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A new species of velvet worm of the genus *Oroperipatus* (Onychophora, Peripatidae) from western Amazonia

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Abstract

The diversity of Neotropical velvet worms (Onychophora, Neopatida) is significantly underestimated, particularly within the Andean clade represented by the genus *Oroperipatus*, the last species of which was described more than 70 years ago. Here, we describe a new species of *Oroperipatus* from the Amazonian lowlands of Ecuador, bringing the total number of described species on mainland Ecuador to seven and in western Amazonia to three. The new species, *Oroperipatus tiputini* **sp. nov.**, can be distinguished from its congenerics by the following combination of characters: two variations of primary papillae alternated between dorsal plicae; four scale ranks in the apical piece of primary papillae; reduced fifth spinous pad of legs IV and V; four supraocular papillae; occasionally reduced anterior papilla; males with two crural tubercles per leg in the first pregenital pair and a single crural tubercle per leg in the next pair; and some accessory papillae with one lateral rudimentary apical piece. We also discuss novel morphological similarities and differences with other Neopatida genera, as revealed by scanning electron microscopy (SEM).

Key Words

Andean peripatids, Ecuador, Neopatida, new species, taxonomy, Tiputini Biodiversity Station, Yasuni

Introduction

Onychophorans, commonly known as velvet worms, possess a soft, elongated body covered by a lightly sclerotised cuticle, multiple locomotor limbs, and a pair of anterior slime papillae that expel a sticky slime used to immobilise their prey (Mayer et al. 2015). Members of the phylum Onychophora are found in tropical and subtropical regions around the world, with about 230 described species divided into two families: Peripatidae, with a pantropical distribution (Neotropics, Antilles, west Africa, and southeast Asia), and Peripatopsidae, with a circum-Antarctic distribution (Chile, South Africa, New Guinea, Australia, and New Zealand) (Monge-Nájera 1995; Oliveira et al. 2012; Giribet et al. 2018). Neotropical peripatids form the clade Neopatida and are divided into two lineages: the "Andean peripatids", represented by species of the genus *Oroperipatus* Cockerell, 1908, and the "Caribbean peripatids", comprising all other neopatid genera (Giribet et al. 2018; Costa and Giribet 2021).

Oroperipatus is characterised by four or more foot papillae and a nephridial tubercle on legs IV and V inserted in a complete third spinous pad (Bouvier 1905; Clark 1913; Costa et al. 2021). While knowledge of the diversity of Caribbean peripatids has significantly increased (e.g., Morera-Brenes and Nájera 2010; Costa et al. 2018; Barquero González et al. 2020; Costa and Giribet 2021), the most recent descriptions of *Oroperipatus* species date back over 70 years (du Bois-Reymond Marcus 1952). Currently, twenty species of *Oroperipatus* are known from México, Panama, Colombia, Ecuador, Peru, Bolivia, and Brazil, with a wide altitudinal range from the Pacific coast to the high Andes and the Amazonian lowlands (Bouvier 1905, Fuhrmann 1915; Clark and Zetek 1946; Sampaio-Costa et al. 2009; Oliveira 2023). In South America, only two described species have been reported from the lowlands of western Amazonia: *Oroperipatus bluntschlii* (Fuhrmann, 1915), from the area of the Samiria and Lagartococha rivers, Loreto, Peru, and *O. weyrauchi* (Bois-Reymond Marcus, 1952), from Yúrac, River Aguaytía, Ucayali, Peru (Fuhrmann 1915; du Bois-Reymond Marcus 1952; Icochea and Ramírez 1996). In this contribution, we are pleased to describe a new species of *Oroperipatus* from the northern Amazonian lowlands of Ecuador.

Methods

We conducted fieldwork at the Tiputini Biodiversity Station (TBS), situated approximately 280 km ESE of Quito, in the Orellana province, Republic of Ecuador. Established in 1994 by Universidad San Francisco de Quito (USFQ), TBS is a research station spanning 744 hectares of undisturbed lowland evergreen rainforest on the northern bank of the Tiputini River, within the Yasuni Biosphere Reserve – one of the planet's most biodiverse regions (Cisneros-Heredia 2003, 2006; Bass et al. 2010; Blake et al. 2012; Ryder and Sillett 2016; Romo et al. 2017). The station encompasses various habitats, including Terra Firme Forest, Várzea Forest, small areas of Igapo Forest, palm swamps, and natural gaps. Mean annual precipitation ranges between 2700 and 3100 mm, with a relatively aseasonal climate characterised by peak rainfall from April to August and drier conditions from November to March and August (Cisneros-Heredia 2003, 2006; Blake et al. 2012; Ryder and Sillett 2016; Romo et al. 2017).

Opportunistic collections were conducted at night on trails at TBS in April–July 2001, June 2017, May–June 2018, April–May 2019, May–June 2022 and June 2023. Specimens were collected by hand, placed in plastic bags with leaf litter for transportation to the laboratory, photographed alive, and then euthanised and preserved in 75% ethanol. Additionally, we examined specimens deposited by previous researchers at the Museo de Zoología, Universidad San Francisco of Quito, Ecuador (ZSFQ). All specimens of the type series are deposited at ZSFQ. Jaws are preserved in glycerol in microvials alongside their respective specimens. Information for comparative diagnoses was obtained from the original descriptions and the comprehensive revision by Bouvier (1905).

Description, character definition, and terminology adhere to standards proposed by Oliveira et al. (2010, 2012). We followed the definition of antennal tip by Oliveira et al. (2010) due to the undetected chemoreceptors (see Remarks). The concept of diagnosis is used as proposed by the ICZN (1999). Specimens were examined using an Olympus SZX16 stereomicroscope. To facilitate jaw extraction and minimise mouth damage, specimens were rehydrated using gradually lowered ethanol concentrations (from 75% to 10%) and warm water for five hours. Jaws were then placed on a slide with gel alcohol and observed under an Olympus CX22 optic microscope. All measurements were taken in preserved specimens under a stereomicroscope with a Truper digital vernier calliper (0.05 mm accuracy, rounded to the nearest 0.1 mm) and reported as a mean ± standard deviation (range, sample size). Specimens were studied and photographed using an Olympus SZX16 stereomicroscope with an Olympus DP73 digital camera attached. Photographs shown in Fig. 3 were obtained by photograph stacking using CombineZP 1.0 software and then adjusted for brightness and contrast to highlight taxonomically important structures with Adobe Photoshop CC 2020 software (Adobe Systems, USA). Raw photographs are available at http://doi.org/10.5281/zenodo.10864497. Photographs in other figures were not adjusted. Descriptions of colouration in life are based on digital in-situ photographs.

We used scanning electron microscopy (SEM) to study the morphology of the tegument. One male paratype (ZSFQ-i8004) preserved in 75% ethanol was dissected to extract samples of its dorsal tegument, legs, antenna, and genital pad. Images were captured using a JEOL JSM-IT300L SEM at 15 kV with a working distance of 13 mm, operated under low vacuum conditions (30 Pa) and a high probe current of 40 nA. Samples were carefully dried by natural convection on a petri dish using a fluorescent lamp for 20 minutes. This method was chosen due to the lack of a critical point dryer. Samples were gold-coated for 1 minute and electrically grounded to the stage using carbon tape.

We conducted this research under research permits (006-2015-FAU-DPAP-MA, 001-16 IC-FLO-FAU-DNB/MA, 018-2017-IC-FAU-DNB/MAE, 019-2018-IC-FAU-DNB/MAE, and MAAE-ARSFC-2022-2204) issued by the Ministry of Environment of Ecuador.

Results

Oroperipatus tiputini **sp. nov.**

https://zoobank.org/F37273EE-10A9-49D7-A332-8B354F12DCBC

Figs 1–5

Material examined. ***Holotype.*** Ecuador • ♀, province of Orellana, Tiputini Biodiversity Station; -0.637, -76.152; 220 m elevation; 6 Jun. 2022; Pedro Peñaherrera-R., Roberto J. León-E., and Diego F. Cisneros-Heredia leg.; ZSFQ-i8249

Paratypes. Ecuador • 1 ♂, same locality data as holotype; 22 May 2018; Diego F. Cisneros-Heredia, Francisco Velásquez, and Juan Pablo Jordán leg.; ZSFQ-i5151; • 1 ♂, same locality data as holotype; 21 May 2019; Francisco Velásquez and Diego F. Cisneros-Heredia leg.; ZSFQ-i8004, • 1 ♂, same locality data as holotype; 13 Apr.

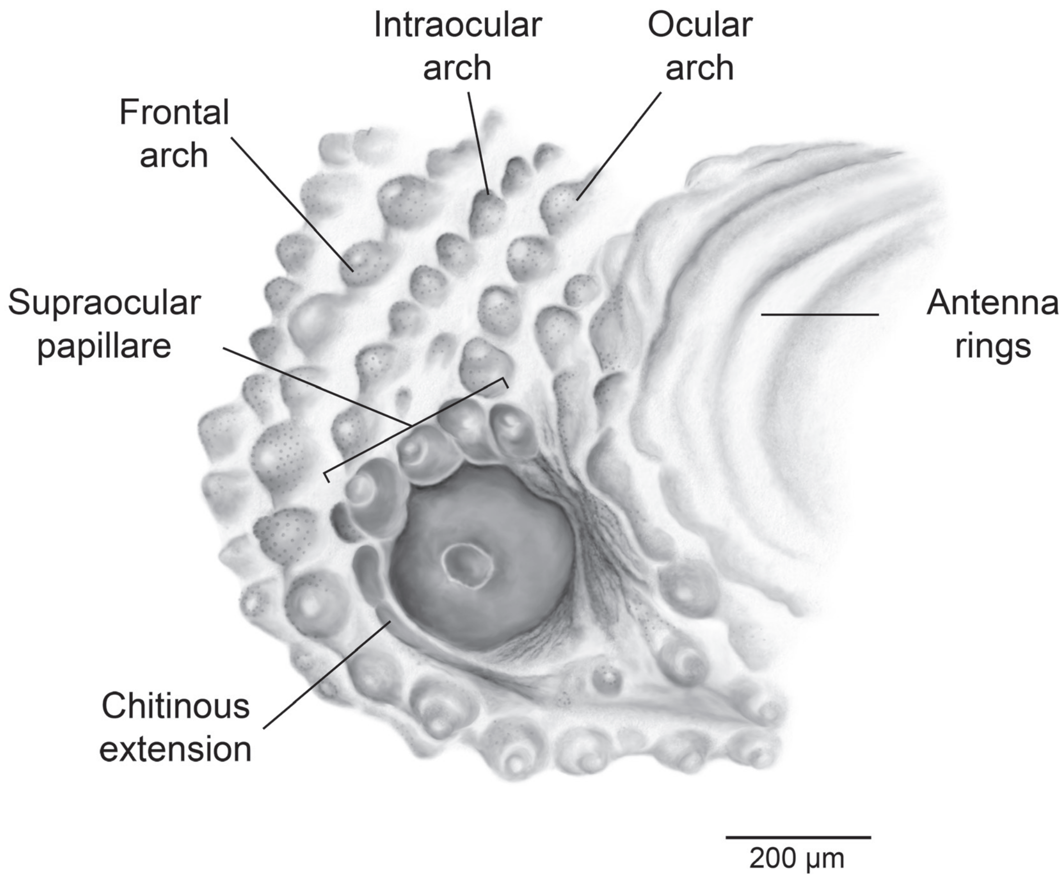

Figure 1. Illustration of the head morphology around the eye of *Oroperipatus tiputini* sp. nov. showing four supraocular papillae, the chitinous extension, and frontal, intraocular, and ocular arches.

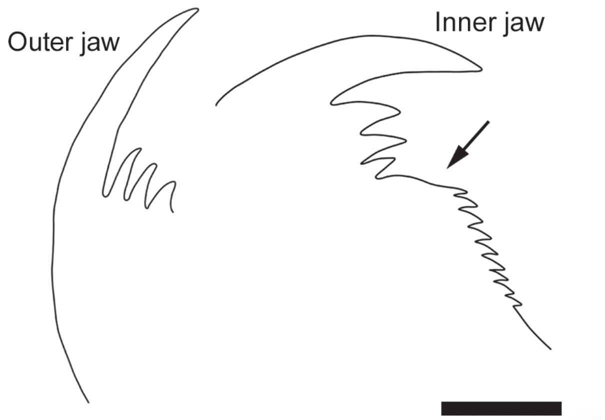

Figure 2. Drawing of the outer and inner jaws of *Oroperipatus tiputini* sp. nov.; the black arrow points to the diastema. Scale bar: 0.2 mm.

2021; K. Faloon leg.; ZSFQ-8250; • 1 ♂, same locality data as holotype; 30 Jun. 2023; Montalvo, J. leg. ZSFQ-i17992• 1 ♂, same locality data as holotype; 8 Jun. 2022; Pedro Peñaherrera-R., Roberto J. León-E., and Diego F. Cisneros-Heredia leg.; on the root of a Ceiba tree; ZSFQ-i8270; 1 ♀ and 1 juvenile, same locality data as holotype; 7 Jun. 2017; Diego F. Cisneros-Heredia leg.; ZSFQ-i5143, ZSFQ-i17793; • 1 juvenile, same data as holotype; ZSFQ-i17794; • 1 ♀, same locality data as holotype; 25 May 2022; Diego F. Cisneros-Heredia, Paula Leoro and María Sol Salazar leg.; ZSFQ-i8248. • 1 juvenile, same locality data as holotype; 30 Jul. 2001; Diego F. Cisneros-Heredia leg.; ZSFQ-i5149.

Type locality. Tiputini Biodiversity Station (-0.637, -76.152, 220 m elevation), provincia de Orellana, República del Ecuador.

Diagnosis. *Oroperipatus tiputini* sp. nov. differs from all other congeneric species by having two size variations of primary papillae alternated between dorsal plicae (Figs 3A, 4C), apical piece of primary papillae with four scale ranks (Fig. 4B), reduced fifth spinous pad of legs IV and V (Fig. 3B), four foot papillae, four supraocular papillae, and occasionally the anterior papilla reduced (Fig. 1); some accessory papillae with one lateral rudimentary apical piece (Fig. 4C); males with two crural tubercles per leg in first pregenital pair and a single crural tubercle per leg in the next pair (Fig. 3C).

Oroperipatus tiputini sp. nov. is most similar to *O. lankesteri* by having dorsal plica alternation, two variations of primary papillae alternated between dorsal plicae, two to three accessory teeth in outer jaw, one to two accessory teeth in inner jaw, reduced fifth spinous pad of legs IV and V, and seven rings on tip of antenna. However, *O. tiputini* sp. nov. is distinguished from *O. lankesteri* (characters in

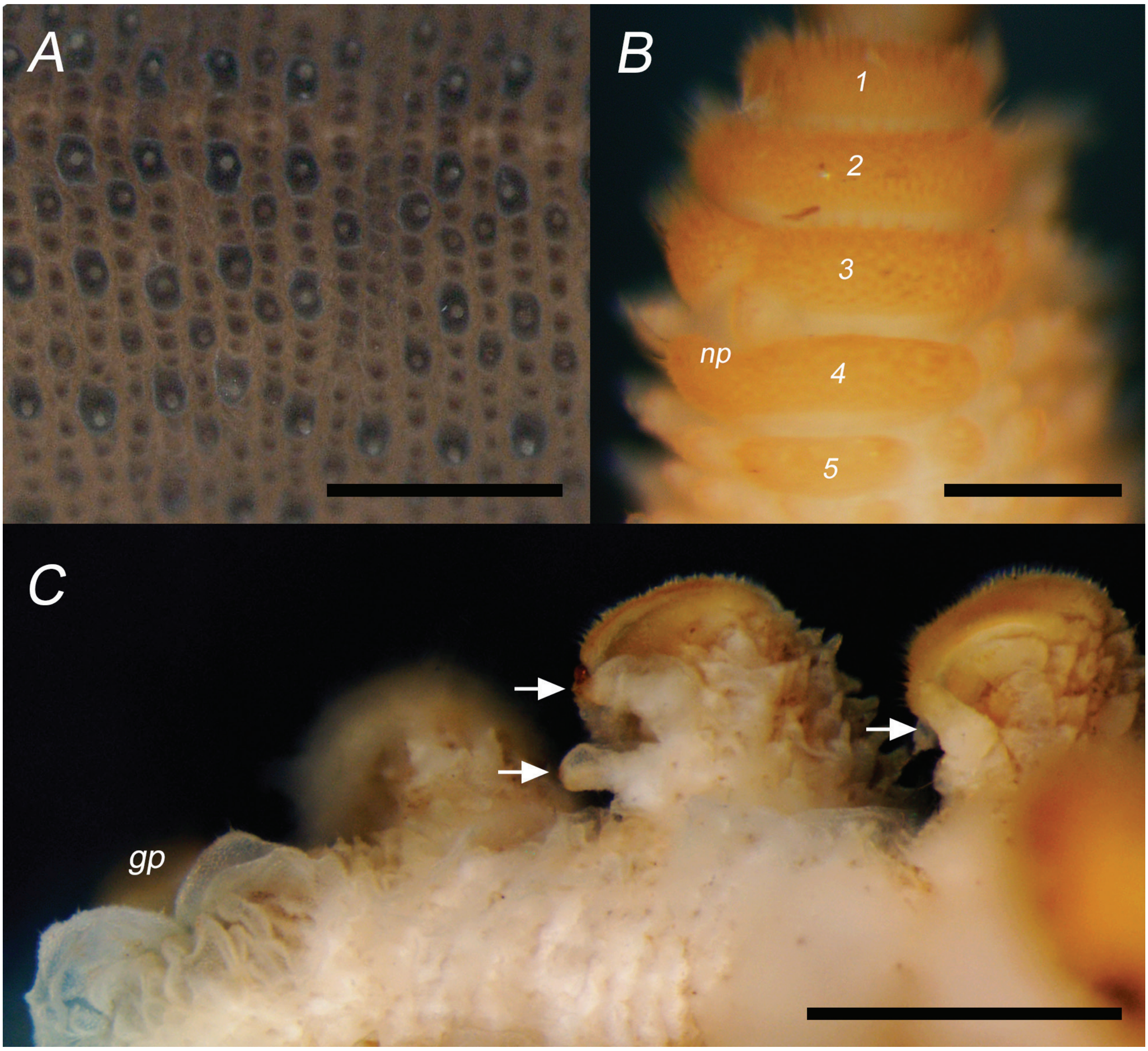

Figure 3. Tegument and leg morphology of *Oroperipatus tiputini* sp. nov. **A.** Dorsal integument. **B.** Ventral detail of the right V leg showing five spinous pads and a nephridial tubercule (np) indented at the third spinous pad. **C.** Genital pad (gp) and pregenital legs of the right side showing the crural tubercules pointed by white arrows. Scale bars: 1 mm (**A**); 0.2 mm (**B**); 0.4 mm (**C**).

parentheses) by having a well-developed diastema (short diastema), absence of distal foot papillae, and always presenting two anterior and posterior foot papillae (five to seven foot papillae with distal papillae); third spinous pad divided into two unequal fragments by nephridial tubercle (nephridial tubercle at posterior edge of third spinous pad without dividing it); a smaller frontal organ (size as five to six papillae); four supraocular papillae (two); and one to three accessory papillae between primary papillae (uniformly three accessory papillae). *Oroperipatus tiputini* sp. nov. differs from *O. ecuadoriensis* (characters in parentheses), a species similar to *O. lankesteri*, by having reduced fifth spinous pad in IV and V pairs of legs (same width as other spinous pads), two variations of primary papillae (three), hyaline organs inconspicuous (conspicuous), incomplete plicae in every segment (some segments without incomplete plicae), four foot papillae (five to six), a smaller frontal organ (size as five to six papillae), and accessory papillae more abundant (rare on dorsum and more abundant on flanks). *Oroperipatus tiputini* sp. nov can be differentiated from *O. weyrauchi* and *O. bluntschlii*, the other two described species from the Amazonian lowlands (characters of *O. weyrauchi* and *O. bluntschlii* in parentheses) by having two pair of crural tubercles in pregenital pair of legs (one pair in *O. weyrauchi*), legs with more number of transverse leg rings (17–18 in *O. tiputini* vs. 14 in *O. weyrauchi*), four foot papillae (some legs with five in *O. weyrauchi* and *O. bluntschlii*), two types of primary papillae (primary papillae greatly varies in size with all intergradations to accessory papillae), diastema well-developed (short diastema in *O. bluntschlii*), five spinous pad (sixth vestigial spinous pad in *O. bluntschlii*), and biggest primary papillae disposed on large plicae (biggest primary papillae in all segments).

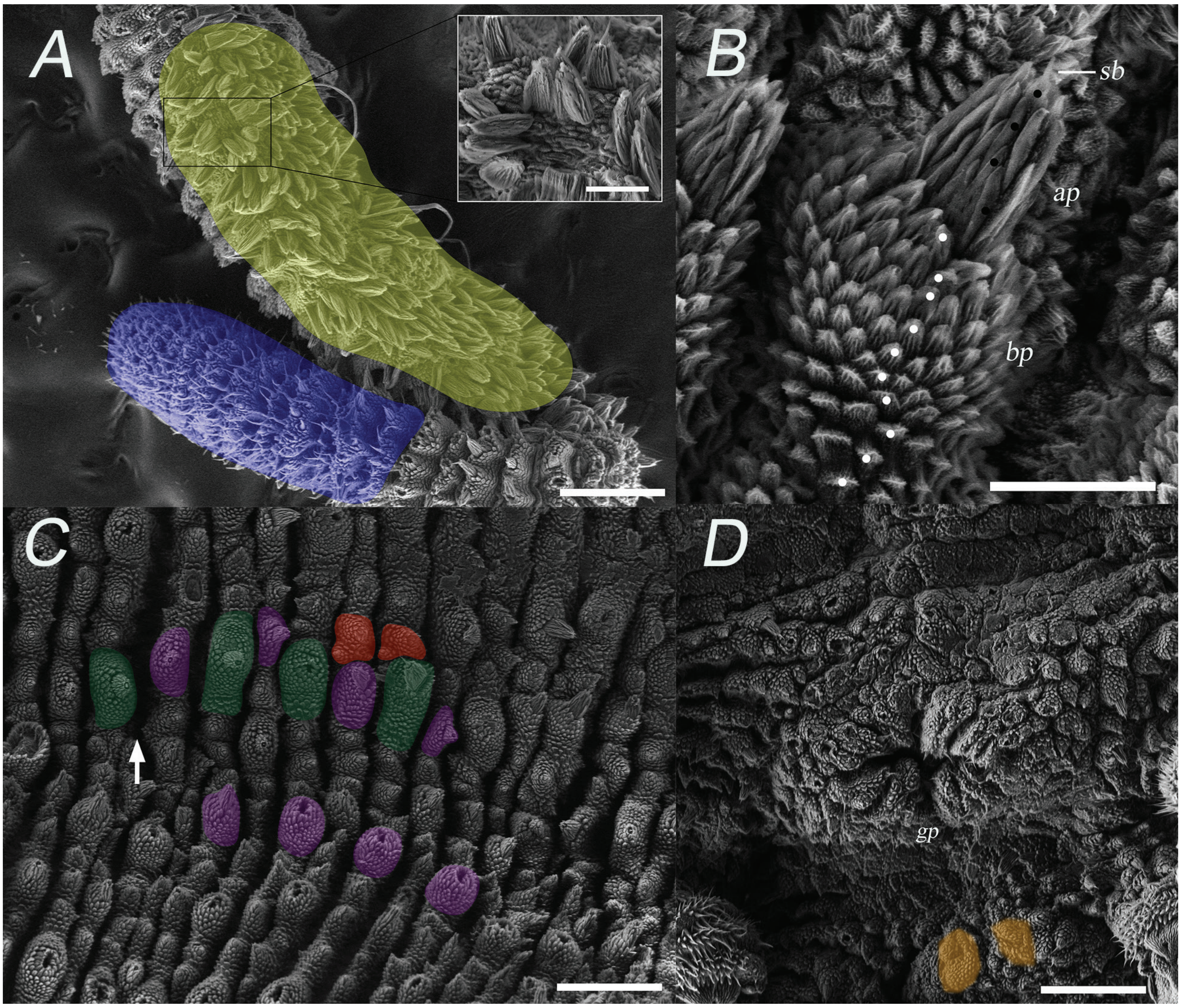

Figure 4. Antenna, dorsal integument, and genital pad morphology of *Oroperipatus tiputini* sp. nov. under a scanning electron microscope. **A.** Antenna: in blue, the antennal tip, and in yellow, the sensory field of the antenna; insert in **A**: spindle-shaped papillae in detail. **B.** Primary papilla with 10 scale ranks in the basal piece (bp), four scale ranks in the apical piece (ap), and the sensory bristle (sb). **C.** Dorso-lateral integument: in green, the biggest primary papillae; in purple, the smallest primary papillae (or secondary papillae); and in red, the accessory papillae that possess rudimentary apical pieces; the arrow points to the incomplete plica. **D.** Posterior region in ventral view showing the opening of the genital pad (gp) and, in orange, the anal glands. Scale bars: 200 µm (**A, C, D**), 50 µm (**B** and insert in **A**).

Description. ***Head.*** Antennal rings 40 to 52. Antennal tip with 14 antennal rings alternated type I and type II sensillum; smallest rings only with type II sensillum (Fig. 4A). Antennal chemoreceptors not detected. Ventrally, from ring 17 to base of the antenna, spindle-shaped papillae form sensory field of antenna (Fig. 4A). Slightly wrinkled eyes laterally behind base of antennae. Ocular and frontal arches with large primary papillae and intraocular arch formed by smaller primary papillae and accessory papillae. Intraocular arch interrupted, with a chitinous extension under eye (Fig. 1). A frontal organ located ventral behind base of antennae and equivalent in size to four to five anterior dermal papillae. Mouth with seven pairs of lobes or internal lips (although in some specimens is difficult to distinguish most posterior pair) and unpaired lip. One to three accessory teeth in outer jaw and two or three accessory teeth in inner jaw with deep diastema, followed by seven to nine denticles (Fig. 2).

Dorsal integument. Plicae per segment 12, alternating between large and narrow, ten complete plicae and two incomplete plicae and irregular above base of legs; seven plicae overpass between legs to venter. Dorsomedian furrow continuously and flanked by one to three accessory papillae on both sides. Two variations of primary papillae, ovoid. Biggest primary papillae on the large plicae, while smallest primary papillae (or secondary papillae) on every plica. Primary papillae separated by one to three accessory papillae, more frequently by three (Figs 3A, 4C). Primary dermal papillae cylindrical. Apical pieces with four scale ranks. Basal pieces with ten scale rank in largest primary papillae and nine in smallest primary dermal papillae. Scales of apical pieces elongated, three

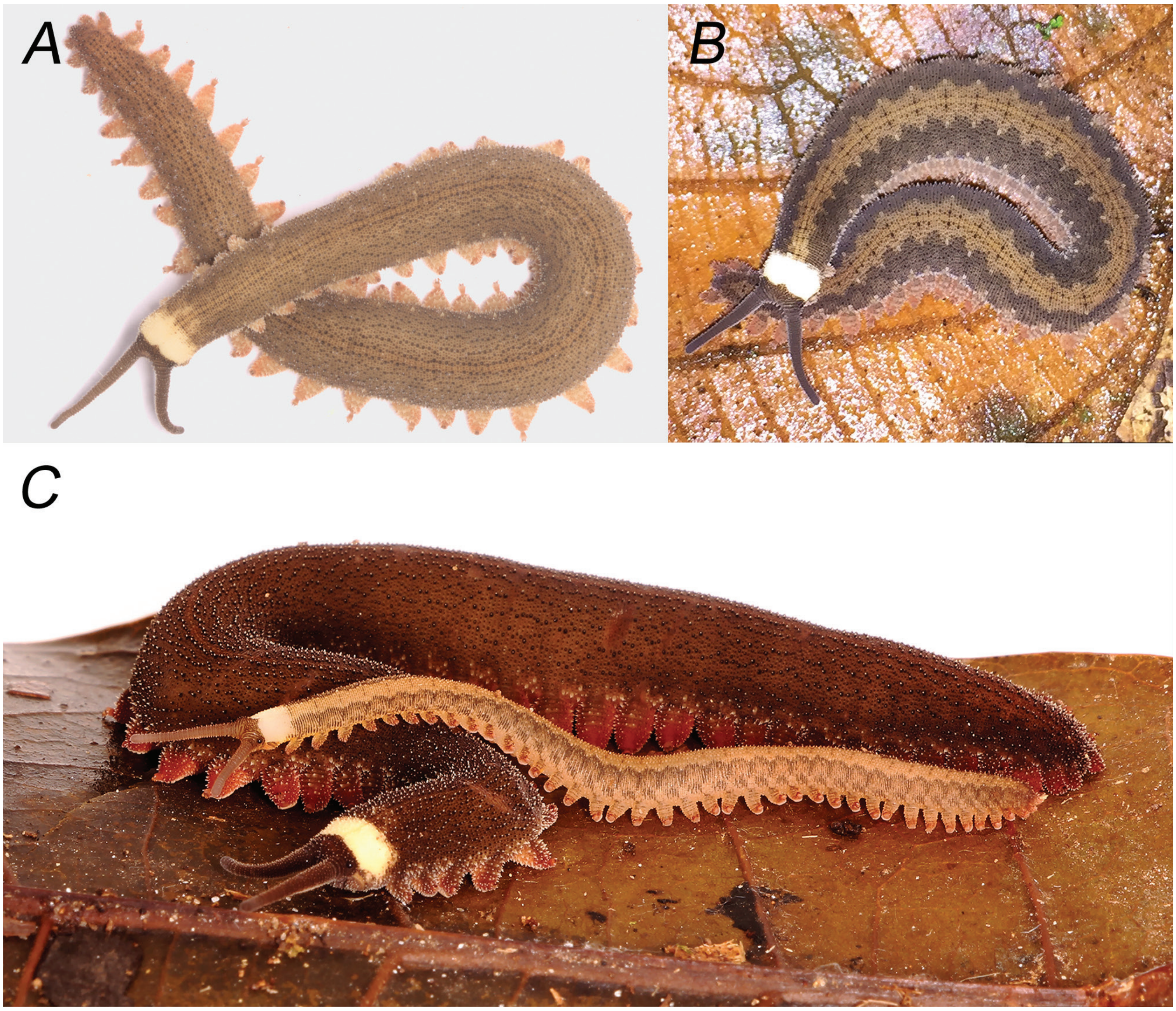

Figure 5. **A–C.** Colour variation in the life of *Oroperipatus tiputini* sp. nov. **A.** Adult male paratype, ZSFQ-i8270; **B.** Adult male paratype, ZSFQ-i5151; **C.** Adult female holotype (ZSFQ-i8248) and youngling paratype (ZSFQ-17794) a few days after being born. All photographs were taken at the Tiputini Biodiversity Station. Photographs by Pedro Peñaherrera R. (**A, C**) and Diego F. Cisneros-Heredia (**B**).

times larger and half wider than scales of basal pieces (Fig. 4B).

Ventral integument. Visible ventral organs. Preventral organs inconspicuous.

Legs. Transverse rings 17 to 18. Pairs of legs IV and V with four first spinous pads of the same size and fifth one reduced. Proximal margin of third spinous pad indented by nephridial tubercle and separate not completely into two unequal segments (Fig. 3B). Three spinous pads on last pair of legs plus one vestigial, four spinous pads on penultimate pair of legs, and four spinous pads on first pair of legs. Last pair of legs not rotated and used for walking. Eversible coxal vesicle present but not seen in all legs. Two anterior foot papillae and two posterior foot papillae. Two bristles on distal and proximal setiform ridges. Females with 37–40 pairs of legs and males with 34–36 pairs of legs.

Posterior region. Genital opening of females and males cruciform (Fig. 4D). Crural tubercles on four pregenital legs of the male: two crural tubercles per leg in first pregenital pair, and a single crural tubercle per leg in the next pair (Fig. 3C). Concolorous slit-like anal glands in males.

Colouration. One adult male (ZSFQ-i8270) was brown with faded rhomboids (Fig. 5A); two adult males and one adult female (i5151, i17992, 8248; Fig. 5B) were brown with orange diamonds; an adult female (ZSFQ-i8249, holotype) was completely plain dark orange and the youngling it gave birth was yellowish with diamond-shaped dorsal patterns (ZSFQ-i17794; Fig. 5C). All specimens, juveniles and adults, have a very conspicuous anterior white band with a heart-shaped border along midline (Fig. 3). All specimens show head and antennae darker than dorsum, and orange or brown legs. Preserved specimens show high depigmentation, with background colouration changing from pale orange or brown to white and dorsal patterns lost or blurred.

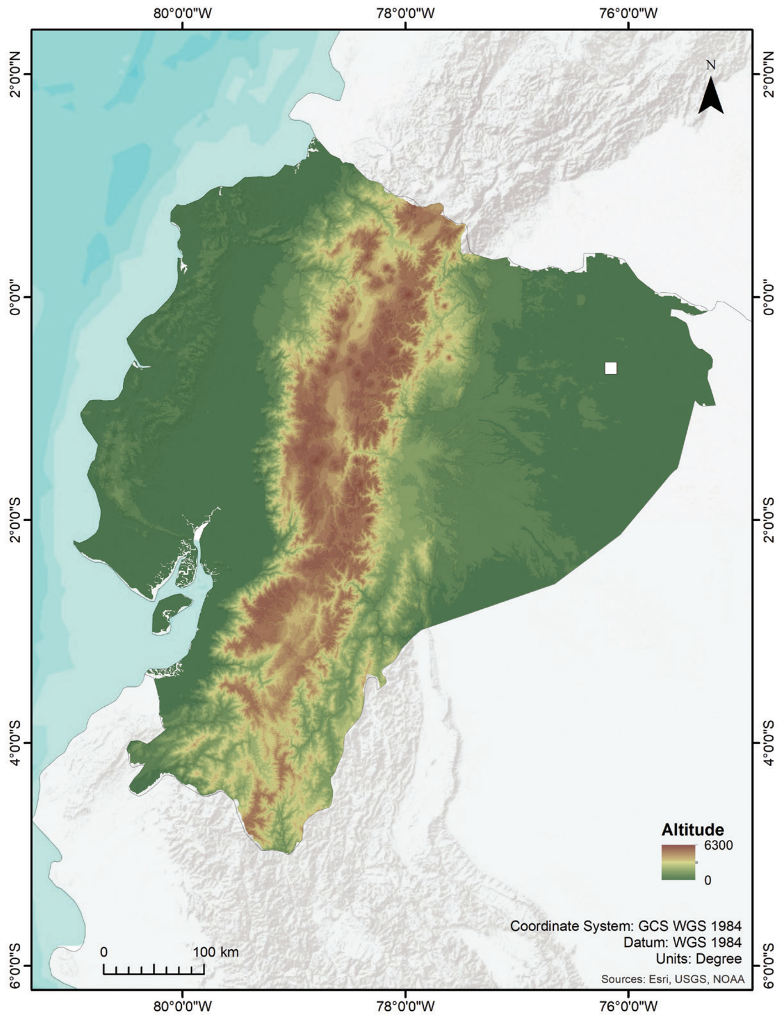

Figure 6. Map of Ecuador showing the location of the Tiputini Biodiversity Station (white square), type locality of *Oroperipatus tiputini* sp. nov., in the Amazonian lowlands.

Measurements. ***Holotype in preservative (in mm):*** Length: 48.1, width: 3.15, number of pairs of legs: 40.

All preserved specimens (in mm): Length of females: 52.6 ± 11.0 (46–65.3, n = 3), width of females: 4.7 ± 1.6 (3.2–6.3, n = 3); length of males: 32.5 ± 6.9 (22.7–39.8, n = 5), width of males: 3.4 ± 0.9 (2.0–4.3, n = 5); length of juveniles: 30.1 ± 4.4 (25.5–34.3, n = 3), width of juveniles: 2.9 ± 0.4 (2.5–3.3, n = 3); number of pairs of legs in females: 37–40, number of pairs of legs in males: 34–37.

Etymology. The specific epithet is used as a name in apposition in reference to the type locality of the new species, Tiputini Biodiversity Station (TBS). We present this new species in recognition of the hard work done to protect Amazonian biodiversity by TBS's management, research, and field team at one of the most important research stations in western Amazonia (Bass et al. 2010).

Distribution and natural history. The species is currently known only from the type locality, Tiputini Biodiversity Station, in the northern Amazonian lowlands of Ecuador (Fig. 4). Most individuals of *O. tiputini* sp. nov. have been found in old-growth, closed-canopy Terra Firme forests, on the leaves and stems of small forbs at less than 70 cm above ground, in leaf litter, and on buttress roots. One specimen (ZSFQ-i8250) was found inside a bromeliad. Most specimens were found active at night (19h00–23h00), except for a male individual active on a tree trunk, 1.5 m above the floor in old-growth Várzea forest, at 16h00. Individuals have been found singly or in pairs. In captivity, the female holotype (ZSFQ-i8248) gave birth to a single youngling (ZSFQ-i17794) (Fig. 5C), staying together for three days until euthanised; during that time, the juvenile remained surrounded by the mother or on her back. One adult male (ZSFQ-i17992) was caught using a baiting net at 1 m height in the vegetation during the day.

Remarks. One male specimen (ZSFQ-i5151) exhibited a different number of legs on each side, with 35 on the right and 36 on the left. The new species undergoes ontogenic colour changes, as shown by the uniform dorsal colouration of the adult female holotype compared with the rhomboid pattern over a yellowish background of its youngling. Juveniles display brighter colours (lighter yellow and rhomboid pattern), which darken with age, and the rhomboid pattern fades in males or is lost in females.

We encountered challenges with two characters in our SEM images. Spindle-shaped papillae appeared notably flattened (Fig. 4A), a condition not previously reported in Onychophora. Additionally, antennal chemoreceptors were not detected, a feature only reported in *Mongeperipatus*. We think these characters were affected by the SEM preparation method.

During our examination, technical limitations prevented a thorough review of certain structures, notably the interpedal structures. However, as these structures are not described for any other *Oroperipatus* species and a comparative analysis was unfeasible, we deemed them non-essential for the purposes of our study aimed at describing a new species.

Discussion

The description of *Oroperipatus tiputini* sp. nov. brings the total number of described velvet worm species from mainland Ecuador to seven. This species is the first described from the Amazonian lowlands of Ecuador and the third from western Amazonia. Most velvet worm species from Ecuador are known only from their type localities, and, in some cases, their taxonomy is unclear and requires further revision (Table 1) (Oliveira 2023). Morphologically, *O. tiputini* sp. nov. is more similar to *O. lankesteri* than to *O. weyrauchi* or *O. bluntschli*, despite the last two being the only congeners inhabiting the Amazon basin. The morphological similarities between *O. tiputini* sp. nov. and *O. lankesteri* could indicate an evolutionary relationship; however, without additional data, proposing any phylogenetic hypothesis would be premature. *Oroperipatus lankesteri* is known solely from its type locality, Paramba, in the northern Pacific lowlands of Ecuador (Table 1). While *O. tiputini* sp. nov. is easily diagnosed from *O. weyrauchi* and *O. bluntschlii*, it is important to note that the descriptions of both species lack certain important characters and others are only presented in figures, making interpretation difficult. The author of these descriptions emphasised characters such as pigmentation, leg number, and dentition, which can be variable. The holotype of *O. bluntschli* was fixed with formaldehyde (Fuhrmann 1915), likely causing deformation of its tegument. The number of leg pairs in onychophorans is related to the length of the individual; however, this variability is low in many species (Monge-Najera, 1994). Therefore, it could be useful for distinguishing certain species if length-related correlations are accounted for (Monge-Nájera 1994). The male reported for *O. weyrauchi* had a length (in 75% ethanol) of 35 mm (du Bois-Reymond Marcus 1952), which falls within the range of *O. tiputini* sp. nov. Thus, the number of leg pairs could be comparable, with *O. weyrauchi* having more leg pairs (40) than *O. tiputini* sp. nov. (34–37). Moreover, the female of *O. weyrauchi*, which was 10 mm longer than the male, had fewer leg pairs (38) than the male, while females of *O. tiputini* sp. nov. have a higher number of leg pairs than males.

Table 1. Described species of *Oroperipatus* (Onychophora, Peripatidae) currently known from mainland Ecuador.

Species	Author	Known distribution	Sources
Oroperipatus quitensis	Schmarda, 1871	Described from the unspecific locality "Aequatorial-Hochland" (= Equatorial highlands), subsequently reported from the valley of Quito, northern Andean highlands[1]	Schmarda (1871); Bouvier (1905); Correoso Rodríguez (2011)
Oroperipatus corradoi	Camerano, 1898	Surroundings of Quito, northern Andean highlands, but also reported from Guayaquil, Balzar and River Giron on the western Andean slopes of Ecuador, and from localities in Panama and Venezuela	Camerano (1898); Bouvier (1905); Clark (1914a, 1914b); Brues (1925); Clark and Zetek (1946); Ribera (1977)
Oroperipatus cameranoi	Bouvier, 1899	Sigsig and Cuenca, southern Andean highlands	Camerano (1897); Bouvier (1905)
Oroperipatus lankesteri	Bouvier, 1899	Paramba, northern Pacific lowlands[2]	Bouvier (1899, 1905)
Oroperipatus ecuadoriensis	Bouvier, 1902	Bulim (nowadays Pulún), northern Pacific lowlands[3]	Bouvier (1902, 1905)
Oroperipatus belli	Bouvier, 1904	Durán, southern Pacific lowlands	Bouvier (1904, 1905)
Oroperipatus tiputini sp. nov.	Montalvo-Salazar & Cisneros-Heredia, 2023	Tiputini Biodiversity Station, northern Amazonian lowlands	This paper

[1] We consider the record of *O. quitensis* from the northern Amazonian lowlands of Ecuador presented by Read (1988) to be in error and correspond to a different, unidentified species.
[2] See Reyes-Puig et al. (2020) for details about the location of Paramba.
[3] See Paynter (1993) for details about the location of Bulim or Pulún.

The rhomboid pattern on the dorsum of *O. tiputini* sp. nov. has been reported in *O. weyrauchii* (du Bois-Reymond, 1952). Field observations suggest this dorsal pattern with some colour variations could be widespread in described and undescribed species from the Ecuadorian and Peruvian Amazonia. The colouration ontogenic changes evidenced in *O. tiputini* sp. nov. are apparently responsible for the significant colour variation observed in the new species. It would be the first case of drastic colour ontogenic changes reported in Onychophora. It has been reported that there are variable intraspecific colourations within the same brood in some species of Peripatopsidae (Ruhberg & Daniels, 2013), and three stages of pigmentation in juveniles of the *Peripatoides novaezealandiae* complex have been distinguished, getting more pigmented and lustred between 25 and >50 days after birth (Pripnow and Rhuberg 2003). Ontogenetic colour changes have been reported in several species of terrestrial arthropods and are related mainly to anti-depredation mimicry and aposematism (Booth 1990).

Oroperipatus tiputini sp. nov. presents four scale ranks in the apical pieces of the primary papillae. The number of scale ranks in the apical pieces varies interspecifically from four to five in *Oroperipatus*, a characteristic that helps differentiate it from most *Epiperipatus* (except for *E. adenocryptus*; Oliveira et al 2011) and *Macroperipatus*, which has three or fewer scale ranks (Read 1988; Chagas-Júnior and Costa 2014). Read (1988) reported that *Oroperipatus* was divided into two groups based on the shape of the primary papillae.*Oroperipatus tiputini* sp. nov. is more closely related to what Read (1988) identified as *Oroperipatus quitensis*, although it probably belongs to an undescribed species given its conical-shaped apical piece and Amazonian locality. In contrast, *O. corradoi* and *O. eisenii* present spherical apical pieces. The number of scale ranks in the basal piece of the dermal papilla shows intraspecific variation and lacks taxonomic relevance. Currently, no additional SEM characters can be used to compare *O. tiputini* sp. nov. with other species of Andean peripatids. It is necessary to explore the morphological diversity of *Oroperipatus* due to its usefulness in onychophoran taxonomy (Oliveira et al. 2012; Barquero González et al. 2020).

The arrangement of antennal sensilla in *O. tiputini* sp. nov. does not differ from that in other species of Neotropical peripatids. The spindle-shaped papilla presents two scale ranks, as seen in other known peripatid species (Oliveira et al. 2012). The shape of the gonopore opening resembles that of other Andean species, such as *O. quitensis* and *O. eisenii* (Bouvier 1905; Contreras-Félix et al. 2018), and does not vary between sexes, as is the case in *Eoperipatus* and *Principapillatus* (Oliveira et al. 2012, 2013).

There are some morphological similarities between *Oroperipatus tiputini* sp. nov. and *Mongeperipatus* in characters otherwise considered restricted to *Mongeperipatus*, including the absence of hyaline organs, the presence of four scale ranks in the apical piece (although it varies from four to seven in *Mongeperipatus*), and the alternation between the largest and mid-sized primary papillae in the dorsal plicae. Also, *Oroperipatus tiputini* sp. nov. shares with *Mongeperipatus keköldi* the absence of antennal chemoreceptors and the presence of accessory papillae with lateral apical rudimentary pieces. Currently, it is unknown whether these characteristics are present in other species of *Oroperipatus*, due to the poor SEM exploration of Andean peripatids. These morphological similarities are likely the result of convergence, as phylogenetic analyses have placed *Mongeperipatus* in the Caribbean peripatid clade (Barquero González et al. 2020).

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