obliquely oriented and located in middle of nasal suture; supranasal higher than wider, bordering rostral anteriorly, infranasal inferiorly, first and second supralabials, and ocular posteriorly, and frontal and supraocular dorsally; supranasal ventral margin half the length of upper border of infranasal scale; infranasal about twice as high as wide, longer than any of the supralabials; upper lip border formed by rostral, infranasal, two anterior supralabials, ocular, and posterior supralabial; temporal distinct in size from dorsal scales of lateral rows; three supralabials, first two anterior to ocular and one posterior (2+1); first supralabial almost twice as high as wide, not reaching nostril and eye levels, second supralabial almost twice as high as wide, higher than first supralabial, reaching nostril level; third supralabial trapezoidal, as high as wide, reaching nostril level, its posterior margin in broad contact with temporal; ocular enlarged, subhexagonal, anterior border barely rounded at eye level, higher than wide, contacting posterior margins of supranasal and second supralabial anteriorly, parietal and third supralabial posteriorly, and supraocular dorsally; eye distinct (diameter = 0.7 mm), located in central area of upper part of ocular, displaced above nostril level; supraocular longer than wide, as long as frontal, between ocular and frontal, contacting supranasal anteriorly, frontal and ocular laterally, and parietal and postfrontal posteriorly; frontal, interparietal, and interoccipital subequal in size, hexagonal and imbricate, postfrontal smaller; frontal longer than wide, contacting rostral, supranasal, supraocular, and postfrontal; postfrontal as long as wide, contacting frontal, supraocular, parietals, and interparietal; interparietal as long as wide, contacting postfrontal, parietals, occipitals, and interoccipital; interoccipital wider than long, contacting interparietal, occipitals, and first dorsal scale of vertebral row; parietal and occipital subequal, irregularly heptagonal; parietal longer than occipital, twice as high as wide, lower margin contacting upper border of third supralabial, posterior margin contacting temporal, occipital, and interparietal, anterior border in contact with ocular, supraocular, and postfrontal; occipital twice as high as wide, its lower limit attaining upper margin of third supralabial, separated from the latter by temporal; symphyseal trapezoidal, anterior border slightly concave and posterior border convex except in the middle, five times wider than high; four infralabials; first infralabial twice as high as wide; second infralabial as high as wide; third infralabial twice as wide as high and not pigmented; fourth infralabial as high as wide. Cephalic shields with uniformly scattered sensory pits. Middorsal scales 203; midventral scales 182; scales rows around middle of body 14, reducing to 12 rows in middle of tail; cloacal shield triangular, as wide as long; subcaudals 19; fused caudals present; terminal spine conical, slightly longer than wide; elongated cloacal sacs present. Dorsal scales



**Fig. 3.** *Trilepida pastusa* in life. Lateral view of body (A) and head (B) of holotype (QCAZ 8690) and lateral (C) and ventral (D) views of body of juvenile paratype (QCAZ 5846). Photographs by O. Torres-Carvajal and S.R. Ron.

homogeneous, cycloid, smooth, imbricate, and wider than long.

*Coloration in preservative of the holotype (Fig. 2).*—Middorsal scales (i.e., seven longitudinal rows) bluish gray. The remaining seven scale rows forming the ventral and lateral sides of the body are occupied on the center by the same bluish gray color, but the margins of each scale are cream white; the latter pattern is less apparent on the anterior fourth of the body. Border of mouth, mental scale, nostrils and eyes are cream. Cloacal shield bluish gray except on its posterior margin, which is cream with bluish-gray dots.

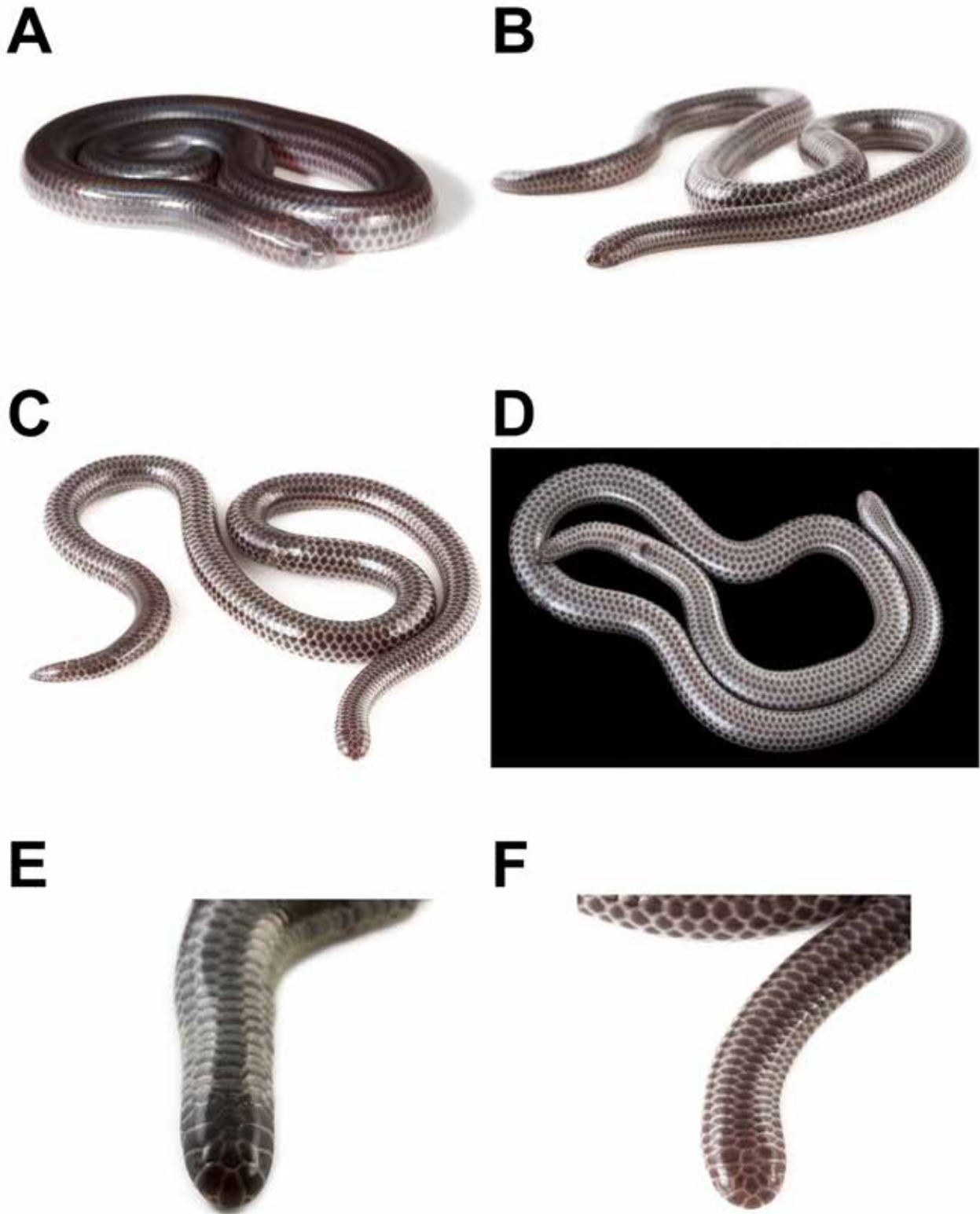
*Color variation.*—Dorsal ground color of body similar to that of the holotype in one of the juveniles (QCAZ 5846), the other juvenile (QCAZ 5778) is dark gray; ventral coloration is similar in all specimens.

*Color in life.*—Dorsum uniform Dark Blue Gray (Color 194) (Figs. 3A, 3C, 4A), with upper part of head Brick Red (Color 36) on both juveniles (Figs. 3C, 4A). Venter of body and tail Dark Blue Gray, with interspaces between scales Cream White (Color 52) (Figs. 3B, 3D, 4A). Anal plate entirely Dark Blue Gray. After a few minutes of handling, the borders of each scale became apparent

and they turned Pale Neutral Gray (Color 296) (Fig. 3D). Tongue Smoky White (Color 261).

*Quantitative variation.*—Scale counts in *Trilepida pastusa* vary as follows: middorsal scales 203–214 ( $\bar{x} = 206.67 \pm 6.35$ ,  $n = 3$ ); midventral scales 182–193 ( $\bar{x} = 186 \pm 6.08$ ,  $n = 3$ ); subcaudals 18–19 ( $\bar{x} = 18.67 \pm 0.58$ ,  $n = 3$ ); TL 315 mm ( $n = 1$ ) in adult and 123–136 mm ( $\bar{x} = 129.5 \text{ mm} \pm 9.19$ ,  $n = 2$ ) in juveniles; TAL 29 mm ( $n = 1$ ) in adult and 9–12 mm ( $\bar{x} = 10.5 \text{ mm} \pm 2.12$ ,  $n = 2$ ) in juveniles; TL/MB ratio 30.94 ( $n = 1$ ) in adult and 28.63–34.55 ( $\bar{x} = 31.59 \pm 4.19$ ,  $n = 2$ ) in juveniles; TAL/MT ratio 3.81 ( $n = 1$ ) in adult and 2.67–3.41 ( $\bar{x} = 3.04 \pm 0.52$ ,  $n = 2$ ) in juveniles; infralabials 4 ( $n = 1$ ) in adult and 5 ( $n = 2$ ) in juveniles; relative eye diameter 3.07 ( $n = 1$ ) in adult and 1.70–1.73 ( $\bar{x} = 1.71 \pm 0.02$ ,  $n = 2$ ) in juveniles; relative rostral width 0.37 ( $n = 1$ ) in adult and 0.31–0.38 ( $\bar{x} = 0.35 \pm 0.05$ ,  $n = 2$ ) in juveniles.

*Skull (Fig. 5).*—Premaxilla roughly rectangular in frontal and ventral views, edentulous, pierced by six foramina; transverse process of premaxilla absent and vomerian process double; nasals paired, approximately quadrangular dorsally, and pierced by a pair of foramina in lateral border of contact with prefrontals; nasal septum descending as medial vertical flanges; prefrontals paired,



**Fig. 4.** Lateral (A) view of body of juvenile paratype of *Trilepida pastusa* (QCAZ 5778). Lateral (B), dorsal (C), and ventral (D) views of body of *T. macrolepis* (DHMECN 11400). Dorsal view of head of the holotype of *T. pastusa* (QCAZ 8690) (E) and *T. macrolepis* (DHMECN 11400) (F). Photographs by L.A. Coloma, O. Torres-Carvajal, and S.R. Ron.

subtriangular in dorsal view; septomaxillae paired, complex in shape, expanding dorsally into the naris; conchal invagination absent; ascending process of premaxilla pierced by single large foramen; vomers paired, located midventral to vomeronasal cupola, bearing transversal arms, and with short posterior arms; frontals paired, nearly rectangular dorsally, without anterolateral projections to attach to prefrontals; frontal pillars absent; optic nerve restricted to lateral descending surface of frontals; maxilla edentulous, irregular in shape, pierced by three large juxtaposed foramina; posterior orbital element absent; parietal single, wide, representing largest bone of braincase; parabasisphenoid arrow-like, with tapered anterior tip lying below palatine, and fitting in medial line of vomeronasal cupola; parabasisphenoid with shallow pituitary fossa; basioccipital single and pentagonal; supraoccipitals fused into single unit, subpentagonal; prootics paired and triangular; large statolythic mass present in *cavum vestibuli*; *crista tubularis* not enclosing juxtastapedial recess; stapedia footplate apparently not co-ossified with prootic; otoccipitals paired and rectangular; palatines paired and triradiate; anterior margin of maxillary process slightly flexing ventrally; pterygoids slender and rod-like, not contacting quadrate posteriorly, and not extending beyond the anterior margin of basioccipital; ectopterygoid indistinct; quadrate long and slender, about 50% of skull length; dentary supports a series of five teeth ankylosed to the inner surface of the anterolateral margin of dental concha; mental foramen nearly under the 3<sup>rd</sup>–4<sup>th</sup> teeth; splenial conical, representing smallest bone in lower jaw; anterior mylohyoid foramen absent on splenial; posterior mylohyoid foramen on the ventral surface of angular; angular conical; compound bone pierced by two foramina in the surangular lamina, posterior surangular foramen large and anterior to the articular portion of compound bone, anterior surangular foramen located below the coronoid; coronoid rests on the compound bone.

*Postcranial data*.—Preloacal vertebrae 176–184 ( $\bar{x}$  = 179 ± 4.16,  $n$  = 3); cervical vertebrae 6 + trunk vertebrae 170 ( $n$  = 1); caudal vertebrae 23–24 ( $\bar{x}$  = 23.3 ± 0.6,  $n$  = 3), the last vertebrae representing the fusion of three vertebrae ( $n$  = 2). Correlation ( $n$  = 3) between middorsal scales and preloacal + subcaudal vertebrae (1:0.99), between midventral scales and preloacal vertebrae (1:1.02), and between subcaudal scales and caudal vertebrae (0.8:1). Pelvic girdle located at the level of the 171<sup>st</sup> and 176<sup>th</sup> preloacal vertebrae (QCAZ 5778), or 176<sup>th</sup> preloacal and 2<sup>nd</sup> subcaudal (QCAZ 8690). Pelvic girdle represented by four non-fused bones: ilium, ischium, femur, and pubis. Ilium, ischium, and femur rod-like; ilium represents the longest bone of pelvic girdle; femur stout.

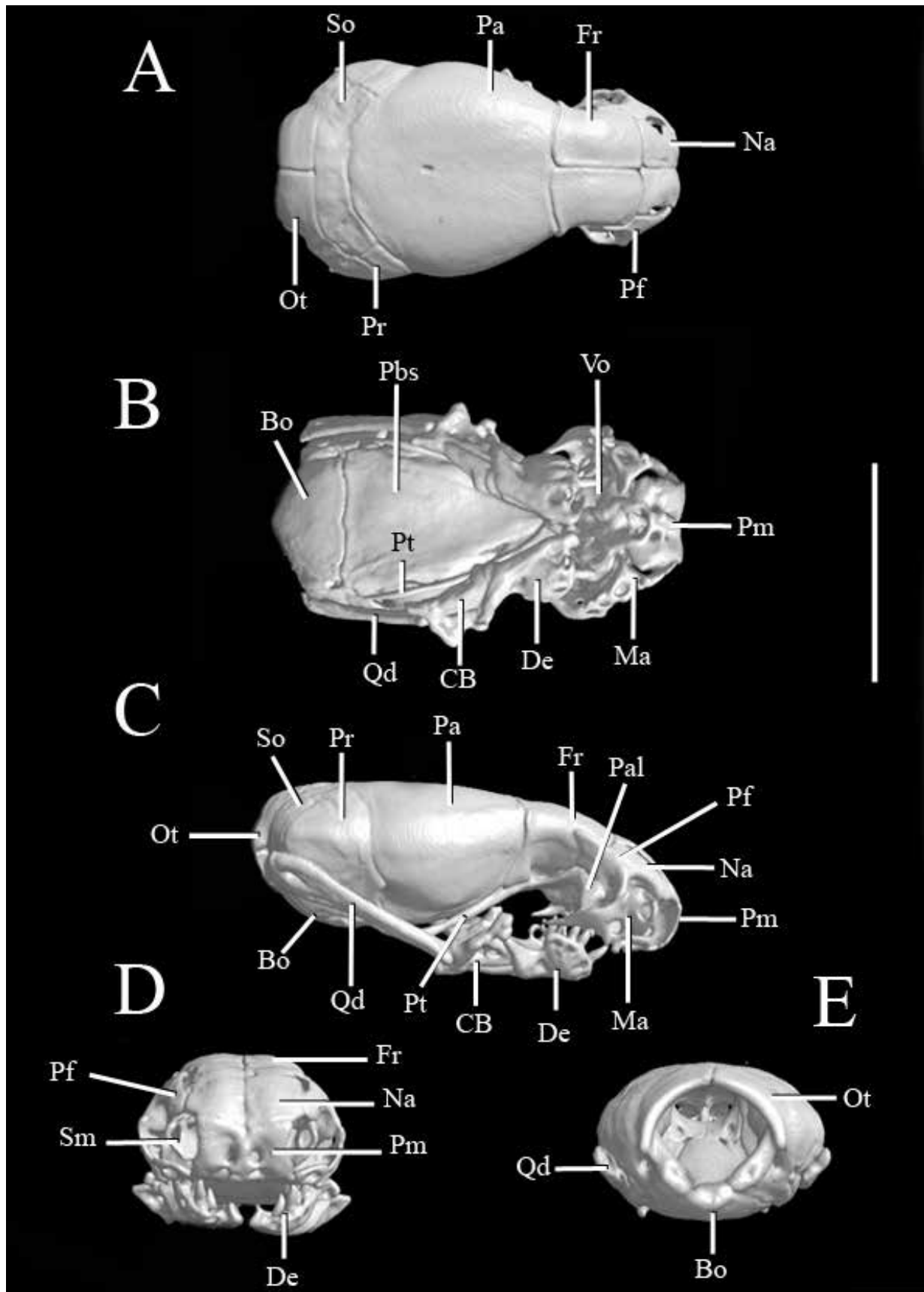
*Etymology*.—The specific epithet is used as a noun in apposition. As explained in Coloma et al. (2010), *pastuso* or *pastusa* is a Spanish word used to refer to the

inhabitants of the Pasto region in northern Ecuador and southern Colombia. Here, we also use it to recognize the presence of Los Pastos pre-hispanic culture (500–1500 CE) (Delgado-Troya 2004), whose vestiges remain in the type locality and allowed the discovery of *Trilepida pastusa* and specimens of another cryptozoic snake species: *Atractus savagei* (Salazar-Valenzuela et al. 2014).

*Proposed standard English and Spanish names*.—Pastuso threadsnakes; Serpientes hebra pastusas.

*Distribution and natural history* (Figs. 6, 7).—Western versant of the Cordillera Occidental of extreme northern Ecuadorian Andes in Tulcán County, Carchi province. *Trilepida pastusa* is known only from the type locality, which belongs to Montane Cloud Forest (Valencia et al. 1999) at 2,071 m. The holotype was found below mounds of dirt, stones, pasture and moss in conjunction with eggs of *Liophis vitti* (nomenclature following recommendations expressed in Curcio et al. 2009) and adult specimens of *Atractus savagei* (Salazar-Valenzuela et al. 2014). Juvenile paratypes were found below rocks (ca. 40 cm in diameter) in areas of pasture.

*First records of Trilepida macrolepis for Ecuador*.—The big-scaled threadsnake, *T. macrolepis*, is a relatively large (126–322 mm) leptotyphlopoid snake with the widest geographical distribution of all species in the genus (Pinto et al. 2010). Localities for the species in northern South America include Panama, Colombia, Venezuela, Guyana, Suriname, French Guiana, Brazil, and Peru (Wallach et al. 2014). It is distinguished from congeners by having three supralabial and four infralabial scales, 10 rows in the middle of the tail, more than 210 middorsal scales, and more conspicuously because of a dorsal and ventral coloration pattern consisting of dark brown to black scales with white borders (i.e., reticulate) (Passos et al. 2005; Pinto and Fernandes 2012; Pinto et al. 2010). Two specimens from Esmeraldas province in northern Ecuador agree with most of these characters, their scale counts vary as follows (QCAZ 10247, juvenile of undetermined sex and DHMECN 11400, adult male, respectively): middorsal scales 239, 250; midventral scales 220, 228; subcaudals 21, 20; TL 158 mm, 333 mm; TAL 11 mm, 23 mm; SL 2+1, 2+1; IL 4, 6; SO 1, 1; midtail scales 12, 10. Coloration pattern on both is reticulate dark brown dorsally and reticulate pale brown ventrally (Figs. 4B–4D). Specimen QCAZ 10247 was collected on 13 February 2010 in Otokiki Reserve, Alto Tambo (0°54'21.6" N, 78°36'21.6" W, 620 m), San Lorenzo County, Esmeraldas province; the snake was found in primary forest 30 cm below ground among fern roots. Specimen DHMECN 11400 was collected on 01 April 2012 near Durango (1°02'30.7" N, 78°37'26.6" W, 243 m), San Lorenzo County, Esmeraldas province; the snake was found in secondary forest one m above ground among leaf litter accumulated on the junction of



**Fig. 5.** Three-dimensional reconstruction of the skull of *Trilepida pastusa* based on HRXCT data. Dorsal (A), ventral (B), lateral (C), anterior (D), and posterior (E) views of juvenile paratype (QCAZ 5778). Scale bar = 3.5 mm. Bo, basioccipital; CB, compound bone; De, dentary; Fr, frontal; Ma, maxilla; Na, nasal; Ot, otico-occipital; Pa, parietal; Pal, palatine; Pbs, parabasisphenoid; Pf, prefrontal; Pm, premaxilla; Pr, prootic; Pt, pterygoid; Qd, quadrate; Sm, septomaxilla; So, supraoccipital; Vo, vomer.

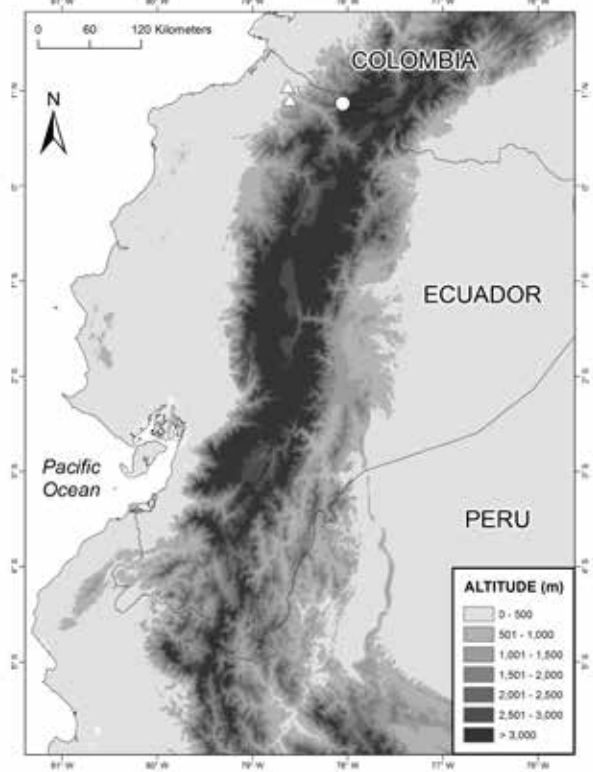


lianas. Both localities belong to Lowland and Foothill Evergreen Forests of northwestern Ecuador (Cerón et al. 1999) (Fig. 6).

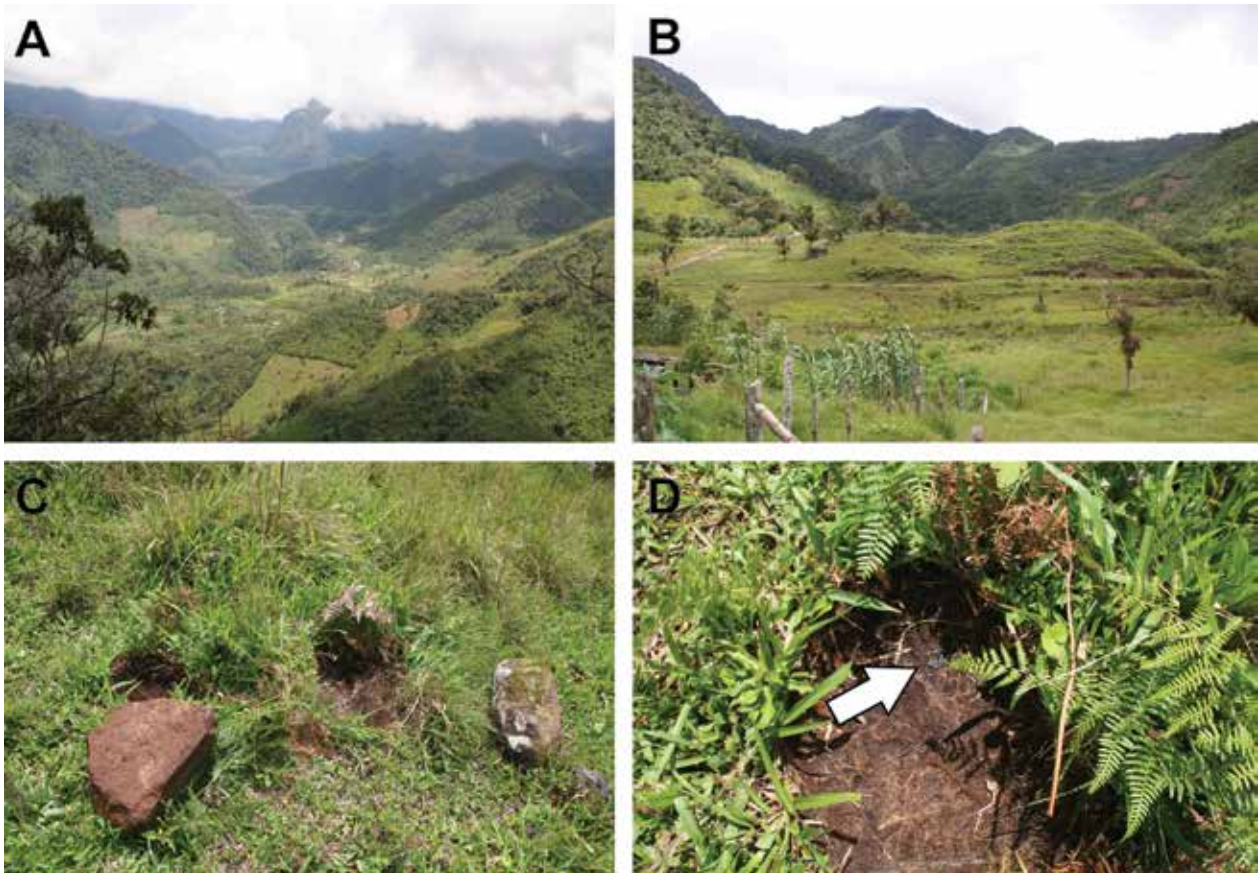
### Discussion

The conservation assessment of reptile species belonging to families that are completely or primarily fossorial (e.g., Amphisbaenidae, Anomalepididae, Leptotyphlopidae, Typhlopidae, Uropeltidae) is incomplete (Santos 2013). Due to their secretive habits and non-inclusion during routine herpetological surveys, knowledge about their distribution and population dynamics is scarce (Measey 2006; Pyron and Wallach 2014). Böhm et al. (2013) estimated that 10.5% (range: 5.6–57%) of species of fossorial reptiles are Threatened; however, the authors recognized that this low estimate and wide confidence intervals reflect the fact that a large number (47% from a subsample of 1,500 reptile species) of the included taxa had been classified as Data Deficient. Therefore, this study re-emphasized the need to target these groups in future research and surveys.

Records for *Trilepida macrolepis* and *T. pastusa* provided here come from a region where several new species of snakes have been discovered in the last 15 years (e.g., Dixon 2000; Passos et al. 2009; Salazar-Valenzuela



**Fig. 6.** Geographic distribution of *Trilepida pastusa* (circle) and *T. macrolepis* (triangles) in Ecuador.



**Fig. 7.** Habitat of *Trilepida pastusa* surrounding the cloud forests near the town of Chilmá Bajo, Tulcán County, Carchi province (A); pasture areas where individuals were collected (B); microhabitat of *T. pastusa* (C); and a juvenile individual of the new species *in situ* (arrow) (D). Photographs by D. Salazar-Valenzuela.

et al. 2014; Torres-Carvajal et al. 2012). The singularity of this region may be attributable to the proposed existence of a habitat transition between northern and central parts of the Chocó bioregion (western Colombia and northwestern Ecuador) and communities found further south along the Pacific coast and adjacent Andean slopes of Ecuador (Anderson and Jarrín-V 2002; Anderson and Martínez-Meyer 2004; Cisneros-Heredia 2006; Salazar-Valenzuela et al. 2014).

*Trilepida macrolepis* has been suggested to represent a complex of species due to its wide distribution, presence on both sides of the Andes, and deep molecular divergence between individuals from two localities in northern Brazil and Guyana (Adalsteinsson et al. 2009; Orejas-Miranda 1967). Our data from Ecuador agree with the diagnosis provided for this species in Pinto et al. (2010), except for the presence of 12 midtail scales in specimen QCAZ 10247. This character has been used in the taxonomy of members of the genus (Orejas-Miranda and Peters 1970; Pinto et al. 2010) and will need to be evaluated in future studies. We tentatively assign QCAZ 10247 to *T. macrolepis* based mainly on the presence of a high number of middorsal and midventral scales (239 and 220, respectively), an ocular with rounded anterior border, and a reticulate dorsal and ventral coloration pattern, but acknowledge that a detailed revision of this taxon is needed to confirm the taxonomic identity of this specimen. Pérez-Santos and Moreno (1991) showed two color photographs of leptotyphlopids snakes of Ecuador without species identification. One of them (picture 148) seems to agree with the dorsal reticulate pattern present in *T. macrolepis*, suggesting that this taxon was already collected in Ecuador. However, the same image (picture 85) was also included in Pérez-Santos and Moreno (1988)'s book on snakes of Colombia rendering questionable the origin of that specimen. The discovery of individual DH-MECN 11400 among leaf litter one m above the forest floor is in agreement with the report of individuals of this species complex from the Amazonian lowlands wrapped two m above ground around small tree trunks and moving their heads back and forth (Vitt and Caldwell 2013). These authors suggested that the snakes were probably trying to detect airborne chemical cues associated with termite nests.

Putative synapomorphies for the genus *Trilepida* include a hemipenis body with a narrow base and a robust terminal portion, middorsal cephalic scales of moderate size (i.e., supraocular scales smaller or equal to frontal and postfrontal scales), and an enlarged terminal spine (Passos et al. 2006; Pinto and Curcio 2011; Pinto and Fernandes 2012). Although we could not examine hemipenis for *T. pastusa* since adult males were not available in our sample, we assign this species to the genus *Trilepida* based on the presence of middorsal cephalic scales of moderate size and a slightly enlarged terminal spine (see Pinto and Curcio, 2011). Also, the paired or unpaired condition of the nasal bone is variable in differ-

ent members along the Leptotyphlopidae family (Rieppel et al. 2009). Although osteological characters have not been employed in less inclusive phylogenetic analysis on the *Renina* subtribe (represented by the genus *Rena* and *Trilepida*), previous morphological studies on the skull of members pertaining to this subtribe (e.g., Brock 1932; List 1966; McDowell and Bogert 1954; Rieppel et al. 2009) indicate that the paired condition of the nasal bones may be a feature that could distinguish the genus *Trilepida* (paired condition) from the genus *Rena* (fused condition). As many other species currently allocated in the genus *Trilepida*, *T. pastusa* also has paired nasal bones. Intrageneric phylogenetic relationships have not been established for members of the genus *Trilepida*; out of the 14 species of the genus, three consistently show the presence of 12 midtail scales: *T. guayaquilensis*, *T. joshuai*, and *T. pastusa*. These species are restricted to Colombia and Ecuador and these shared features may indicate close phylogenetic relationships between them. *Trilepida guayaquilensis* is still only known from the holotype even though it was described 45 years ago from a specimen collected in Guayaquil, Guayas province, Ecuador. We analyzed photographs from specimens collected in this locality and misidentified as *T. guayaquilensis*. These specimens actually represent *Epictia subcrotilla*, which is a leptotyphlopids snake distributed in the lowlands of Ecuador and Peru, relatively common in natural history collections (Cisneros-Heredia 2008; Purtschert 2007). Indeed, specimen QCAZ 12769 collected by us in Guayaquil confirms the presence of this species in urban areas of this city. *Trilepida guayaquilensis* therefore remains to be confirmed as a species with a distribution that includes Guayaquil but no further records exist from this area because it is either extremely rare in abundance or searching efforts have not been enough to locate this fossorial animal. Alternatively, *T. guayaquilensis* could be a species whose only known specimen did not originate from Guayaquil but may have been brought there from a nearby locality in the Pacific lowlands or the western versant of the Andes, as has been suggested for a couple of other species of Ecuadorian snakes (Cadle 2005; Curcio et al. 2012).

As is common in tropical parts of the world where these groups have significantly diversified (Pyron and Burbrink 2012; Vitt and Caldwell 2013), knowledge about the diversity of fossorial snake fauna in Ecuador is still fragmented. Cisneros-Heredia (2008) clarified much of the confusion present at the time regarding the existence of voucher specimens for species registered in the country and concluded that only three species of the family Leptotyphlopidae were present in the country. The addition of two species of threadsnakes to the snake fauna of Ecuador reported in this study should bring us closer to the true diversity present in the country, even though it is clear that there are more species that remain to be described in this group (Cisneros-Heredia 2008, *pers. observ.*).

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### APPENDIX

#### *Specimens examined*

*Epictia subcrotilla* ( $n = 4$ ).—ECUADOR: Provincia Guayas: Guayaquil, 7 m, QCAZ 12769; USNM 232401–03 (photographs examined).

*Trilepida anthracina* ( $n = 1$ ).—ECUADOR: Provincia Zamora Chinchipe: 6.5 km SE of Tundayme, 1,300–1,500 m, QCAZ 7396.

*Trilepida guayaquilensis* ( $n = 1$ ).—ECUADOR: Provincia Guayas: Guayaquil, ZMB 4508 (holotype) (photographs examined).

*Trilepida macrolepis* ( $n = 2$ ).—ECUADOR: Provincia Esmeraldas: Alto Tambo, Otokiki Reserve, 620 m, QCAZ 10247; Durango, 243 m, DHMECN 11400.



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**Angele Martins** received her Master's degree in 2012 from Museu Nacional do Rio de Janeiro/UFRJ–Brazil, and is now a Ph.D. student in Zoology at this same institution. She has dedicated her research efforts in the last six years to the study of snake morphology and herpetofauna from the Atlantic Forest in Brazil. In the last three years, she has focused on the study of the comparative anatomy of scolecophidians, with significant interest on threadsnakes (Leptotyphlopidae), which lead her to investigate the comparative anatomy of this group for her Ph.D. thesis.



**Luis Amador-Oyola** graduated in Biological Sciences from the University of Guayaquil (UG) in 2005. He is currently completing his Master's thesis on the biogeography and systematics of amphibians from the Chongón Colonche mountains (equatorial pacific) at the same university. His work has focused on the distribution and biodiversity of amphibians and reptiles of areas on the coast of Ecuador, however Luis is interested in future work on evolution and biogeography of amphibians. This manuscript represents the first description of a species of herpetofauna coauthored by Luis; other works are in preparation.



**Omar Torres-Carvajal** graduated in Biological Sciences from Pontificia Universidad Católica del Ecuador (PUCE) in 1998, and in 2001 received a Master's degree in Ecology and Evolutionary Biology from the University of Kansas under the supervision of Dr. Linda Trueb. In 2005 he received a Ph.D. degree from the same institution with the thesis entitled “Phylogenetic systematics of South American lizards of the genus *Stenocercus* (Squamata: Iguania).” Between 2006–2008 he was a postdoctoral fellow at the Smithsonian Institution, National Museum of Natural History, Washington DC, USA, working under the supervision of Dr. Kevin de Queiroz. He is currently Curator of Reptiles at the Zoology Museum QCAZ of PUCE and an Associate Professor at the Department of Biology in the same institution. He has published more than 30 scientific papers on taxonomy, systematics, and biogeography of South American reptiles, with emphasis on lizards. He is mainly interested in the theory and practice of phylogenetic systematics, particularly as they relate to the evolutionary biology of lizards.

In accordance with the *International Code of Zoological Nomenclature* new rules and regulations (ICZN 2012), we have deposited this paper in publicly accessible institutional libraries. The new species described herein has been registered in *ZooBank* (Polaszek 2005a, b), the official online registration system for the ICZN. The *ZooBank* publication LSID (Life Science Identifier) for the new species described here can be viewed through any standard web browser by appending the LSID to the prefix "http://zoobank.org/". The LSID for this publication is: urn:lsid:zoobank.org:pub:3FC7DC45-E3D4-49B6-AEDD-3925A347665E.

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