



A new genus and species of Ingolffiellidae (Crustacea, Ingolffiellida) from the hyporheic zone in the Sierra de la Ventana, and its biogeographic relevance

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Abstract

With the purpose of collecting macroinvertebrates for benthic studies of hill streams of the Argentinean Pampean ecoregion, a sampling program was performed in different seasons during 2015. The ingolffiellid crustaceans described in this paper were found only in May 2015 in a sector of the rithron of the Ventana Stream located below the point of the upwelling of hyporheic water, 50 m upstream where the stream is covered by larger conglomerates. The specimens (5 females and 4 males) were measured and photographed, and some were dissected and mounted in Euparal. Appendages of head, pereion and pleon were illustrated. The analysis of the examined material allowed us to conclude that it constitutes a new taxon, *Yacana ventania* n. gen. n. sp., enlarging the distribution of the family Ingolffiellidae in South America. Characteristics: body long and thin; without eyes; short antennae; inner seta of the outer lobe of maxilla 1 is bi-dentate, vestigial molar process and serrations on one side, three spine row elements decreasing in size and the last one toothed; labium present; gnathopod 1 and 2 with a notch on the inner side of the carpus, the carpus of gnathopod 1 has three spines, the proximal one is on the top of a finger-shaped process, while the carpus of gnathopod 2 presents just two spines, propodus in both gnathopods with finger-shaped process at its distal end, a tiny spine and a seta; pereopods dissimilar, with seta and terminal claw; pereopod 7 differs from the others in size, number and arrangement of its setae. Uropod 2 longer than uropod 1, uropod 3 small and uniramous; sexual dimorphism clearly present in pleopods and uropod 2 because the females present more rows of setae than males, and probably in the setation of pereopod 7. Sizes of specimens varied between 3–8.8 mm. The cladistic analysis (TNT) demonstrates that *Yacana ventania* n. gen. n. sp. is closely related to South African genera because of the vestigial mandibular palp, also the new taxon here described shared the sexual dimorphism with *Stygobarnardia* and *Trogloleleupia*, its discovery gaining relevance on biogeographical aspects and providing new evidence to the theory of continental drift. Type specimens are deposited in the Carcinology Collection of the División Zoología Invertebrados, Museo de La Plata, Argentina.

Key words: *Yacana ventania*, South America, interstitial habitat, hill streams, Pampa ecoregion.

Introduction

Hansen (1903) described the family Ingolffiellidae from specimens collected in deep sea waters of the North Atlantic Ocean. The order Ingolffiellida is presently known by 45 species (Vonk & Jaume 2013) included in two families, Metaingolffiellidae (Ruffo 1969) and Ingolffiellidae (Vonk & Schram 2003; Shimomura *et al.* 2006), distributed worldwide, with underground habits and wide habitat tolerances, of which the most important are: sea water at different depths (Hansen 1903; Shimomura *et al.* 2006), brackish water (Stock 1976; Peralta & Grosso 2009) and interstitial marine water (Vonk & Schram 2003), freshwater (Karaman 1959), mountain streams (Noodt 1965) and continental underground waters (Ruffo 1985). Four species of ingolffiellids have been reported so far from South America, all in the genus *Ingolffiella* Hansen, 1903. Two of them are from interstitial freshwaters, *I. uspallatae* Noodt, 1965 and *I. manni* Noodt, 1961 in high altitude streams, at 2000 meters above sea level (m.a.s.l.) and 800 m.a.s.l., respectively. The others are from brackish waters, *I. ruffoi* Siewing, 1958 and marine waters, *I. rocaensis* Senna & Serejo, 2005 (Peralta & Grosso, *op. cit.*). This group of amphipods is characterized by a quite

uniform morphology, showing an elongate and slender body, sizes shorter than 23 mm of total length (Ruffo 1964; Stock 1976), no eyes and reduced coxal plates. The antennae 1 have an accessory flagellum; mandible with molar process; gnathopods with broad carpus; a progressive reduction of the pleon appendages as it is observed in the short pleopods of the derived forms, also a shortening of the third pair of uropods and telson. In the primitive genera (*Stygobarnardia* Ruffo, 1985 and *Trogloleleupia* (Ruffo, 1974)) a sexual dimorphism in the pleopods shape can be observed (Ruffo 1964, 1985; Peralta & Grosso *op. cit.*).

This paper describes a new genus and a new species of the family Ingolfiellidae collected in the Ventana Stream, a waterbody of intermittent characteristics with a hyporheic habitat in the Sierra de la Ventana, Argentina. In this study, its cladistic relationships with other genera of this family with Gondwanan distribution is proposed.

Materials and methods

Study Area. The Ventania System is located between 37°38'S 62°24'W–37°51'S 61°38'W–38°06'S 62°30'W–38°20'S 61°51'W (Fig. 1). It is the most important rock exposure within the South American plate from an extensive paleozoic basin, developed in the margin of Gondwana. Together with other nowadays exposed sectors in South Africa, Australia and Antarctica, it was distorted in the Permo-Triassic to form the Gondwanides. The precambrian rocks that constitute the crystalline basement of these hills are 2200 million years old, the most ancient in the World. The Ventania System is formed by subparallel mountain ranges, 180 km long in a NW to SE direction, and 50 km wide in its central part (Sellés-Martínez 2001; Campo *et al.* 2012). Their maximum altitude being 1239 m.a.s.l. although they rise between 400 and 700 m from the surrounding plain (Campo *et al. op. cit.*). The two geomorphological units show sharp slopes in the watershed area. The headwaters of most of the tributaries, which run in short and deep canyons can be observed in this area (Gaspari *et al.* 2011).

With respect to the hydrography, these hills are the origin of several water courses which form endorheic and exorheic basins. All feed exclusively on rainfall water, whereby their water flow is conditioned either by the drought or the excess of water period (Campo *et al.* 2012). Within these basins, the Ventana Stream feeds on tributaries from the surrounding mountains located in a natural protected area with a bioma conformed by native grasslands. The stream shows rithronic sectors with different sizes of clasts along its course (from coarse sand to gravels and cobbles bigger than 20 cm) (Fig. 1B). It particularly presents an intermittence in the rain dependent waterflow (of irregular distribution within the year) causing some sectors of the flow to be only hyporheic and superficial and hyporheic in others. This fact causes the flow to reach levels high enough to produce a constant flow of water during the rainfall period and only hyporheic draining during the periods of low rainfall. Lateral drainage and the small ponds from secondary basins also contribute to keep the water level of the stream.

Sampling. With the purpose of collecting benthic macroinvertebrates from hill streams of the Pampean ecoregion, two sampling programs were carried out in contrasting climatic seasons during 2015. Areas of 30 × 30 cm were selected, from where rocks were removed manually (Fig. 1C); these rocks were placed in a tray with water and they were gently brushed in order to remove the attached organisms (Domínguez & Fernández 2009; Elosegi & Sabater 2009). Collected material was placed in plastic containers and fixed in the field with 5% formaldehyde. Physicochemical parameters were measured using a multiparameter digital sensor Horiba and Mini-Water 20 for the flow speed. The organisms described in this paper were found only in May 2015 in a sector of the rithron of the Ventana stream located posterior to the upwelling of hyporheic water, 50 m upstream where the stream is covered by larger conglomerates.

Samples were washed in the laboratory using a 500 µm sieve, stained with erithrosin and preserved in 70% alcohol. Specimens were separated manually under stereoscopic microscope Olympus SZX16 and measured from the tip of the head to the base of the telson. They were also photographed with a camera Olympus E 330. Four specimens (1 female and 3 males) were dissected, and appendages, pereion and pleon were mounted definitely with Euparal. Illustrations were done under optic binocular microscopes Olympus CH-2 and Zeiss Standard 25 with attached camera lucida. The remaining specimens were fixed undissected in 80% alcohol. The terminology for setae and spines follows Watling (1989), naming all processes articulating with the cuticle as seta (both slender and robust), and the non-articulating structures as spine.

Cladistic analysis. In order to corroborate the entity of this new genus a previous phylogenetic analysis of the clade Ingolfiellidea was performed (Vonk & Schram 2003). For this analysis the matrix of 43 morphological

characters (30 multistate and 13 binary) of the mentioned authors was used, adding herein two new character states to the following characters: the state bi-dentate to the internal seta of the external lobe of the maxilla I, and the state moderately transverse to the palm of the gnathopod 2. Thus, the matrix is composed by 43 characters, 31 multistate and 12 binary.

Coincidentally with Vonk & Schram (*op. cit.*) *Mictocaris* Bowman & Iliffe, 1985, *Bogidiella* Hertzog, 1933 and two species of *Pseudingolfiella* Noodt, 1965 were considered as out-groups. TNT (Tree analysis using New Technology) was employed to do the phylogenetic analysis under parsimony (Goloboff *et al.* 2000). An heuristic search with unordered and unweighted characters resulted in 10 trees with a tree length of 276 steps. From the 10 resulting trees, the one which resolved the relationships between this new taxon and the ones exposed in the mentioned work was chosen, highlighting that all trees linked *Yacana* **n. gen.** with the African taxa. From these obtained trees we only considered the relationship between the taxon herein described with the other Ingolfiellidea genera and the external group, without delving in the interspecific relationships within the clade *Ingolfiella* because it was not the objective of this study.

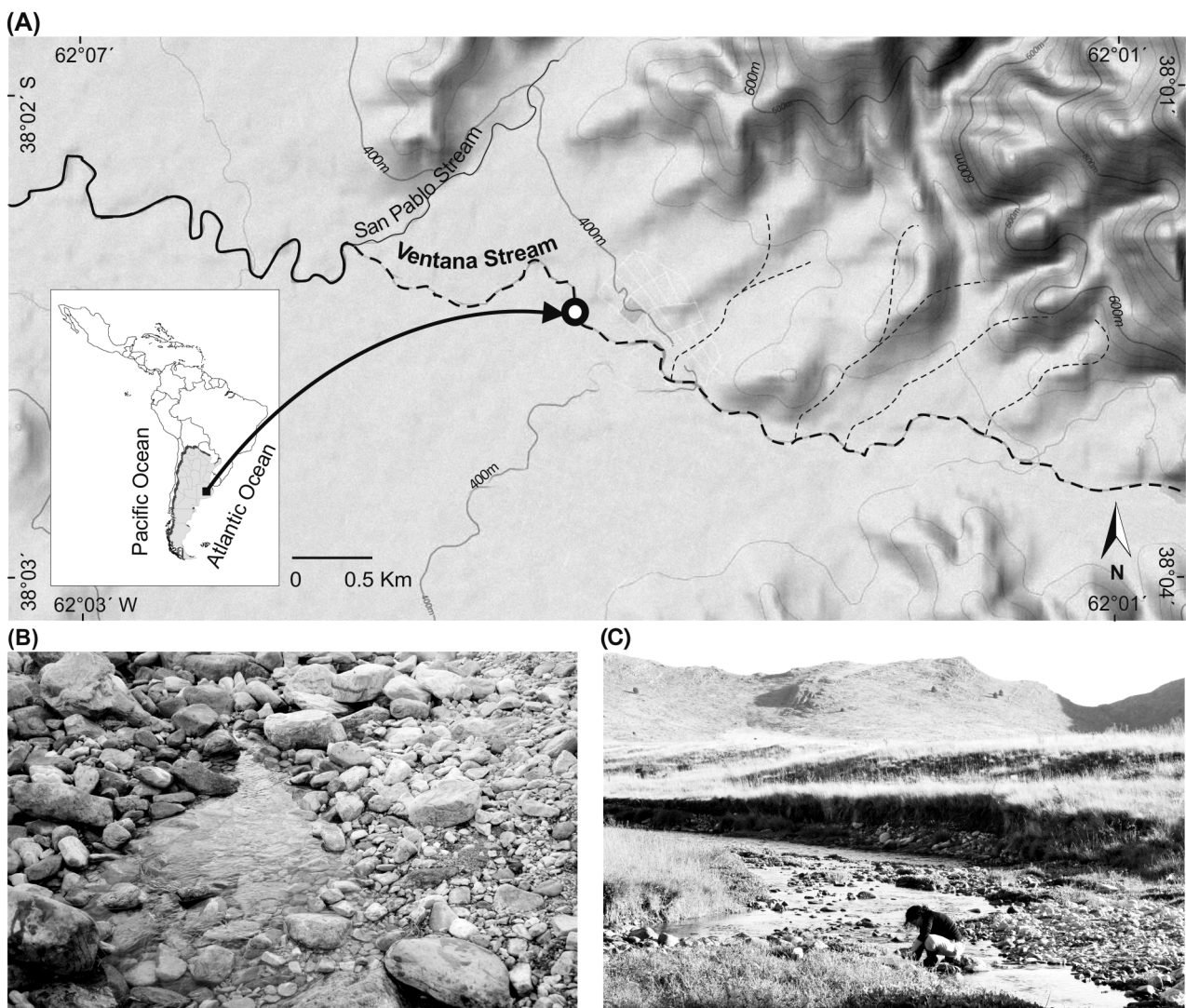


FIGURE 1. **A.** Map of a section of Ventana Stream showing the sampling site where *Yacana ventania* **n. gen. n. sp.** was collected. **B.** Rithronic sector of Ventana Stream showing the different size of clasts where the hyporheic water emerges. **C.** Sampling of the material.

Results

Systematics

Order: Ingolfiellida Hansen, 1903 (Lowry & Myers, 2017)

Suborder: Ingolfiellidea Hansen, 1903 (Ruffo, 1970)

Superfamily: Ingolfielloidea Hansen, 1903 (Lowry & Myers, 2017)

Family: INGOLFIELLIDAE Hansen, 1903

***Yacana* n. gen.**

Diagnosis. Labium present with one pointed end; carpus of gnathopod 1 and 2 with notch in the inner side, the carpus of gnathopod 1 has three spines, the proximal one is on the top of a finger-shaped process in the inner side; propodus in both gnathopods with finger-shaped process at its distal end, with a tiny spine and a seta; the carpus of gnathopod 2 bears just two spines; pereiopods 3–7 dissimilar; uropod 2 larger than uropod 1; lack of lenticular organs; sexual dimorphism in the shape of pleopods and in the setation of uropods 1 and 2.

Etymology. The generic name refers to a native population inhabiting these hills called «yacana-cunnees». This name is also linked to the Andean mythology and evokes the relationship between the «llamas», the «alpacas» and the water, attributing the creation of springs and lakes to these South American camelids.

Remarks. The presence of a labium, which has pointed ends that correspond to what Ruffo (1985) described in *Stygobarnardia* as an output glandular duct is also highlighted. Griffiths (1991) described in *Proleleupia* a labium with a single small sharp tooth, which would correspond to the pointed ends we observed in *Yacana* n. gen. In this new genera can be observed a glandular drainage to the pointed ends (Fig. 2F). Both gnathopods have at the distal ends of the finger shaped propodus a large seta and a tiny spine on them. *Yacana* n. gen. has notches or pockets in its gnathopods, while *Proleleupia* exhibit a pocket only in the first pair and *Trogloleleupia* a “depression selliforme” in the second one; furthermore, in *Yacana* n. gen. the pocket of gnathopod 1 is associated with a spine (Ruffo 1985; Griffiths 1991). Carpus with a pocket or notch had been described in a few species of *Ingolfiella*, like *I. moluccensis* Vonk & Jaume, 2013 and *I. arganoi* Ianilli & Vonk, 2013. Pereiopods are dissimilar, all of them with setae and a terminal claw; pereiopods 7 differ from the others in size, number and arrangement of their setae. This taxon has sexual dimorphism clearly denoted in the pleopods and at the amount of rows of setae in uropod 2, because in females was observed a quite larger number of rows than males. It is still to be found, in further studies, if this difference in setation would be due to the number of ecdysis involved.

***Yacana ventania* n. sp.**

(Figs 2–8)

Material examined. Holotype (MLP-Cr 27050): 1 ♀, 8.8 mm, whole specimen stored in ethanol, collected at Ventana Stream, Sierra de la Ventana, Argentina, 38°3'17.74"S 62°4'49.76"W, 28 May 2015. Allotype (MLP-Cr 27051): 1 ♂, 6.4 mm, dissected and mounted on glass slides. Paratype (MLP-Cr 27052): 6 specimens, 3 ♀ and 3 ♂, range length 3–3.78 mm; three of them were completely dissected and mounted on glass slides, from one specimen only its head was dissected, and the other four are stored in ethanol. Other female specimen is stored at the Instituto de Limnología “Dr. Raúl A. Ringuelet” CONICET-UNLP.

Locality and collection date of allotype and paratype are the same as for holotype.

Diagnosis. Flagellum of first antenna with 4 articles and; accessory flagellum with 3 articles; antenna 2 with gland cone. Labrum present. The inner setae of outer lobe of maxilla1 are bi-dentate. Pereiopods are progressively longer towards pereiopod 7; dactyli dissimilar: 3 and 4 with a bifid claw, 5–7 with simple claw. Pereiopod 7 with abundant setae on merus and carpus.

Description. Female. Body elongated and laterally compressed with small setae on each body somite, without coloration (Fig. 2A). Head without rostrum, neither eyes nor ocular lobes. Large uropods, the second pair extending beyond the telson. Total body length (without antennae) 8.8 mm.

Antenna 1 (Fig. 2B, C): peduncular article 1 is as long as article 2 and 3 combined and progressively shorter towards distal, length ratio as 1:0.57:0.42, all of them with setae. Flagellum consisting of 4 articles, articles 1–3

with 1–3 setae on each, and the last article has 6 setae and a spatulate structure of unknown function; the last 3 articles bear one aesthetasc on each of them. The accessory flagellum is 3-articulated and exceeds the second article of the flagellum, at most with 4 setae per article. The distal portion ends in 2 filiform structures and in the middle, a structure of unknown function as in the last article of the flagellum.

Antenna 2 (Fig. 2D): slightly shorter than antenna 1. The peduncle is 4-articulated and three times as long as the flagellum; the first article with a gland cone, the others with 2, 6 and 10 setae, respectively. The flagellum consists of 5 articles, articles 1 and 3 with 3 setae while articles 2, 4 and 5 with 4 apical setae, the last article also has a terminal structure of unknown function as in the antenna 1.

Labrum (Fig. 2E): subquadrangular and as big as the following mouth pieces, gently depressed on the center of the outer side.

Labium (Fig. 2F): without inner lobe, the outer lobes small and separated, on the distal part with a pointed end. As it is mentioned on remarks of the genera, a gland drains to the pointed ends.

Female mandibles (Fig. 3A, B): with molar process non-tritulative, reduced, spiniform and serrated on one of its sides. Right mandible: with 5-denticulate incisor, lacinia mobilis with 2 longer teeth on both ends and a flattened blade in between; spine row consisting of two short strong bladelike denticulate spines and one plumose on one of its side. Left mandible: incisor subrectangular, 4-denticulate; lacinia mobilis subrectangular, broader than incisor and cutting edge irregularly multi-denticulate; apparently without spine row.

Male mandibles (Fig. 3C, D): right mandible: with 3-denticulate incisor, lacinia mobilis with 2 longer teeth on both ends and a flattened blade in between; spine row with two short strong bladelike smooth spines and one plumose on one of its side. Left mandible: incisor subrectangular, cutting edge irregularly multi-denticulate; lacinia mobilis with one long tooth; the spine row is as in the right mandible but denticulate.

Maxilla 1 (Fig. 3E–G): the coxal endite (= inner lobe) has 4 setae; the basal endite (= outer lobe) has 6 setae of different type: bifid or trifid, pectinated, simple, dentate and bi-dentate; the endopod (=palp) is bi-articulated and has 3 large apical setae. Particularly, the outer setae of the outer lobe is bifid or trifid, followed by a pectinated, simple and pectinated setae; the fifth seta has five or six teeth in the left maxilla 1 and three teeth in the right one; and finally the inner seta is bi-dentate. This last type of seta in maxilla 1 is a new character, not mentioned before in ingolfiellids. Maxilla 2 (Fig. 3H): the inner lobe with 3 to 5 setae; outer lobe with 3 to 5 setae distally.

Maxilliped (Fig. 3I, J): basal endite small and narrow, finger-like, with an apical single curved spine and a lateral seta; palp consisting of 6 articles; ischium with two simple setae on inner margin; merus, carpus, and propodus each with single simple seta; and finally, dactylus with two setae, and long unguis.

Gnathopod 1 (Fig. 4A, B): has a wide basis with disto-ventral seta; short merus with a seta and ischium with 2 distal setae, one twice longer than the other. Carpo-subchelate consisting of an elongated article with 3 spines, the proximal one is on the top of a finger-shaped process in the inner side; palm margin smooth, not serrated, armed by a row of 6 or 7 submarginal setae and others dispersed on the palm, on the inner side there is a notch like a “pocket” apparently to accommodate distal portion of unguis. Propodus and dactylus form the claw; propodus is distally produced into a finger-shaped process carrying a seta and a minute and broad spine. The dactylus has 3 blade-like teeth.

Gnathopod 2 (Fig. 4C, D): The basis slightly elongate with a disto-ventral seta; short merus with a seta and ischium with 2 distal setae and one medial tiny seta. Carpo-subchelate, stout and subtrapezoidal, palm angle defined by one large seta and with a quite robust, elongated tooth-like spine, palm with a median smaller spine, 6 or 7 setae and a notch on the inner side apparently to accommodate distal portion of unguis. Palm margin smooth. Propodus with a distal outer seta, and a finger-like form at its distal end with a seta and a tiny spine. Finally, the dactylus has 3 blade-like teeth and a seta at the base of the unguis. Dactylus stronger than in gnathopod 1.

Pereiopods 3–7 are dissimilar (Figs. 5, 6): 3 and 4 their dactyli point backward while 5–7 are forward pointed, pereiopods 3–5 with gills and pereiopods 6 and 7 without them, none of them have oostegites.

Pereiopods 3 and 4 (Fig. 5A–D): coxa with 1–2 setae, basis elongated armed with 4–6 setae; short merus with a distal seta; ischium with 3 setae; carpus with a seta and a spine; propodus with 3 setae aligned and the distal end has 2 spines one of them bifid and, a seta; finally, the dactylus as a bifid claw. The suture between dactylus and unguis is inconspicuous in pereiopod 3 but not visible in pereiopod 4.

Pereiopod 5 (Fig. 5E, F): coxa with a seta; basis with 4 setae; merus with a seta; ischium with 1–3 setae and a spine; carpus has distally 6 setae and 3 spines; propodus bears 2 setae aligned, 3 terminal spines and a seta; dactylus like a claw, the suture between dactylus and unguis does not distinguish.

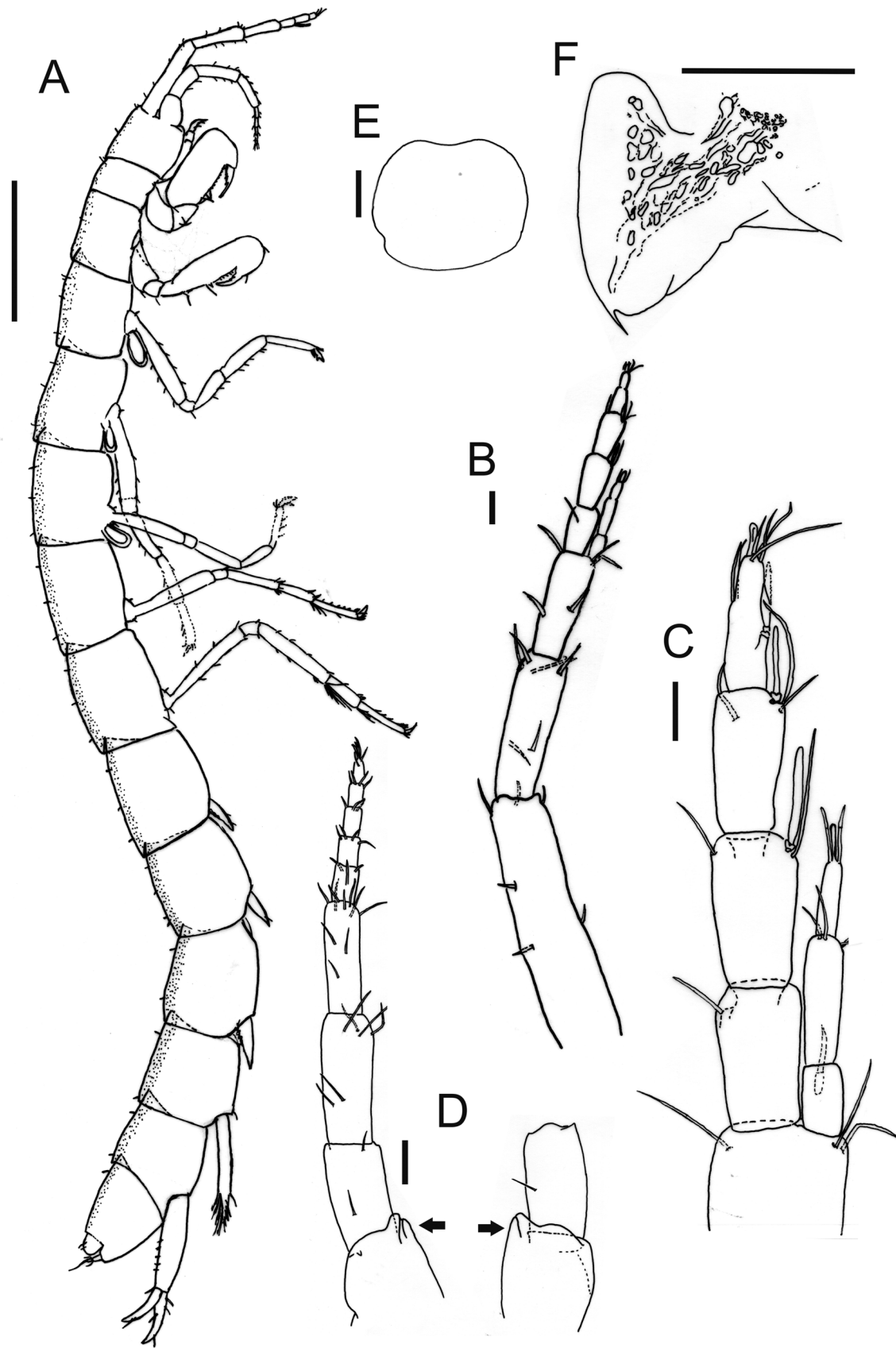


FIGURE 2. **A.** *Yacana ventania* n. gen. n. sp., holotype female. Scale bar: 1 mm. **B.** Antenna 1, paratype female. Scale bar: 100 μ m. **C.** Detail of antenna 1. Scale bar: 100 μ m. **D.** Left antenna 2 and basis-merus of right antenna 2, the arrows show the gland cones, paratype female. Scale bar: 50 μ m. **E.** Labrum, paratype female. Scale bar: 100 μ m. **F.** Labium, paratype female. Scale bar: 50 μ m.

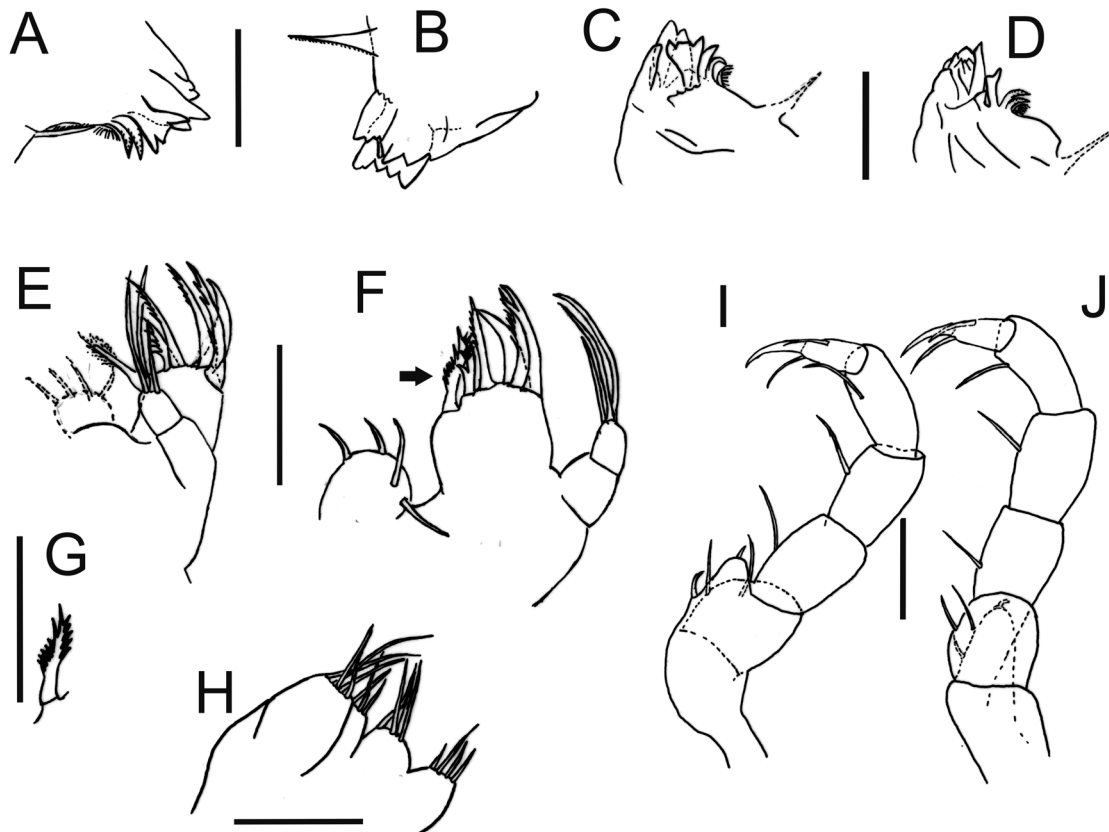


FIGURE 3. *Yacana ventania* n. gen. n. sp. **A.** Right mandible, paratype female. **B.** Left mandible, paratype female. **C.** Right mandible, paratype male. **D.** Left mandible, paratype male. **E.** Right maxilla 1, paratype female. **F.** Left maxilla 1, paratype female. **G.** Detail of inner seta of outer lobe of maxilla 1, indicated with an arrow on left maxilla 1. **H.** Right and left maxilla 2, respectively. **I.** Right maxilliped, paratype female. **J.** Left maxilliped, paratype female. Scale bars: 50 μ m.

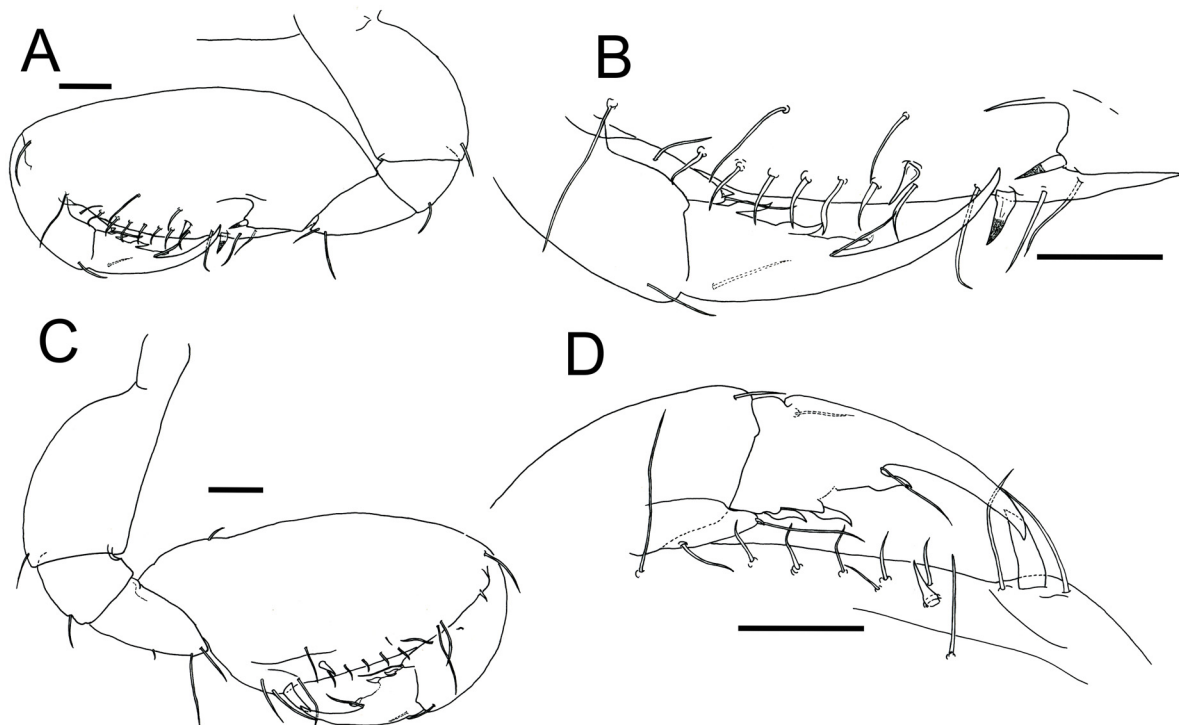


FIGURE 4. *Yacana ventania* n. gen. n. sp. **A.** Right gnathopod 1, lateral, paratype male. **B.** Right gnathopod 1, detail of palm and dactylus, paratype male. **C.** Left gnathopod 2, lateral, paratype male. **D.** Left gnathopod 2, detail of palm and dactylus, paratype male. Scale bars: 50 μ m.

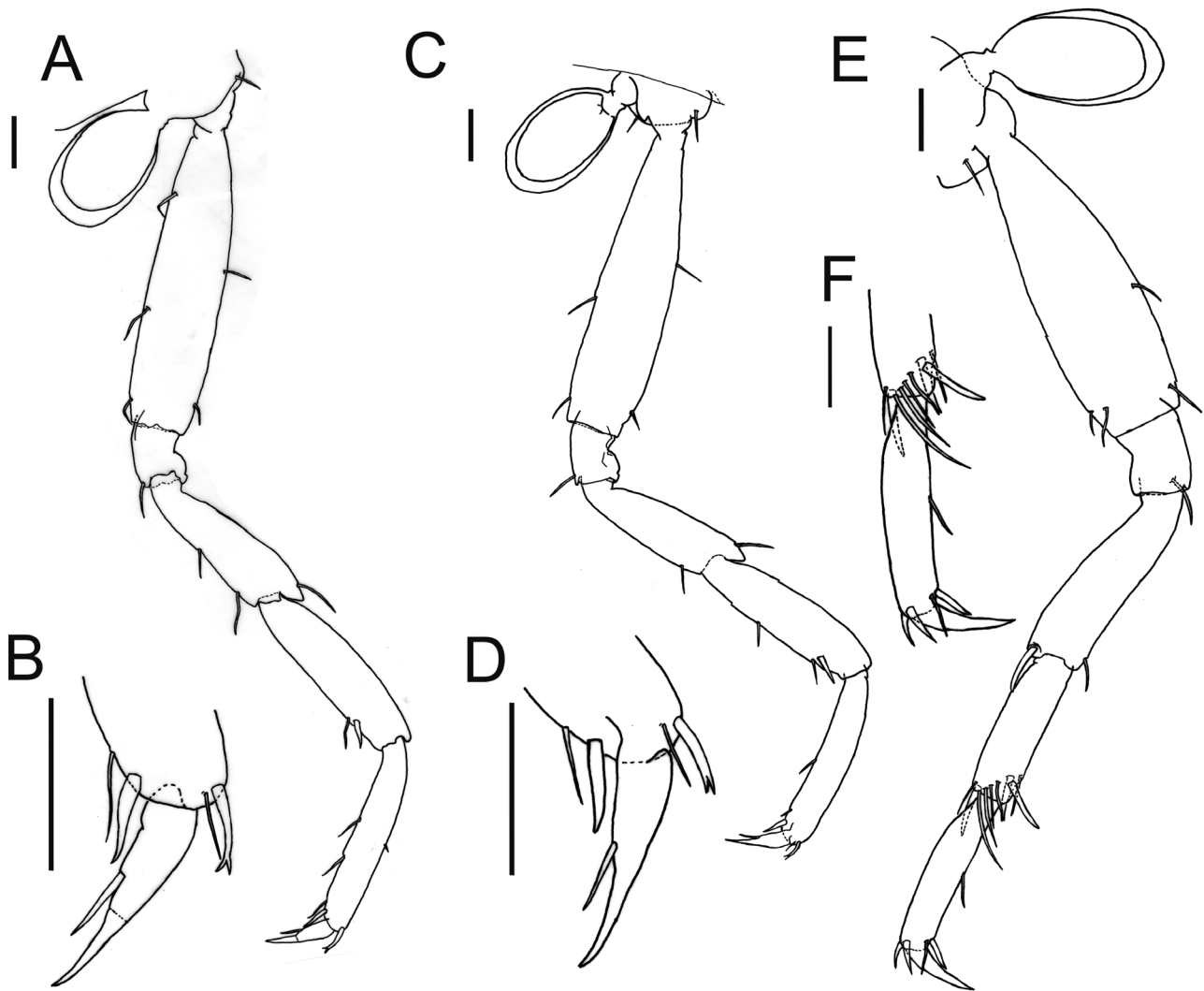


FIGURE 5. *Yacana ventania* n. gen. n. sp. **A.** Left pereopod 3, paratype female. **B.** Detail of claw of pereopod 3, paratype female. **C.** Right pereopod 4, paratype male. **D.** Detail of claw of pereopod 4, paratype male. **E.** Left pereopod 5, paratype female. **F.** Detail of claw of pereopod 5, paratype female. Scale bars: Scale bars: 50 μ m.

Pereopod 6 (Fig. 6A–C): coxa with 2 setae; basis with 4 setae; merus with a seta; ischium with a seta and a spine; carpus has at its end 4 setae and 3 spines; propodus bears 2 terminal setae and 2 spines, one of them bifid; dactylus like a claw and the suture of the unguis visible.

Female pereopod 7 (Fig. 6D–F): is the longest appendix from the pereion; coxa with 2 setae, basis with a seta, merus short and with a seta; ischium with 5 setae and a spine, 3 of which are as long as the carpus and one bifid; carpus has on the distal part 6 setae and a spine, one of the seta is pectinated (Fig. 6D, E, arrowed); propodus with 4 setae and a spine, 3 of them distally; dactylus with claw and unguis.

Male pereopod 7 (Fig. 6G–I): as in the female is the longest appendix from the pereion; coxa with a seta, basis with 4 setae, merus short and without any seta; ischium with 5 medial setae and at its end, a spine surrounded by many setae: 3 of them are as long as the carpus, the other 3 smaller; carpus has a proximal small seta, on the distal part has 2 setae, a spine, and also 9 setae in a transversal row, the outer one is pectinated (Fig. 6G, H, arrowed); propodus with 4 setae, 3 of them distally; dactylus with claw and unguis. It is remarkable that this pereopod is more setose in males than females.

Pleopods (Fig. 7A–F): uniramous and armed with 1–2 distal setae; on females (Fig. 7A–C) the pleopods are almost triangular, the second pleopod is the widest and with feeble serrations on the inner side. Pleopods 1 and 3 has a small seta on the lateral surface near the apex. On males (Fig. 7D–F), the first pleopod is like a long fin having 2–3 setae, from them 1 or 2 are long and on the apex.

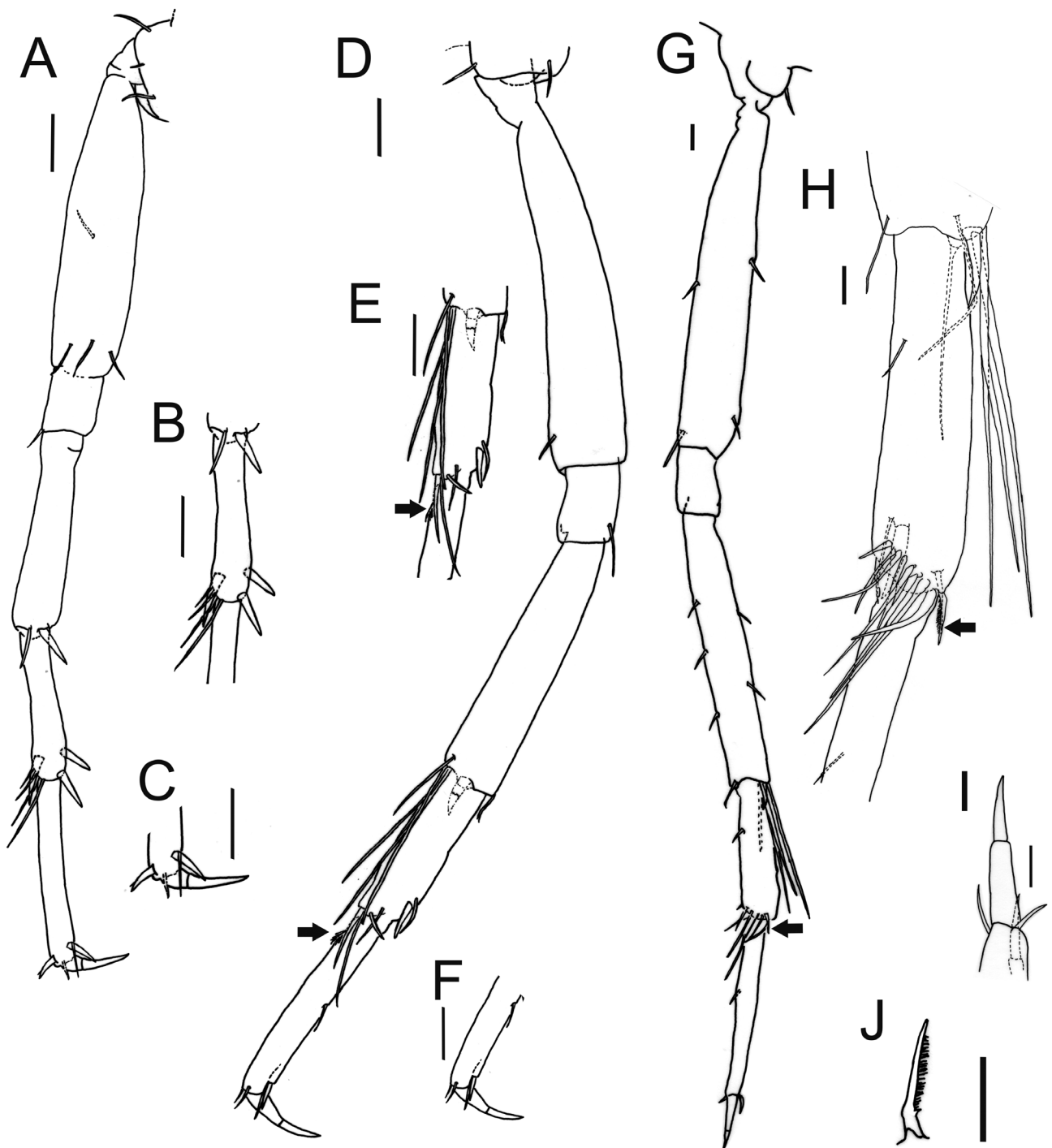


FIGURE 6. *Yacana ventania* n. gen. n. sp. **A.** Left pereopod 6, paratype female. **B.** Detail of merus and carpus of left pereopod 6, paratype female. **C.** Detail of claw of pereopod 6, paratype female. **D.** Left pereopod 7, paratype female. **E.** Setation and spines of merus and carpus of female's pereopod 7. **F.** Claw of female's pereopod 7. Scale bars: Scale bars: 50 μ m. **G.** Left pereopod 7, allotype male. **H.** Detail of the arrangement of the setae of male pereopod 7. **I.** Claw of male's pereopod 7. **J.** Sensory feature of seta, indicated with an arrow on pereopods 7 of the female and male specimens. Scale bars: 100 μ m.

Uropod 1 (Fig. 7G, I): with a large peduncle; the external ramus is unarmed, five times shorter than the peduncle and pointed end; the internal ramus is half long than the peduncle, the distal end of the ramus is provided with 2 sharp, tooth-like projections and a medial lanceolate structure. In females the peduncle has a row of 3 setae on anterolateral margin and a seta on the opposite side, while in males it has a row of 7 setae on anterolateral margin and 2 lonely setae on the other side.

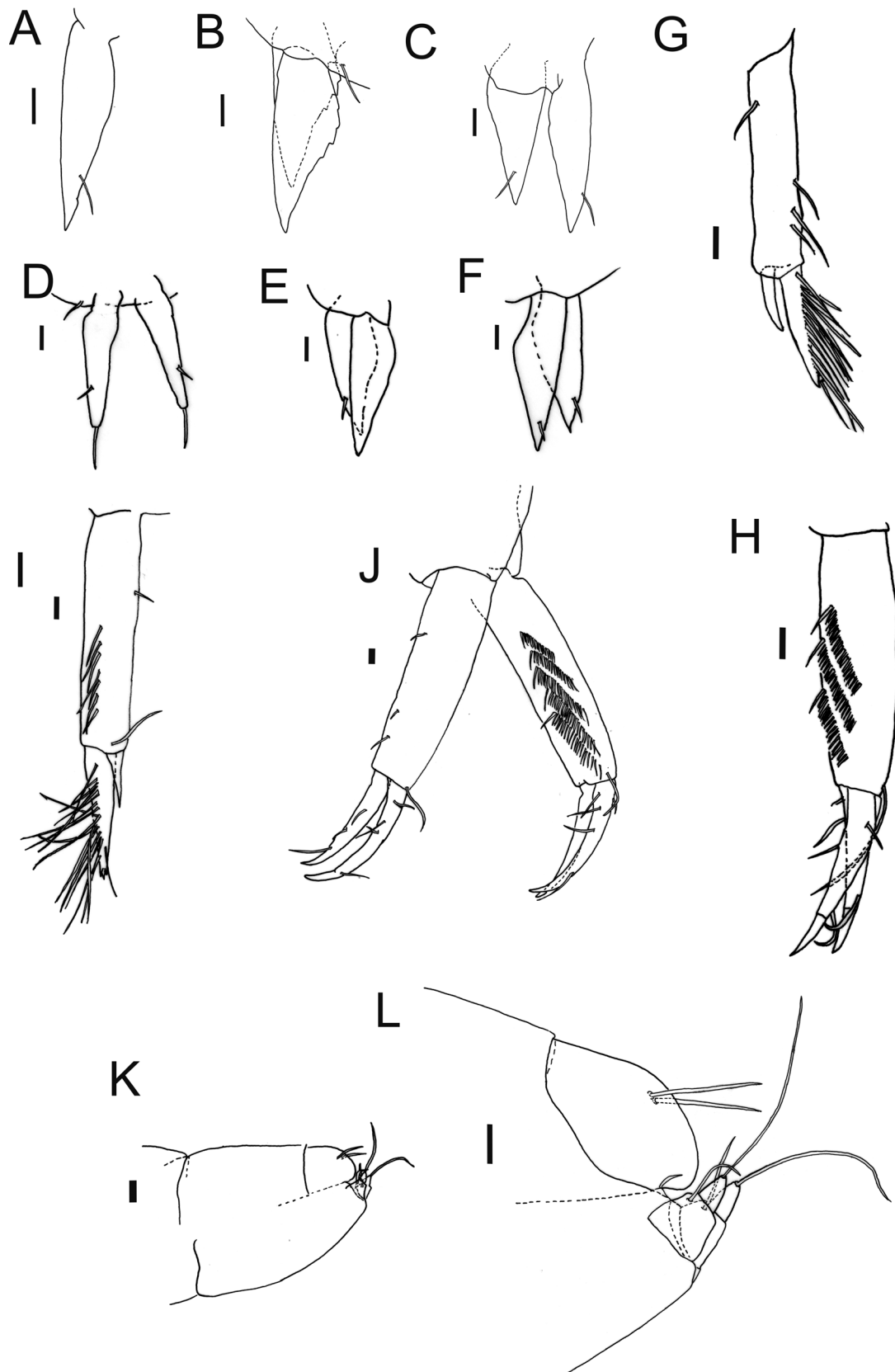


FIGURE 7. *Yacana ventania* n. gen. n. sp. **A.** Pleopod 1, paratype female. **B.** Pleopod 2, paratype female. **C.** Pleopod 3, paratype female. **D.** Pleopod 1, allotype male. **E.** Pleopod 2, allotype male. **F.** Pleopod 3, allotype male. **G.** Left uropod 1, paratype female. **H.** Right uropod 2, paratype female. **I.** Left uropod 1, allotype male. **J.** Uropods 2, detail of inner side, allotype male. **K.** Uropods 3 and telson, paratype female, lateral view. **L.** Detail of uropods and telson, paratype female, lateral view. Scale bars: 100 μ m.

Uropod 2 (Fig. 7H, J): is barely longer than uropod 1; the peduncle is more robust than uropod 1, on its inner surface bears oblique rows of setae with a longer seta at the upper end of each of these rows, on the outer surface has 3 small setae and a distal large one; rami of U2 subequal in length and width, each ramus with 3–4 setae. On holotype female the peduncle has 7 rows of setae but in other females it has fewer rows, on males it has 5 rows of setae.

Uropod 3 is rudimentary (Fig. 7K, L); the peduncle with a seta disto-dorsally; the ramus is short with a very long simple seta terminally.

The telson (Fig. 7K, L): is a fleshy lobe provided with a pair of quite long setae.

Remarks. The main features found in *Yacana ventania* **n. gen. n. sp.**, are: the presence of a terminal structure of unknown function at the end of the flagellum of both antennae and at the accessory flagellum of antenna 1. In some species, like *I. alba* and *I. arganoi*, the authors (Iannilli *et al.* 2008; Iannilli & Vonk 2013) describe this structure on the last article of the flagellum of antenna 2 as an aesthetasc. The new taxon here described has mandibles with molar processes vestigial and serrated on one side, spine rows with two bladelike and plumose spines. The outer lobe of the maxilla 1 has two distinctive setae: one bi-dentate on the inner side and other bifid or trifid on the outer side. The suture between dactylus and unguis of the pereopods is visible only in some of them, regardless if the specimens are females or males. The paratype females agree in almost all characters with the holotype, nevertheless the peduncle of uropod 2 has more rows of setae in the holotype than the paratypes; this could be due to the bigger size of the holotype in respect to the paratypes.

Etymology. The specific epithet refers to the geographical region and the type locality.

Distribution and biology. *Yacana ventania* **n. gen. n. sp.** was collected at Ventana Stream, Ventania Hills, Buenos Aires province, Argentina on 28th May 2015 in the rithron substrate. Female sizes varied between 3.55 and 8.8 mm; the smaller showed three rows of setae in the second pair of uropods, while the larger exhibited 7 rows of setae. With regard to males, their sizes varied between 3.0 and 6.4 mm; the smaller showed two rows of setae in the second pair of uropods, five rows in the larger specimen.

When the collection took place the physicochemical parameters registered were: temperature 14.40 °C, pH 8.97, flow speed 0.2 m s⁻¹, average depth 0.25 m, conductivity 0.164 mS cm⁻¹, dissolved oxygen 7.42 mg L⁻¹, nutrients: P-PO₄ 0.023 mg L⁻¹, N-NO₃ 0.833 mg L⁻¹, N-NO₂ 0.003 mg L⁻¹ y N-NH₄ <0.001 mg L⁻¹.

The main accompanying fauna were the flatworms Dugesidae, the oligochaetes Enchytraeidae and Naididae, the polychaetes Aeolosomatidae, the black flies Simuliidae, the caddisflies Hydropsychidae and Copepoda. Vegetation at the sampling site: *Ludwigia peploides*, *Rorippa nasturtium-aquaticum* and *Gymnocoronis spilanthoides*.

Examination of the gut content revealed that *Yacana ventania* **n. gen. n. sp.** might be detritivorous because particles from 5 µ to 12.5 µ were found in it. Although only nine specimens were collected, we suppose a sex ratio (♀/♂) of 1.25 in the population of the type locality.

Cladogram

When the cladistic analysis TNT was performed during this study, without considering the taxon *Yacana ventania* **n. gen. n. sp.** within the data matrix, we obtained the same cladogram that Vonk & Schram (2003) presented in their paper using the program PAUP 4.0 b10. When *Y. ventania* **n. gen. n. sp.** was incorporated in the data matrix of our analysis 10 trees were obtained, of which the one presented in Figure 8 was chosen that preserves the results obtained by Vonk & Schram (*op. cit.*). In the nine remaining trees the relationships between *Rapaleleupia gobabis* Vonk & Schram, 2007 (= *Paraleleupia gobabis* Vonk & Schram, 2003), *Trogloleleupia dracospiritus* Griffiths, 1989 and *Ingolfiella* spp. were modified, and only slightly in the outgroup topology. Anyway, all these trees were equally useful for our purpose, because all of them maintained the same relationship of *Yacana ventania* **n. gen. n. sp.** with *Metaingolfiella mirabilis* Ruffo, 1969, *Stygobarnardia caprellinoides* Ruffo, 1985, *Proleleupia nudicarpus* Vonk & Schram, 2003, *Trogloleleupia eggerti* (Ruffo, 1964) and *T. leleupi* Ruffo, 1951.

Yacana **n. gen.** splits from *Trogloleleupia* by the following characteristics: the lack of lenticular organs versus the presence, in an incipient or developed state, in the last genera; the finger-like form of the propodus of gnathopod 2 versus the unmodified or tooth-like form; the dactyli ends of pereopods 3–7 with spurs versus not produced; and finally, the telson short and fleshy in *Yacana* **n. gen.** and medium-fleshy or short-bifurcate in

“trogloleleupians” (Fig. 8, node indicated in the cladogram). However, three of the mentioned characteristics are shared with *Stygobarnardia*, such as the lack of lenticular organs, the dactyli ends of pereopods 3–7 and the form of the telson.

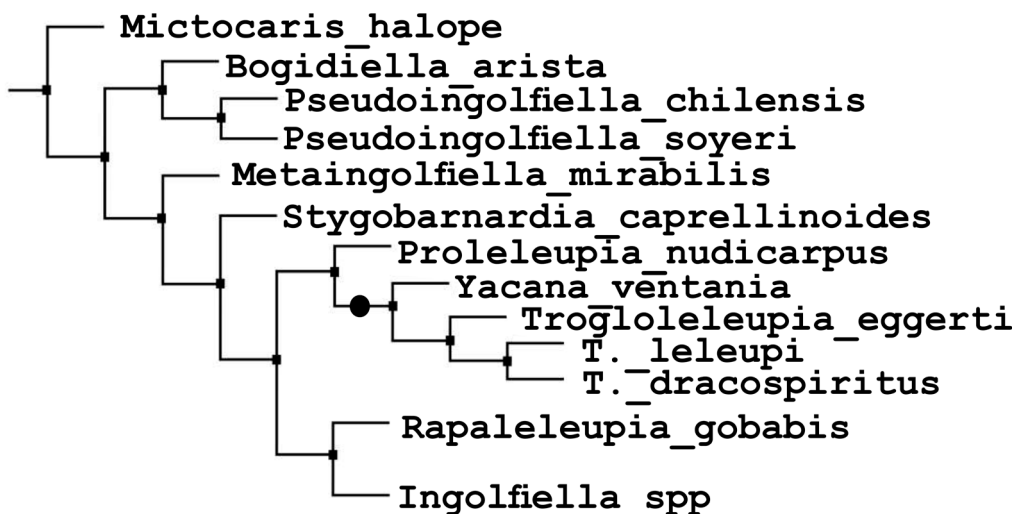


FIGURE 8. Tree number 8 (rooted by using user-specified out group): Tree length: 276. Consistency index (CI): 0.348, Retention index (RI): 0.547. Black dot indicates the node explained in the text.

Discussion

Although the results obtained in the cladistic analysis locate *Yacana ventania* **n. gen. n. sp.** closely linked to *Trogloleleupia*, we think that if more morphological aspects were analysed, the relationship could be closer to *Stygobarnardia* due to the following shared characteristics: the molar process serrated, the labium with pointed ends, and the presence of sexual dimorphism in pleopods. What would happen if these characters already mentioned were incorporated in a new matrix and analyzed?

Supposing the previously mentioned characteristics with respect to the molar process, it could be assumed that an evolutionary trend could have been the presence of a molar process, vestigial and serrated on both sides (as observed in *Stygobarnardia*), then serrated on only one side (as *Proleleupia* and *Yacana* **n. gen.** presents) and finally, smooth in the rest of the genera. Then, in the labium another trend could be observed in the progressive reduction of the three “pointed ends” which probably are in correspondence with multiple outputs of glandular ducts as observed in *Stygobarnardia* (Ruffo, 1985) to only one output of a glandular conduct in *Y. ventania* **n. gen. n. sp.**, next the “pointed ends” described in *Proleleupia nudicarpus* Griffiths, 1991 and then its absence in the other genera whose descriptions do not mention this character so far.

It is worth mentioning that a cladistic analysis incorporating all the species known to date could provide more precise information on the phylogenetic relationships between the Ingolfiellida. It would then be necessary to include in the analysis the four species of *Ingolfiella* not included in the work of Vonk and Schram (*I. abyssi*, *I. atlantisi*, *I. littoralis* and *I. kapuri*) besides the new species described from 2003 such as *I. inermis* Shimomura *et al.*, 2006, *I. azorensis* Rubal & Larsen, 2013 and *I. arganoi* Iannilli & Vonk, 2013. On the other hand, the analysis of the new characters would be important, the labium and oöstegites, among others.

In South America, the knowledge of the stygofauna is still scarce and its antecedents refer mostly to the families Bathynellidae, Bogidiellidae, Tanaidae, Kaliapseudidae, Protojaniridae, Stygocarididae, Patagonaspidae (Lopretto & Tell 1995, Peralta & Grosso 2009). In relation with Ingolfiellidae only two freshwater species were recorded in South America to date, *I. manni* Noodt, 1961, found in underground brackish water in Chile at sea level and at 800 m.a.s.l. and *I. uspallatae* Noodt, 1965, recorded in the Cordillera de los Andes, Argentina at the “riverbanks of a floodplain” at 2000 m.a.s.l. The specimens of *Yacana ventania* **n. gen. n. sp.** were found in Pampean hill systems very distant geographically and geologically from the localities where *Ingolfiella* was previously mentioned. The specimens of this new species were collected from under the rocks in the basin of a

mountain stream. The absence of eyes and pigmentation of the body suggest a groundwater species, of underground and/or interstitial habits. It could be assumed that these organisms could come from a hyporheic environment, and perhaps emerged by the pressure of interstitial phreatic water in the rainfall period that reached the rithronic environment where they were found. Margalef (1986) mentions that the organisms accustomed to underground water can sometimes be pushed to open environments where although food is more abundant they are generally easy prey for predators as they do not seem to possess bioecological features to subsist for long periods in this situation. They could have also ascended circumstantially from the hyporheic in search for food or to reproduce and then submerge again.

Biogeographically, it is interesting to note that our genus is more closely related to the South African forms, suggesting a Gondwanan origin of the clade. Griffiths (1991) considered the South African genera as “larger ingolfiellids” with sizes between 8 and 23 mm (in *Stygobarnardia* the total length registered is 15 mm, in *Trogloleleupia* is 23 mm and *Proleleupia* has sizes between 8 to 11 mm); *Yacana* **n. gen.** is the first South American “giant” freshwater ingolfiellid with almost 9 mm in length.

The Ventania Hills are considered an “orographic ecological closure”, meaning that they act as an ecological trap allowing the persistence of relict ecosystems (Kristensen & Frangi 1995). Due to their age, these hills have been part of important evolutionary, geologic and climatic processes. Their present fauna and flora are a result of these events and present numerous endemisms: the cactus “barrilito” *Opuntia ventanensis* (Long, 2012); the “iguana de cobre” *Pristidactylus casuhatiensis* (Gallardo, 1968); the rodent “pericote bonaerense” *Phyllotis bonariensis* Crespo, 1964; and the migid *Calathotarsus simony* Schiapelli & Gerschman, 1975. The linking of *Yacana ventania* **n. gen. n. sp.** to the South African genera of the family Ingolfiellidae becomes relevant in biogeographical aspects as it provides further proof to the theory of continental drift proposed by Wegener in 1912. Due to the different aspects mentioned, the preservation of this kind of relictual environments is of the utmost importance.

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