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# Revision of the *Remaneicaris argentina*-group (Copepoda, Harpacticoida, Parastenocarididae): supplementary description of species, and description of the first semi-terrestrial *Remaneicaris* from the tropical forest of Southeast Mexico

PAULO HENRIQUE C. CORGOSINHO[1], NANCY F. MERCADO-SALAS[2], PEDRO MARTÍNEZ ARBIZU[2], EDINALDO NELSON DOS SANTOS SILVA[3] & TERUE C. KIHARA[2]

[1]*UNESCO-IHE, Westvest 7, 2611 AX Delft, The Netherlands*
[2]*Senckenberg am Meer Wilhelmshaven, German Center for Marine Biodiversity Research Südstrand 44, 26382, Wilhelmshaven, Germany*
[3]*Plankton Laboratory, CBIO/INPA, Av. André Araújo, 2936 Petrópolis, CP 478, 69011970, Manaus-AM, Brazil.*
[1]*Corresponding author. E-mail: pcorgo@gmail.com*

## Abstract

*Remaneicaris* is a species-rich Neotropical monophyletic group, easily recognized by the synapomorphic position of the outer seta of the third exopodite of leg 4, localized at 2/3 of the outer margin. The genus, comprising 35 species in five monophyletic groups, plus *R. ignotus* and *R. meyerabichi*, retains an unusual set of plesiomorphic characters. Herein we supplement the descriptions of the species belonging to the *Remaneicaris argentina*-group, and describe a new species from the tropical forest of Southeast Mexico. The present study extends the geographic distribution of the genus, with the northernmost record until now being from El Salvador. The genus having hitherto been known from interstitial groundwater habitats, this is its first record in epigean semi-terrestrial habitats. *Remaneicaris siankaan* **sp. nov**. was found in phytotelmata (bromeliads), leaf litter, moist soil, permanent ponds (known locally as "aguadas"), and temporal and permanent wetlands (savannahs). The new species can be easily characterized by its finely pitted cuticle, the ε (epsilon)-shaped thumb of the male P3 and the bifid accessory spine with distal hyaline inner tip, which precedes the thumb. A new method for the 3D reconstruction of microcrustaceans is described.

**Key words:** Neotropics, phytotelmata, harpacticoids, distributional patterns

## Introduction

The family Parastenocarididae Chappuis, 1940 is highly specialized for life in groundwater and interstitial habitats; and together with Canthocamptidae Brady, 1880, it represents the most successful group of benthic freshwater harpacticoids in terms of diversity and abundance (Galassi & De Laurentiis 2004; Corgosinho & Martínez Arbizu 2005; Schminke 2010; Karanovic & Lee 2012). The family is a monophyletic group containing more than 260 species and subspecies accommodated in 35 nominal genera with most of species described from European groundwaters (Schminke 2010). The main synaphomorphy of this family is the sexual dimorphism in the P3, which is modified as a grasping organ in males, and used for holding the female during copulation (Glatzel & Schminke 1996; Corgosinho *et al.* 2007b; Karanovic & Lee 2012).

The Neotropical parastenocaridid fauna is very rich in species, being composed of different monophyletic groups from various evolutionary lineages. Nowadays South and Central America share only two distantly related genera, *Brasilibathynellocaris* Jakobi, 1972 (see Noodt 1962; Corgosinho *et al.* 2010b), and *Remaneicaris* Jakobi, 1972, the latter considered the most basal genus of the family.

The first studies of South American Parastenocarididae were performed by Menzel (1916), with the description of *Parastenocaris staheli* Menzel, 1916 and, by Delachaux (1924), who described *P. chelifer*

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Delachaux, 1924, both species from Suriname. For the genus *Remaneicaris*, the first described species was *R. hexacantha* (Kiefer, 1936), from the Northeast of Brazil. Later, Jakobi & Silva (1962) described *R. hurdi* (Jakobi & Silva, 1962) from the South of Brazil, while Noodt (1962) described *R. palaciosi* (Noodt, 1962) and *R. meyerabichi* (Noodt, 1962) from Central America. One year later, in a monograph entitled "Subterrane Crustaceen der zentralen Neotropis", Noodt (1963) created the *Parastenocaris remanei*-group, which included the species of *Parastenocaris* Kessler, 1913 subsequently accommodated into *Remaneicaris*. The genus *Remaneicaris* was first proposed by Jakobi (1972) to accommodate the species included in Noodt's (1963) *P. remanei*-group and was recently redefined by Corgosinho & Martínez Arbizu (2005).

With 35 species, *Remaneicaris* is the most speciose Neotropical group of Parastenocarididae. The genus retains an unusual set of plesiomorphic characters, and can be divided into five monophyletic groups [*R. argentina* (Noodt, 1965), *R. analuizae* Corgosinho & Martínez Arbizu, 2005; *R. tridactyla* Corgosinho *et al.*, 2007, *R. cordobaensis* (Noodt, 1965) and *R. persephone* (Noodt, 1965)] plus *R. ignotus* (Dussart, 1983) and *R. meyerabichi* (Noodt, 1962) (Corgosinho *et al.* 2010a; Table 1 pg 20).

It is not the objective of this contribution to address in detail the phylogenetic relationships within the genus *Remaneicaris*. Considering that the original descriptions are not enough detailed, missing phylogenetically important microcharacters, in this work, we supplement the descriptions of all species belonging to the *Remaneicaris argentina*-group (*sensu* Corgosinho *et al.* 2010a) based on the observation of their type material. Additionally, we describe a new species, which represents the first record of the *Remaneicaris* for Mexico. The new species extends the geographic distribution of this group, whose northernmost record was until now from El Salvador (Noodt, 1962), and represents the first finding of the genus in phytotelmata.

The phylogenetic analysis of the genus *Remaneicaris* and the identification key to all the species attributed to this genus are the objective of forthcoming contributions.

A new method for the 3D reconstruction of microcrustaceans is described.

## Material and methods

The type material based on which the species descriptions are supplemented was loaned from the Noodt's Collection deposited in the Deutsches Zentrum für Marine Biodiversitätsforschung forschung, Senckenberg am Meer, Wilhelmshaven (Germany) and from Kiefer's collection at the Staatliches Museum für Naturkunde Karlsruhe (Germany). Most of Noodt's slide preparations contain more than one specimen, and hence it is often difficult to pinpoint the holotype. In such cases, the material was treated as a syntype and the best preserved appendages were depicted. Drawings were made using a drawing tube on a Leica DMR microscope, equipped with Normarsky interference contrast, at 400x and 1000x magnification. All the characters depicted herein were checked against the literature (Noodt 1962, 1963, 1965; Kiefer 1967).

Only the structures which we consider more informative, or not damaged or insufficiently described in the original descriptions are illustrated in this work. Structures not depicted are described as observed in the type collection.

In the course of a project to determine the diversity of copepods from semi-terrestrial habitats and open water bodies in the tropical forest of Southeast Mexico, samples were collected in September 2014 and September-October 2015 (Collecting permit: PPF/DGOPA-003/15 SEMARNAT-CONAPESCA, Mexico). Five sampling sites were chosen in Sian ka'an Biosphere Reserve (Table 1). For each site one transect of 90 m was earmarked including 4 sampling stations respectively at 0 m (S1) (directly from the littoral area or in the water body –benthic, limnetic, and littoral zones), 30m (S2), 60m (S3) and 90m (S4) meters of distance from the water body (see details in Table 1); moist soil, bromeliads and leaf litter samples were collected at each station, including S1. Leaf litter was collected following the criteria of Fiers & Jocque (2013), and moist soil samples were collected by hand (20—30 cm deep). Organisms from bromeliads were collected using a combination of the methods described by Jocque *et al.* (2010); 1) pipetting (PIP): a 5 ml pipette with the end cut to widen the orifice was used to collect all water from the central pool of the plant, and 2) outer leaf removal and dissection (OLR): the outer leaves are removed and washed with filtered tap water in order to collect the organism living in the sediments. Plankton samples were collected from freshwater bodies, using standard plankton net (200 µm mesh). Bromeliad and zooplankton samples were directly fixed in 96% Ethanol. Moist soil and leaf litter samples were washed with filtered tap water, sieved

through 2 mm and 1 mm sieves and fixed in 96% ethanol in the field. In the laboratory, moist soil and leaf litter samples were rinsed with filtered tap water over a 40µm sieve. The sediment was transferred into labeled plastic bottles with 300ml of Levasil®Solution and then centrifuged three times at 3000 rpm during 6 minutes. After every centrifugation cycle the supernatant was collected over a standard 40 µm sieve, washed with filtered tap water and, then fixed in ethanol 96%. Several males and females of the genus *Remaneicaris* from different habitats were sorted from samples and preserved in vials with 96% ethanol at 4°C.

**TABLE 1.** Additional material of *Remaneicaris siankaan* **sp. nov.** All localities are distributed in Sian ka´an Biosphere Reserve, Quintana Roo, Mexico, and were collected by Nancy F. Mercado-Salas.

| Locality | Date | Habitat/station | Geographic coordinates |
|---|---|---|---|
| Savannah El Mirador | 19-09-2014 | Leaf litter (S1), temporal wetland (S1) | 19°46´9.4´´N, 87°44´30.6´´W |
| Aguada Vigía Chico | 20-09-2014 | moist soil (S1), leaf litter (S1), aguada (S1) | 19°47´00.72´´N, 87°36´37.1´´W |
| Savannah 2 | 21-09-2014 | moist soil (S2, S4), temporal wetland (S2) | 19°47´55´´N, 87°42´1.0´´W |
| Aguada limite de la reserva | 23-09-2014 | moist soil (S1, S4), aguada (S1, S2) | 19°42´32.6´´N, 87°49´40.1´´W) |
| Savannah km 10 | 05-10-2015 | temporal wetland (S1) | 19°52´29.3´´N 87°43´0.7´´W |
| Bajo Savannah 2 | 06-10-2015 | manmade well (S1) | 19°47´42.6´´ N 87°42´22.1´´W |
| Savannah camino Playon | 06-10-2015 | temporal wetland (S1) | 19°49´54.6´´N 87°32´32.54´´W |
| Savannah 2 | 07-10-2015 | temporal wetland (S1) | 19°47´56.0´´N 87°42´03.3´´W |

Animals were dissected in glycerine and mounted on slides sealed with paraffin. Drawings were made at 100x magnification with a drawing tube mounted on a Leica DMR microscope, equipped with Normarsky interference contrast. The new species was described and illustrated following the current standards for the morphological study of the genus (Corgosinho & Martínez Arbizu 2005; Corgosinho *et al.* 2007a, b, 2010a). Holotype, allotype and paratypes were deposited in the Zooplankton Collections of El Colegio de la Frontera Sur (ECO-CH-Z) in Chetumal, Mexico; additional paratypes were deposited at Senckenberg Research Institute Dept. DZMB (Wilhelmshaven, Germany).

Confocal Laser Scanning Microscopy- Two adult specimens of *Remaneicaris siankaan* **sp. nov.** (female and male) were used for CLSM as indicated below.

Before dissection, the specimens were stained with 1:1 solution of Congo Red and Acid Fuchsin overnight using procedures adapted from Michels & Büntzow (2010). The whole specimens were temporarily mounted in glycerine, and self-adhesive plastic reinforcement rings were used to support the coverslip (Kihara & Rocha 2009; Michels & Büntzow 2010).

When required, the specimens were dissected under a Leica MZ12 stereomicroscope and appendages mounted on slides in glycerine. Parts of the body of special interest and difficult positioning due to their tridimensional shape (e.g. male P3) were prepared on slides using Karo® light corn syrup as mounting medium (Kihara *et al.* in preparation), so that the parts were intact and not compressed during the scanning process.

The material was examined using a Leica TCS SP5 equipped with a Leica DM5000 B upright microscope and 3 visible-light lasers (DPSS 10 mW 561 nm; HeNe 10 mW 633 nm; Ar 100 mW 458, 476, 488 and 514 nm), combined with the software LAS AF 2.2.1. (Leica Application Suite Advanced Fluorescence).

Images were obtained using 561nm excitation wavelength with 80% acousto-optic tunable filter (AOTF). Series of stacks were obtained, collecting overlapping optical sections throughout the whole preparation with optimal number of sections according to the software. The acquisition resolution was 2048×2048 pixels and the settings applied for the preparations are given in Table 2. Final images were obtained by maximum projection.

To obtain a three-dimensional representation from selected body parts, the data produced during the CLSM scanning was processed with the free software Drishti (http://anusf.anu.edu.au/Vizlab/drishti/). Final plates were composed and adjusted for contrast and brightness using the software Adobe Photoshop CS4.

Abbreviations used: A1 = antennule, A2 = antenna, Ae = aesthetasc, ap = apomorphy; Cph = cephalothorax, enp = endopod, exp = exopod, exp-1 to 3 = exopodites 1 to 3; Md = mandible, Mx1 = maxillula, Mx2 = maxilla, Mxp = maxilliped, P1-P5 = legs 1 to 5, pl = plesiomorphy, PRVS = proximal row of "V" spinules, Urs =

urosomite(s). Caudal setae labeled as follows: I- anterolateral accessory seta; II- anterolateral (lateral) caudal seta; III- posterolateral (outermost) caudal seta; IV-outer terminal (terminal median external) caudal seta; V-inner terminal (terminal median internal) caudal seta; VI-terminal accessory (innermost) caudal seta; VII- dorsal seta; nomenclature follows Huys and Boxshall (1991). The terms furca and telson are used following Schminke (1976).

The new species name is registered at the Zoobank (www.zoobank.org; LSIDurn:lsid:zoobank.org:act:4B4EA7DC-BC5C-418B-BD0F-29F690DED76C)

**TABLE 2.** List of figures with information on microscope lenses and confocal laser scanning microscopy (CLSM) settings; Ch1 and Ch2 = detection channels 1 and 2.

| Figure | Objective/ Numerical aperture | Detected emission wavelength (nm) | Detector gain (V)/ Amplitude offset(%) | Electronic zoom | Pinhole aperture (µm) |
|---|---|---|---|---|---|
| Figs 13A, B | HCX APO U-V-I 40.0x0.75 DRY UV | Ch1: 570 – 629<br>Ch2: 629 – 717 | Ch 1: 667.0/ -1.7<br>Ch 2: 605.0/ -0.8 | 1.0X | 113.2 |
| Fig. 14A | HCX PL APO CS 63.0x1.40 OIL UV | Ch1: 570 – 629<br>Ch2: 629 – 717 | Ch 1: 688.0/ -1.7<br>Ch 2: 667.0/ -0.8 | 2.0X | 95.5 |
| Fig. 14B | HCX PL APO CS 63.0x1.40 OIL UV | Ch1: 570 – 629<br>Ch2: 629 – 717 | Ch 1: 701.0/ -1.7<br>Ch 2: 680.0/ -0.8 | 2.0X | 95.5 |
| Fig. 14C | HCX PL APO CS 63.0x1.40 OIL UV | Ch1: 570 – 629<br>Ch2: 629 – 717 | Ch 1: 723.0/ -1.7<br>Ch 2: 702.0/ -0.8 | 2.0X | 95.5 |
| Fig. 14D | HCX PL APO CS 63.0x1.40 OIL UV | Ch1: 570 – 629<br>Ch2: 629 – 717 | Ch 1: 731.0/ -1.7<br>Ch 2: 675.0/ -0.8 | 2.0X | 110.0 |
| Fig. 14E | HCX PL APO CS 63.0x1.40 OIL UV | Ch1: 570 – 629<br>Ch2: 629 – 717 | Ch 1: 681.0/ -1.7<br>Ch 2: 643.0/ -0.8 | 1.6X | 95.5 |
| Fig. 14F | HCX APO U-V-I 40.0x0.75 DRY UV | Ch1: 570 – 629<br>Ch2: 629 – 717 | Ch 1: 667.0/ -1.7<br>Ch 2: 656.0/ -0.8 | 3.1X | 113.2 |
| Fig 15A | HCX PL APO CS 63.0x1.40 OIL UV | Ch1: 570 – 629<br>Ch2: 629 – 717 | Ch 1: 681.0/ -1.7<br>Ch 2: 643.0/ -1.6 | 1.1 X | 95.5 |
| Fig 15B | HCX PL APO CS 63.0x1.40 OIL UV | Ch1: 570 – 629<br>Ch2: 629 – 717 | Ch 1: 684.0/ -1.7<br>Ch 2: 662.0/ -1.6 | 2.0 X | 95.5 |
| Fig 15C | HCX PL APO CS 63.0x1.40 OIL UV | Ch1: 570 – 641<br>Ch2: 641 – 717 | Ch 1: 695.0/ -1.7<br>Ch 2: 719.0/ -1.6 | 3.0 X | 95.5 |
| Fig 15D | HCX PL APO CS 63.0x1.40 OIL UV | Ch1: 570 – 641<br>Ch2: 641 – 717 | Ch 1: 735.0/ -1.7<br>Ch 2: 700.0/ -1.6 | 2.2 X | 95.5 |
| Fig 15E | HCX PL APO CS 63.0x1.40 OIL UV | Ch1: 570 – 641<br>Ch2: 641 – 717 | Ch 1: 669.0/ -1.7<br>Ch 2: 648.0/ -1.6 | 1.5 X | 95.5 |
| Fig 15F | HCX PL APO CS 63.0x1.40 OIL UV | Ch1: 570 – 641<br>Ch2: 641 – 717 | Ch 1: 691.0/ -1.7<br>Ch 2: 662.0/ -1.6 | 2.0 X | 95.5 |

## Order HARPACTICOIDA Sars, 1903

## Family PARASTENOCARIDIDAE Chappuis, 1940

### Genus *Remaneicaris* Jakobi, 1972

### *Remaneicaris argentina*-group

**Diagnosis.** *Remaneicaris*. Telson smooth (pl). Last segment of male A1 without modified seta (pl) or hyaline margin (pl). P1 enp not sexually dimorphic (pl) and without ornamentation on inner margin of enp-1 (ap). P3 with hyaline margin on apophysis (ap); modified distal spinule on outer margin of P3 (ap). Basis of male P4 without ornamentation (pl); exp-1 with PRVS on outer margin (pl); exp-2 without ornamentation on inner margin (pl). P5 displaced to a ventrolateral position (pl) and with small inner distal process, with setae distally arranged (pl).

List of species: *R. argentina* (Noodt, 1965), *R. jujuyensis* (Noodt, 1965), *R. drepanephora* (Kiefer, 1967), *R. palaciosi* (Noodt, 1962), *R. clandestina* (Noodt, 1963), *R. hurdi* (Jakobi & Silva, 1962), and *Remaneicaris siankaan* **sp. nov.**

Species *incertae sedis*: *P. ahaggarica* Bozic, 1978 and *R. psammae* (Rouch, 1962).

### *Remaneicaris argentina* (Noodt, 1965)

(Figs. 1–2)

**Synonyms:** *Parastenocaris argentina* (Noodt 1965); *Remaneicaris argentina* (Jakobi 1972); *Parastenocaris argentina* (Rouch 1986); *Parastenocaris argentina* (Dussart & Defaye 1990); *Remaneicaris argentina* (Corgosinho & Martínez Arbizu 2005)

**Material examined:** Noodt's collection; C137 (M3, slide 11; *locus typicus* and M3, slide 12). *Locus typicus:* Rio Sierra (La Bolsa), in the mountain between the city of Córdoba and Alta Gracia (Carretera), Córdoba Argentina.

**Male**: Length 450 µm (Noodt's measurement, from rostrum to distal rim of furca). Rostrum not fused to Cph, with wide base and two sensilla on tip. Cph and Urs-2 with 1 dorsal integumental window each. Urs-5 with 1 oval lateral window on each side of somite (Noodt 1965). Anal operculum smooth and slightly concave. Furca as described by Noodt (1965); shorter than telson, 4 times longer than wide, in dorsal view constricted proximally and dilated at midlength, setae I–III and VII at the distal 1/3 opposite to each other, setae I–III approximately of same size, seta V the longest, seta IV longer than seta VI and VII, seta VI and VII approximately of same size. A1 and A2 armature and segmentation as described by Corgosinho *eta al.* (2007b) for *R. tridactyla*. A1: 9-segmented, haplocer; armature beginning with proximal segment: 0/5/4/2/5+Ae/1/4/2/9+Ae. 2: with allobasis; 1-segmented exp with 1 seta, 1-segmented enp with 7 setae. Md, Mx1, Mx2 and Mxp armature as described by Corgosinho *eta al.* (2005, 2007a, 2007b and 2010a). Mx2: of *Remaneicaris* type, with 2 slender setae on proximal endite and 3 setae on distal endite. P1 as described for female. P2 (Fig. 1A): basis without outer seta, ornamented with 1 row of spinules on outer margin and 1 pore near anterior margin; exp 3-segmented, exp-1 longer than each of the remaining two segments; with PRVS on outer margin, row of spinules anterior to insertion of outer spine, 2 spinules of different size distal to outer spine and inner hyaline frill; exp-2 without armature,with 1 spinule medially on outer margin and row of distal spinules of unequal sizes at distal margin; exp-3 with 1 spinule located medially on outer margin, 1 row of spinules along outer corner, distal hyaline frill, 1 unipinate subapical spine and 2 bipinate apical setae, outer seta shorter than inner one; enp subcylindrical, 1-segmented, nearly half the length of exp-1, with 1 bare distal seta, two distal spinules and 2 spinules on outer margin. P3 (Fig. 1B): basis with outer seta; enp 1-segmented, pointed, with thin tip; exp 1-segmented, straight, increasing distally, with proximal hump at 1/3 of inner margin, inner margin with small process on distal 2/3, 2 rows of spinules on outer margin, proximal row of 5 strong spinules, distal row of 4 spinules, distalmost with a hyaline lamella on inner margin,apophysis shorter than thumb, wider than long, with a well developed hyaline margin, which is inwardly turned at the end of a straight exp, conferring to it a final angle of approximately 90° with the main exp axis; thumb long, almost 2/3 as long as exp, inwardly curved on proximal third and almost straight on distal 2/3. P4 (Fig. 1C): basis with outer seta and 1 pore on anterior margin; exp 3-segmented, exp-1 longer than each of the remaining two segments with PRVS on outer margin, row of spinules anterior to insertion of outer spine, 2 spinules of different sizes distal to outer spine and inner hyaline frill; exp-2 without armature, with 1 spinule medially on outer margin and row of distal spinules of unequal sizes at distal margin (innermost spinules smaller than outermost ones); exp-3 with 1 bipinate apical seta and 1 bipinate setae at 2/3 of outer margin, 1 distal hyaline frill and 2 spinules medially on outer margin; enp 1-segmented, slightly longer than exp-1, slender, with numerous spinules on inner margin. P5 (Fig. 1D): without intercoxal sclerite, 2 plate not fused to the somite, trapezoidal, ending in small process on inner margin, with 1 long outer seta and 3 smooth distal setae, distal most the longest, proximal most the shortest.

**Female**: Sexually dimorphic in A1, P3, P4 and genital field.

Length 450 µm (Noodt's measurement). Rostrum as in male. Cph and double genital somite with 1 dorsal integumental window each. Urs-4 with 1 oval lateral window on each side (Fig. 2D). Furca (Fig. 2D) as described by Noodt (1965), shorter than telson, 4 times longer than wide, in dorsal view constricted proximally and dilated at midlength, setae I–III and VII at the distal 1/3 opposite to each other, setae I–III approximately of same size, seta V the longest, seta IV longer than seta VI and VII, seta VI and VII approximately of same size. A1 armature and

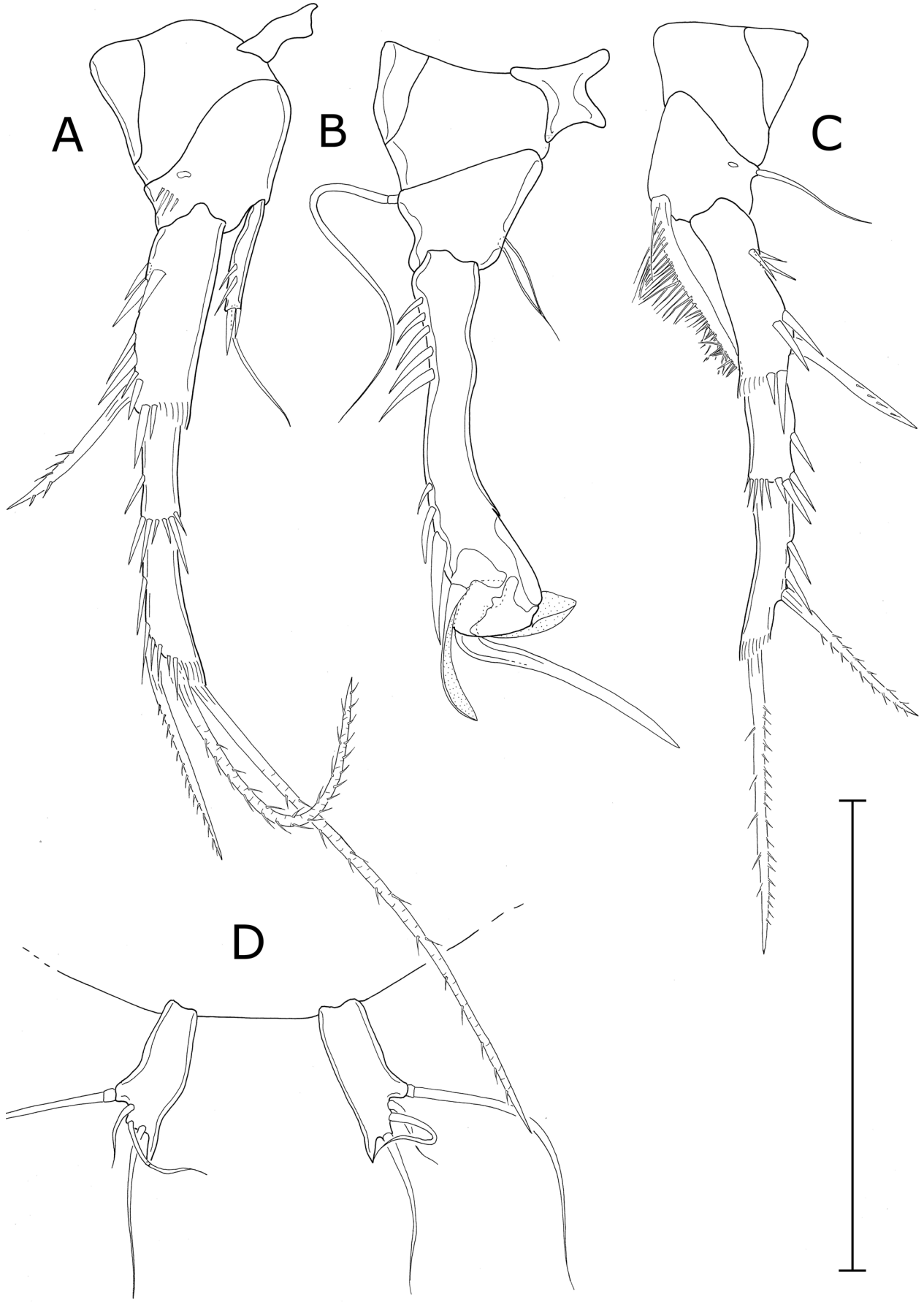


**FIGURE 1.** *Remaneicaris argentina* (Noodt, 1965), male. A, P2; B, P3; C, P4;D, P5. Scale bar= 50µm.

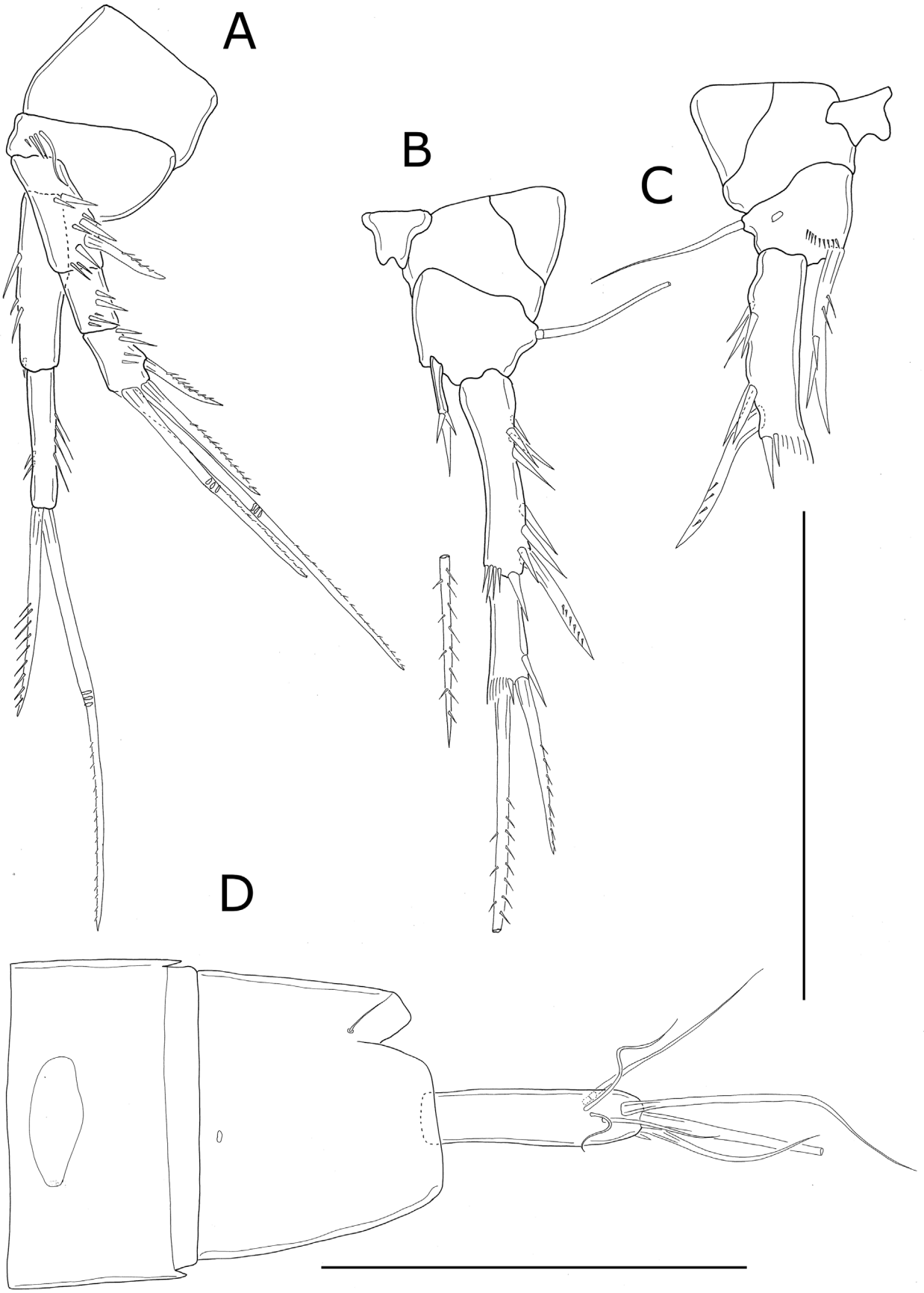


**FIGURE 2.** *R. argentina* (Noodt, 1965), female. A, P1; B, P3; C, P4 (partly); D, Ur-4, telson and furca, lateral view. Scale bar= 50µm.

segmentation as described by Corgosinho *eta al.* (2007b) for *R. tridactyla*. A1: 7-segmented; number of setae beginning at proximal segment: 0/4/5/2+Ae/1/2/9+Ae. A2 and P5: as in male. P1 (Fig. 2A) basis with outer seta, 3 spinules on outer margin below outer seta; enp 2-segmented, enp-1 as long as exp-1 and 2, without ornamentation on inner margin, outer margin with a strong spinule at the proximal 1/3 and 2 spinules at distal 2/3; enp-2 with 4 spinules on inner margin and 2 on outer margin and 2 distal elements, 1 unipinate outer spine and 1geniculated seta twice as long as outer spine; exp 3-segmented, exp-1 with outer spine and rows of spinules on outer margin, exp-2 unarmed, with spinules on outer margin, exp-3 with spinules on outer margin, 1 unipinate outer spine on distal 2/3, 1 unipinate outer spine and 2 geniculated setae, innermost the longest. P3 (Fig. 2B): basis with 1 outer seta; exp 2-segmented, exp-1 with proximal row of spinules, outer spine, row of spinules proximal to outer spine and row of spinules distally, on inner margin; exp-2 with 1 unipinate outer spine and 1 bipinate distal seta; enp 1-segmented and spiniform, with 2 spinules at 3/4 of segment. P4 (Fig. 2C): basis with row of spinules near enp insertion and 1 anterior pore; exp as in male, enp spine-like, as long as exp-1, with 2 small spinules on inner margin and two larger spinules on outer margin. Genital field as described for *R. analuizae* (Corgosinho & Martínez Arbizu, 2005) with 1 medially located copulatory pore. Gonopore is transverse slit.

### *Remaneicaris jujuyensis* (Noodt, 1965)

(Fig. 3)

**Synonyms:** *Parastenocaris jujuyensis* (Noodt 1965); *Remaneicaris jujuyensis* (Jakobi 1972); *Parastenocaris jujuyensis* (Rouch 1986); *Parastenocaris jujuyensis* (Dussart & Defaye 1990); *Remaneicaris jujuyensis* (Corgosinho & Martínez Arbizu 2005)

**Material examined:** Noodt's collection; C134 (M3, slide 7; *locus typicus*). *Locus typicus*: Quebra Honda, 3 km north of Jujuy, Jujuy Argentina.

**Male**: Length 420 μm (Noodt's measurement). Rostrum not fused to Cph, with wide base and two sensilla on tip. Cph with 1 dorsal integumental window; Urs integumental windows not see in Noodt's preparations. Anal operculum smooth and slightly concave, with small protuberance on each side of paraopercular region, just above furca. Furca (Fig. 3F) shorter than telson, 2 times longer than wide, tapering in lateral view, setae I–III and VII at the distal 1/3 opposite to each other, setae I–III approximately of same size, seta V the longest, seta IV longer than seta VI and VII, seta VI minute, approximately as long as lateral setae, seta VII approximately 1/3 shorter than seta IV. A1 and A2 armature and segmentation as described by Corgosinho *eta al.* (2007b) for *R. tridactyla*. A1: 9-segmented and haplocer; armature beginning with proximal segment: 0/5/4/2/5+Ae/1/4/2/9+Ae. A2: with allobasis; 1-segmented exp with 1 seta, and 1-segmented enp bearing 7 setae. Md, Mx1, Mx2 and Mxp armature as described by Corgosinho *eta al.* (2005, 2007a, 2007b and 2010a); Mx2: of *Remaneicaris* type, with two slender setae on proximal and 3 setae on distal endite. P1 (Fig. 3A): basis with outer seta, 3 spinules on outer margin; enp 2-segmented, enp-1 as long as exp-1 and 2, without ornamentation on inner margin, outer margin with 2 spinules at proximal 1/3 and 2 spinules at distal 1/3; enp-2 with 3 spinules on inner margin, 1 unipinate outer spine and 1geniculated seta 2,5 times as long as outer spine; exp 3-segmented, exp-1 with outer spine and rows of spinules on outer margin, exp-2 unarmed, with spinules on outer margin, exp-3 with spinules on outer margin, 1 unipinate outer spine on distal 1/3, 1 unipinate outer spine and 2 geniculated setae, innermost the longest one. P2 (Fig. 3B):basis without outer seta, ornamented with 1 row of spinules on outer margin, 1 pore near anterior margin, and 1 row of small spinules near enp insertion; exp 3-segmented, exp-1 longer than each of the remaining two segments; with PRVS on outer margin, row of spinules anterior to insertion of outer spine, 3 spinules of different sizes distal to outer spine and inner hyaline frill; exp-2 without armature, with 1 spinule medially on outer margin and row of spinules of unequal sizes at distal margin (innermost spinules smaller than outermost); exp-3 with 1 spinule located medially on outer margin, 1 spinule on distal 2/3 of outer margin, distal hyaline frill, 1 unipinate subapical spine and 2 bipinate apical setae, outer seta shorter than inner one; enp 1-segmented, long, dilated subproximally, approximately of same size of exp1, with 1 long unipinate and spiniform distal seta, 2 subdistal spinules and 4 spinules on outer margin. P3 (Fig. 3C): coxa with posterior row of small spinules; basis with outer seta; enp 1-segmented, with row of spinules proximally, on inner margin, very long, dagger like, proximally dilated, almost as long as exp; exp 1-segmented, straight, on the outer margin with row of 4 larger spinules proximally, 3 spinules on distal 2/3 and 1 modified spinule on distal 1/3 with hyaline lamella on inner margin, inner margin with process on

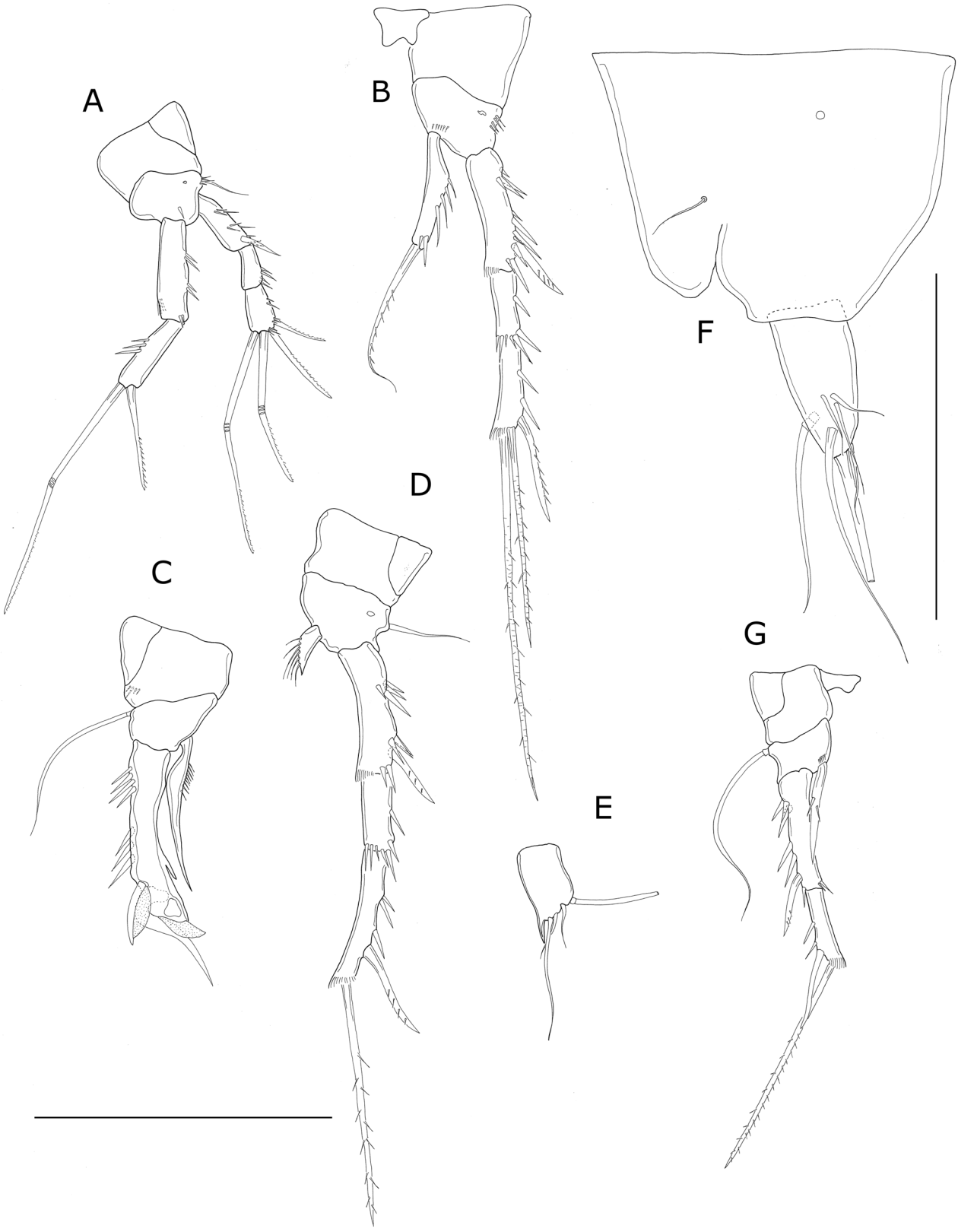


**FIGURE 3.** *Remaneicaris jujuyensis* (Noodt, 1965), A–F, male; G, female. A, P1; B, P2, C) P3, D; P4; E, P5; F, telson and furca, lateral view; G, P3. Scale bar= 50µm.

distal 2/3,; apophysis shorter than thumb, triangular, ending in a blade-like hyaline lamella which is inwardly turned at the end of a straight exp, conferring to it a final angle of approximately 90° with the main exp axis; thumb is long, almost 2/3 as long as exp, strongly curved inwards (s-shaped)**.** P4 (Fig.3D): basis with outer seta and 1 pore on anterior margin; exp 3-segmented, exp-1 longer than each of the remaining two segments with PRVS on outer margin, row of spinules anterior to insertion of outer spine, 2 spinules of different sizes distal to outer spine and inner hyaline frill; exp-2 without armature, with 1 spinule medially on outer margin and row of spinules of unequal sizes at distal margin (innermost spinules smaller than outermost); exp-3 with 1 bipinate apical seta and 1 unipinate spine at 2/3 of outer margin, 1 distal hyaline frill, 2 spinules on proximal 1/3 and 1 medially spine on outer margin; enp 1-segmented, more than 3 times shorter than exp-1, concave on outer margin and with row of spinules along inner and convex margin. P5 (Fig. 3E): as described by Noodt (1965), without intercoxal sclerite, 2 plate not fused to the somite, rectangular, ending in small process on inner margin, with 1 long outer seta and 3 smooth distal setae, distalmost seta the longest, proximalmost seta the shortest.

**Female**: Sexually dimorphic in A1, P2, P3, P4, P5 and genital field. Length 360 µm (Noodt's measurement). Rostrum as in male. Integumental windows probably as in males. Telson and furca as in male. A1 armature and segmentation as described by Corgosinho *eta al.* (2007b) for *R. tridactyla*. A1: 7-segmented; number of setae beginning at proximal segment: 0/4/5/2+Ae/1/2/9+Ae. A2: as in male. P2: enp slightly weaker than enp of males, appearing as long appendix with long distal setae and 3 spinules on outer margin. P3 (Fig. 3G): basis with 1 outer seta and row of spinules near insertion of enp; exp 2-segmented, exp-1 with proximal row of spinules, an outer spine, 2 long spinules near to outer spine, 1 small spinule posterior to outer spine, and 2 small spinules distally, on inner margin; exp-2 with 1 spine at 3/4 of the outer margin, 1 bipinate distal seta and 1 medial spinule on outer margin, 1 spinule near outer spine and distal hyaline frill; enp 1-segmented, spiniform, 0.8 times as long as exp-1 in length, with 2 spinules on middle margin. P4: not observed; probably as described by Noodt (1965), without sexual dimorphism on exp. P5: as in male except for the larger inner process. Genital field with 1 copulatory pore located medially. Gonopore with transversal slit.

### *Remaneicaris palaciosi* (Noodt, 1962)

(Figs. 4–5)

**Synonyms:** *Parastenocaris palaciosi* (Noodt 1962); *Remaneicaris palaciosi* (Jakobi 1972); *Parastenocaris palaciosi* (Rouch 1986); *Parastenocaris palaciosi* (Dussart & Defaye 1990); *Remaneicaris palaciosi* (Corgosinho & Martínez Arbizu 2005)

**Material examined:** Noodt's collection; S64 (*locus typicus*), S127, S332 (K7, slides 78). *Locus typicus*: Acehuafa river (San Salvador, El Salvador).

**Male**: Length 420 µm (Noodt's measurement). Rostrum not fused to Cph, with wide base and 2 sensillae on tip. Cph and Urs-2 with 1 dorsal integumental window. Urs-5 with belt-like integumental window along the dorsal surface. Anal operculum smooth and quadratic. Furca (Fig. 5B) shorter than telson, 2.75 times longer than wide, tapering distally, setae I–III and VII at the distal 1/3 opposite to each other, setae I–III approximately of same size, seta V the longest, seta IV longer than seta VI and VII, seta VI minute, aproximally as long as lateral setae, seta VII approximately 1/3 shorter than seta IV. A1 and A2 armature and segmentation as described by Corgosinho *eta al.* (2007b) for *R tridactyla*. A1: 9-segmented and haplocer; armature beginning with proximal segment: 0/5/4/2/5+Ae/1/4/2/9+Ae. A2: with allobasis; 1-segmented exp with 1 seta, and 1-segmented enp bearing 7 setae. Md, Mx1, Mx2 and Mxp armature as described by Corgosinho *eta al.* (2005, 2007a, 2007b and 2010a). Mx2: of *Remaneicaris* type, with 2 slender setae on proximal and 3 setae on distal endite. P1 (Fig 4A): basis with outer seta, 4 spinules on outer margin below outer seta; enp 2-segmented, enp-1 slightly shorter than exp-1 and 2 together, without ornamentation on inner margin, outer margin with 3 spinules at proximal 2/3 and 2 spinules at distal 1/3, with 2 anterior distal spinules; enp-2 with 3 spinules on outer margin,1 unipinate outer spine and 1geniculated seta 2,3 times as long as outer spine; exp 3-segmented, exp-1 with outer spine and rows of spinules on outer margin, exp-2 unarmed, with spinules on outer margin, exp-3 with 1 unipinate outer spine on distal 1/3, 1 unipinate outer spine and 2 geniculated setae, innermost seta the longest**.** P2 (Fig. 4B): basis without outer seta, ornamented with 1 row of spinules on outer margin, 1 pore near anterior margin, and 1 row of small spinules near enp insertion; exp 3-segmented, exp-1 longer than each of the remaining two segments; with PRVS on outer margin, row of spinules anterior to insertion of outer spine, 3 spinules of different sizes distal to outer spine and inner hyaline frill; exp-2 without armature, with 1 medial spinule on outer margin and row of spinules of unequal sizes at distal margin; exp-3 with 1 medial spinule on outer margin, distal hyaline frill, 1 unipinate subapical spine and 2 bipinate apical setae,

outer seta shorter than inner one; enp 1-segmented, slightly longer than 1/2 exp-1, with 1 distal smooth seta, 2 distal spinules and 2 spinules on outer margin. P3 (Fig. 4C and D): basis with outer seta; enp 1-segmented, short, pointed, with thin tip, without ornamentation or armature; exp 1-segmented, slightly curved, on the outer margin with row of 4 strong spinules on proximal 2/3, 3 strong spinules on distal 1/3, last spinule of distal row very strong and almost straight, without hyaline margin, inner margin with process on distal 2/3; apophysis shorter than thumb, quadratic, ending in an acuminate hyaline lamella, preceded by chitinous plate; apophysis is inwardly turned at the end of a straight exp, conferring to it a final angle of approximately 90° with the main exp axis; thumb is long, strong and almost straight. P4 (Fig. 4E): basis with outer seta and 1 pore on anterior margin; exp 3-segmented, exp-1 longer than each of the remaining two segments with PRVS on outer margin, row of spinules anterior to insertion of outer spine, 3 spinules of different sizes distal to outer spine and inner hyaline frill; exp-2 without armature, with 1 spinule medially on outer margin and row of spinules of unequal sizes at distal margin (innermost spinules smaller than outermost ones); exp-3 with 1 bipinate apical seta and 1 bipinate spine inserted at 2/3 of outer margin,

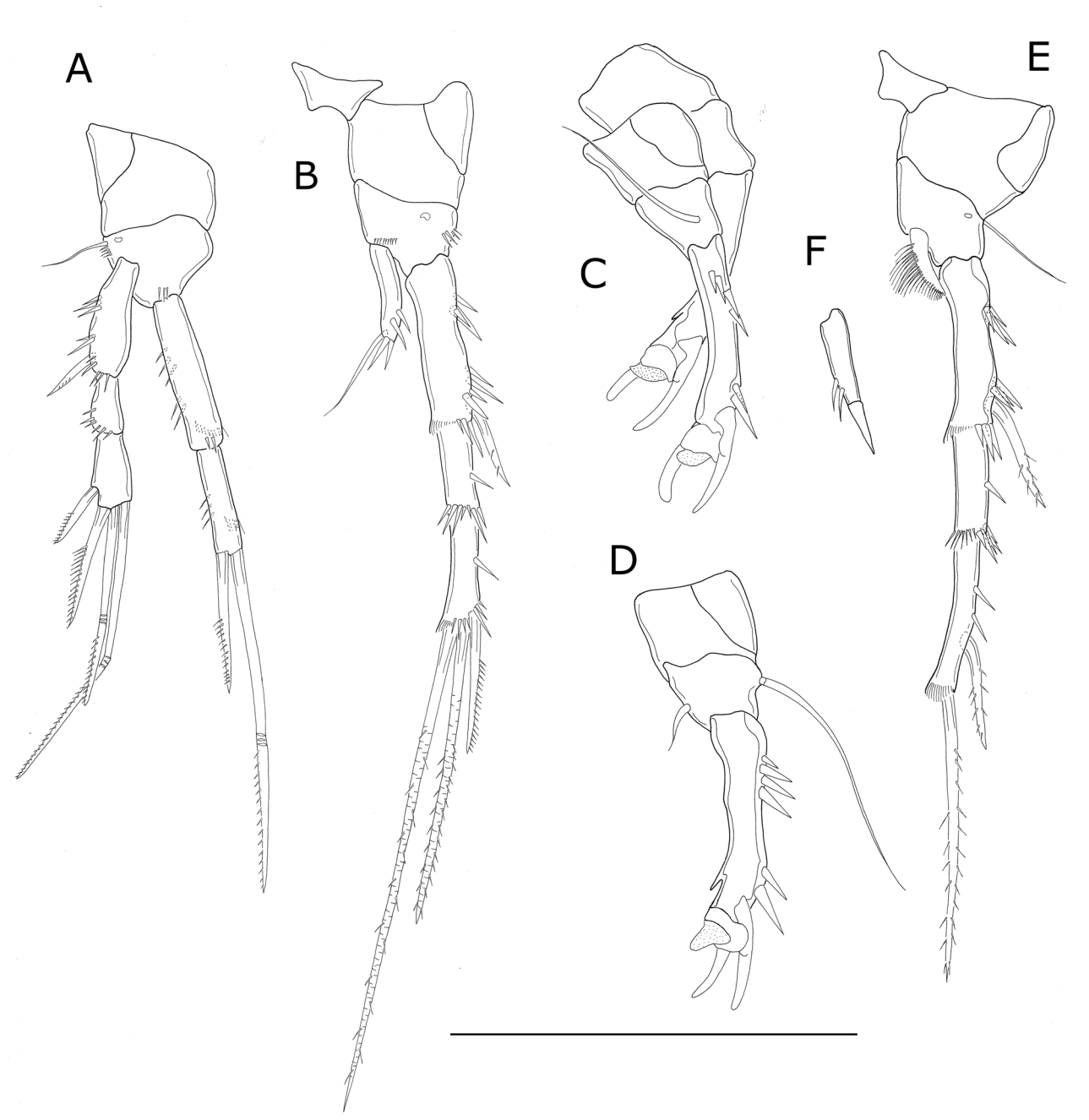


**FIGURE 4.** *Remaneicaris palaciosi* (Noodt, 1962), A–E, male; F, female. A, P1; B, P2; C, P3, lateral view; D, P3, ventral view; E, P4; F, enp, P4. Scale bar= 50µm.

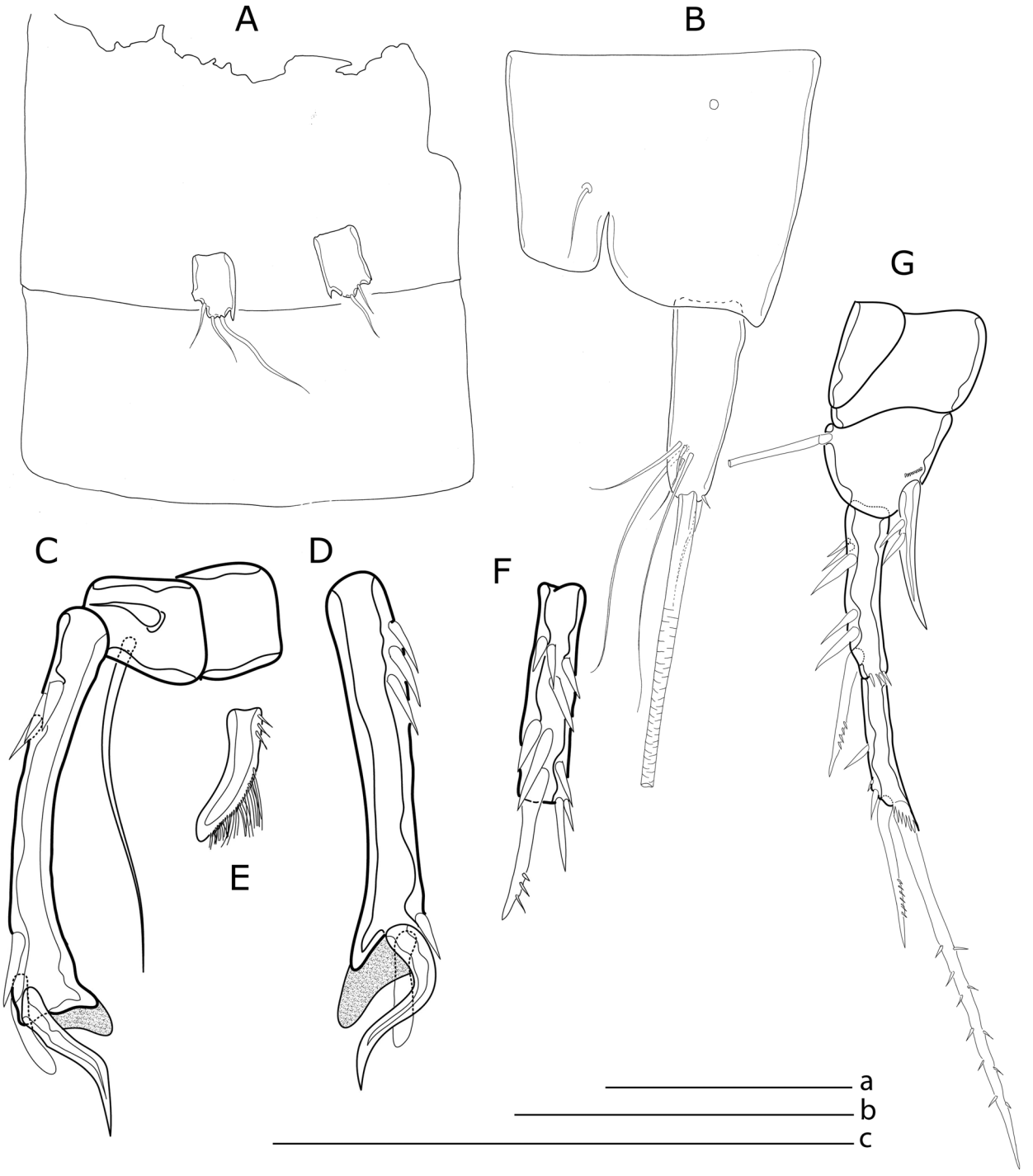


**FIGURE 5.** *Remaneicaris palaciosi* (Noodt, 1962), male. A, P5, Urs-1–2; B, telson, and furca, lateral view. *Remaneicaris clandestina* (Noodt, 1963), C–E, male; F–G, female. C, P3, ventral view; D, P3, dorsal view; E, enp P4; F, enp P2; G, P4. Scale bar= 50μm.

1 distal hyaline frill, 1 spinule medially on outer margin, and 1 spinule at proximal 1/3 of outer margin; enp shorter that half of exp-1, curved outwards, with spinules along inner margin -decreasing in length from proximal to distal margin-. P5 (Fig. 5A): without intercoxal sclerite, 2 plate not fused to the somite, rectangular, ending in small process on inner margin, outer seta broken on left limb, with 3 smooth distal setae, distalmost seta the longest, proximalmost seta the shortest.

**Female**: Sexually dimorphic in A1, P3, P4 and genital field. Length 440 μm (Noodt's measurement). A1

armature and segmentation as described by Corgosinho *eta al.* (2007b) for *R. tridactyla*. A1: 7-segmented; number of setae beginning at proximal segment: 0/4/5/2+Ae/1/2/9+Ae. P3 (Fig. 5G): basis with 1 outer seta and row of spinules near insertion of enp; exp 2-segmented, exp-1 with proximal row of spinules, an outer spine and 2 longer spinules near to insertion of outer spine and row of small spinules distally; exp-2 with 1 unipinate outer spine, 1 bipinate seta and 1 spinule medially on outer margin; enp 1-segmented and spiniform, almost as long as exp-1, with 2 outer spinules on outer surface. P4 (Noodt 1962, fig. 77): exp without sexual dimorphism; enp (Fig. 4F) 1-segmented, with 2 outer spinules and distal, unfused spine. Genital field with 1 medially located copulatory pore. Gonopore with transverse slit.

### *Remaneicaris clandestina* (Noodt, 1963)

(Fig. 5)

**Synonyms:** *Parastenocaris clandestina* (Noodt 1963); *Remaneicaris clandestina* (Jakobi 1972); *Parastenocaris clandestina* (Löffler 1981); *Parastenocaris clandestina* (Dussart 1984); *Parastenocaris clandestina* (Rouch 1986); *Parastenocaris clandestina* (Dussart & Defaye 1990); *Parastenocaris clandestina* (Reid 1998); *Remaneicaris clandestina* (Corgosinho & Martínez Arbizu 2005)

**Material examined:** Noodt's collection; P270 (*locus typicus*; M2, slides 18 and 20) and P275 (M3, slide 2). *Locus typicus:* Hyporheic zone of the margin of the Amazon River, at the city of Santarém (Pará, Brazil).

**Male**: Length 290 µm (Noodt's measurement). Rostrum not fused to Cph, with wide base and 2 sensilla on tip. Integumental windows not shown in Noodt's preparations. Anal operculum smooth and slightly concave. Furca as described by Noodt (1963) shorter than telson, 2.6 times longer than wide, inner margin with strong concavity, with 7 setae; setae I–III and VII at the distal 1/3 opposite to each other, size of Seta I–III impossible to observe, seta seta V the longest, seta IV longer than seta VI, seta VII approximately as long as seta IV. A1 and A2 armature and segmentation as described by Corgosinho *eta al.* (2007b) for *R. tridactyla*.. A1: 9-segmented and haplocer; armature beginning with proximal segment: 0/5/4/2/5+Ae/1/4/2/9+Ae. A2: with allobasis; 1-segmented exp with 1 seta, and 1-segmented enp bearing 7 setae. Md, Mx1, Mx2 and Mxp armature as described by Corgosinho *eta al.* (2005, 2007a, 2007b and 2010a). Mx2: of *Remaneicaris* type, with 2 slender setae on proximal and 3 setae on distal endite. P1 (Noodt 1963, fig. 94): unarmed coxa; basis with an outer seta, one anterior pore and 4 spinules on outer margin, enp 2-segmented, enp-1 without ornamentation on inner margin; enp-2 with 2 distal setae, one of them geniculated; exp 3-segmented, exp-1 with an outer spine, exp-2 unarmed, exp-3 with 1 spine at midlength of outer margin, 1 distal spine on outer margin and 2 geniculated apical setae. P2 (Noodt 1963, fig. 88); basis without outer seta, with one outer row of spinules, one anterior pore and row of spinules before insertion of enp; exp 3-segmented, exp-1 being approximately of same size of remaining exp; proximally with softly developed PRVS on outer margin, with row of spinules anterior to insertion of outer spine and an inner hyaline frill; exp-2 without armature and with one spinule located at midlength of outer margin and with row of distal spinules; exp-2 with 3 setae, distal hyaline frill on inner corner and 1 large spinule at midlength of outer margin; enp 1-segmented, with subdistal seta, 2 distal spinules and 2 outer spinules. P3 (Fig. 5C, D): basis with outer seta; enp 1-segmented, short, pointed, with thin tip, without ornamentation or armature; exp 1-segmented, slightly curved inwards, with proximal row of 3 large spinules and 2 distal spinules on the outer margin; distalmost spinule very strong and curved with rounded tip; without any hyaline structure; apophysis short, triangular, ending in hyaline lamella which is inwardly turned at the end of a almost straight exp, conferring to it a final angle of approximately 90° with the main exp axis; thumb is long, strong and heavily curved in "S" shape. P4 (Noodt 1963, fig. 89): basis with outer seta and one pore on anterior margin; exp 3-segmented, exp-1 almost of same size of remaining segments and with an outer spine inserted posteriorly; with PRVS on outer margin, row of spinules anterior to insertion of outer spine and an inner hyaline frill; exp-2 without setae, with row of spinules distally and with 1 long spinule inserted at midlength on the outer margin; exp-3 with 1 apical and 1 subdistal outer seta, distal hyaline frill on inner margin and 1 larger spinule medially placed on outer margin; enp (Fig. 5E) shorter that half of exp1, outwardly curved and with spinules along inner margin decreasing in length from proximal to distal margin. P5: rectangular, ending in small process on inner margin; armature difficult to observe; possibly as in Noodt (1963).

**Female**: Sexually dimorphic in A1, P3, P4 and genital field. Length 300–310 µm (Noodt's measurement). A1, P3, P4 and genital field as in *R. palaciosi*.

***Remaneicaris drepanephora* (Kiefer, 1967)**
(Figs. 6–7)

**Synonyms:** *Parastenocaris drepanephora* (Kiefer 1967); *Remaneicaris drepanephora* (Jakobi 1972); *Parastenocaris drepanophora* (Löffler 1981); *Parastenocaris drepaneophora* (Dussart 1984); *Parastenocaris drepanophora* (Rouch 1986); *Parastenocaris drepanophora* (Dussart & Defaye 1990); *Parastenocaris drepanephora* (Reid 1998); *Remaneicaris drepanephora* (Corgosinho & Martínez Arbizu 2005)

**Material examined:** The whole type series deposited in the Kiefer's collection at the Staatliches Museum für Naturkunde, Karlsruhe (Germany). *Locus typicus*: Rio Tapajós, near the city of Santarém (Pará Brazil)

**Male**: Length 365 µm from rostrum to distal rim of telson (in accordance with Kiefer 1967, size range vary between 340–380µm from rostrum to telson). Rostrum not fused to Cph, with wide base and 2 sensilla on tip. Cph and Urs-2 with 1 dorsal integumental window. Urs-5 with lateral integumental window on each side of segment. Anal operculum smooth and slightly concave. Furca as depicted for female (Fig. 7G), without row of spinules, shorter than telson, 3 times longer than wide, setae I–III and VII at the distal 1/3 opposite to each other, setae II and III approximately of same size, seta I shorter, seta V the longest, seta IV bipinate, as long as seta VI and shorter than VII, seta VI longer than lateral setae. A1 (Fig. 6A): 9-segmented and haplocer; armature beginning with proximal segment: 0/5/4/2/5+Ae/1/2/1/9+Ae. A2 (Fig. 6B): with allobasis; 1-segmented exp with 1 seta, and 1-segmented enp bearing 7 setae. Md, Mx1, Mx2 and Mxp armature as described by Corgosinho *eta al.* (2005, 2007a, 2007b and 2010a). Mx2: of *Remaneicaris* type, with 2 slender setae on proximal and 3 setae on distal endite. P1 (Fig. 6C): basis with outer seta, 3 spinules on outer margin; enp 2-segmented, enp-1 slightly longer than exp-1 and 2 together, without ornamentation on inner margin, outer margin with 3 spinules at proximal 2/3 and 2 spinules at distal 1/3, with 2 anterior distal spinules; enp-2 with 2 spinules on inner margin, 2 spinules on outer margin, 1 unipinate outer spine and 1geniculated seta 2 times as long as outer spine; exp 3-segmented, exp-1 with outer spine and rows of spinules on outer margin, exp-2 unarmed, with spinules on outer margin, exp-3 with 1 unipinate outer spine on distal 1/3, 1 unipinate distal outer spine and 2 geniculated setae, innermost the longest. P2 (Fig 6D) coxa with posterior row of small spinules; basis without outer seta, ornamented with 1 row of spinules on outer margin, and 1 pore near anterior margin; exp 3-segmented, exp-1 longer than each of the remaining two segments; with PRVS on outer margin, row of spinules anterior to insertion of outer spine, 2 spinules of different sizes distal to outer spine and inner hyaline frill; exp-2 without armature, with 1 spinule medially on outer margin and row of distal spinules of unequal size at distal margin; exp-3 with 1 spinule located medially on outer margin, distal hyaline frill, 1 unipinate subapical spine, 1 unipinate seta and 1 bipinate apical setae, outer seta shorter than inner one; enp 1-segmented, longer than 1/2 exp-1, with 1 distal smooth seta, 2 distal spinules and 3 spinules on outer margin. P3 (Fig. 6E): coxa with posterior row of small spinules; basis with outer seta; enp short, spine-like and without ornamentation; exp 1-segmented, straight, with row of 4 large spinules on proximal 2/3 and 4 strong spinules on distal 1/3; last distal spinule modified, with hyaline lamella on inner margin; apophysis short, triangular, covered by hyaline lamella; thumb is shorter than apophysis, inward curved, with blunt tip. P4 (Fig. 6F): basis with outer seta and 1 pore on anterior margin; exp 3-segmented, exp-1 longer than each of the remaining two segments with PRVS on outer margin, row of spinules anterior to insertion of outer spine, 2 spinules of different sizes distal to outer spine and inner hyaline frill; exp-2 without armature, with 1 spinule medially on outer margin and row of distal spinules of unequal sizes at distal margin (innermost spinules smaller than outermost ones); exp-3 with 1 bipinate apical seta and 1 bipinate spine at 2/3 of outer margin, 1 distal hyaline frill, 2 spinules medially on outer margin; enp longer than half of exp-1, straight on outer margin, tapering distally at inner margin, with spinules along inner surface decreasing in length from proximal to distal margin..P5 (Fig. 6G): without intercoxal sclerite, 2 plate not fused to the somite, rectangular, ending in small process on inner margin, with 1 long outer seta and 3 smooth distal setae, distalmost seta the longest, proximalmost seta the shortest.

**Female**: Sexually dimorphic in A1, P3, P4, furca and genital field. Length 360 µm, from cph to distal rim of telson. Rostrum as in male. For sensila see figure 7A. Dorsal integumental windows on cph and double genital somite; lateral window on Urs-4. Telson as it is in male in Fig. 7F, with 2 ventral spinules on Fig. 7B. Furca variable, proximally inflate, slightly piriform in specimen depicted in Fig. 7B, 2.8 times longer than wide in 7B, with small proximal concavity (Fig. 7G), about 3 times longer than wide in 7B and F, dorsally ornamented with 2 rows of spinules on 7B, both varieties with dorsal and ventral rows of spinules distally; setae I–III and VII on distal 2/3 opposite to each other, setae II and III approximately of same size, seta I shorter, seta V the longest, seta IV

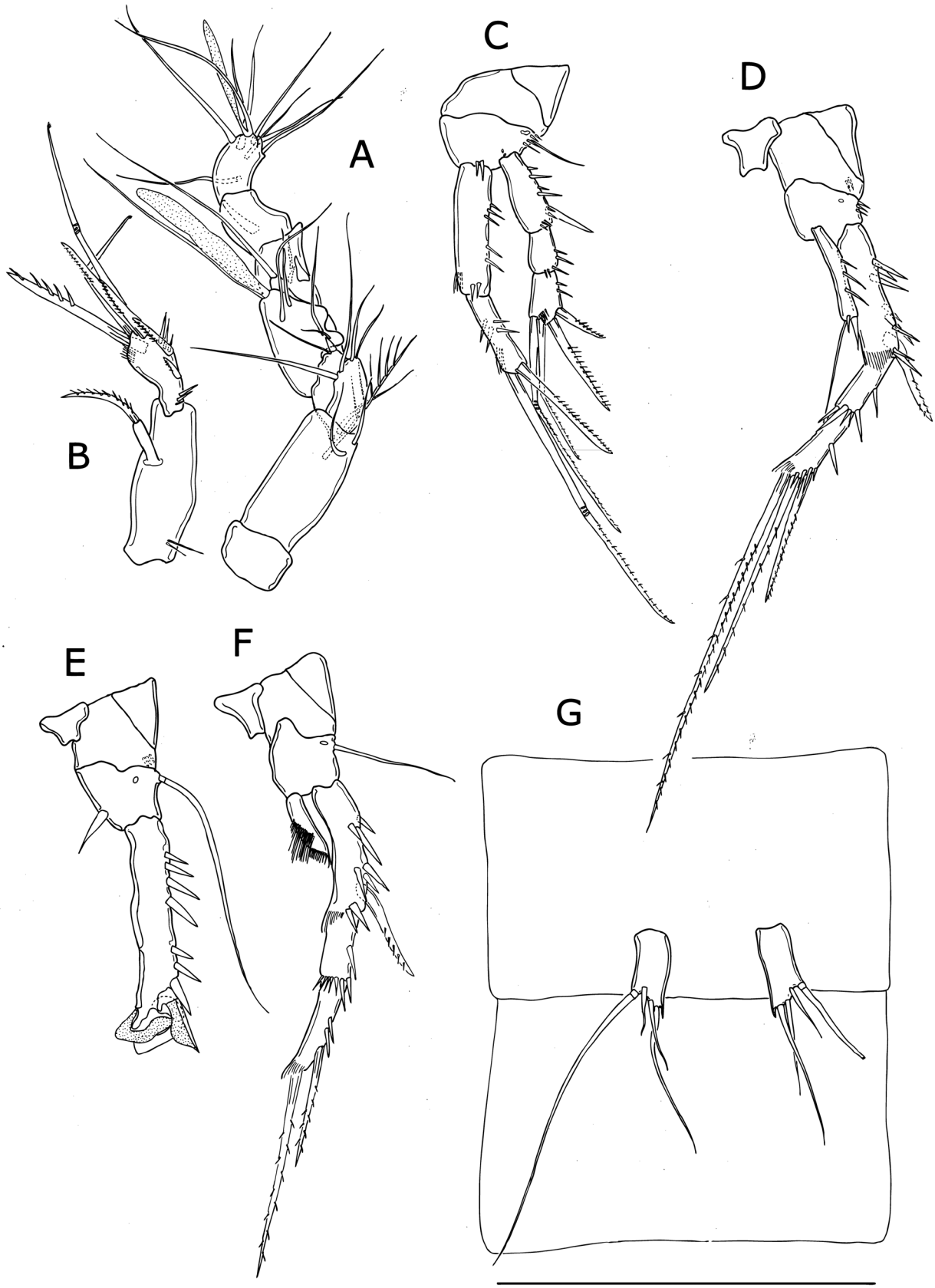


**FIGURE 6.** *Remaneicaris drepanephora* (Kiefer, 1967), male. A, antennule; B, antenna; C, P1; D, P2; E, P3; F, P4; G, P5, Urs-1–2. Scale bar= 50μm.

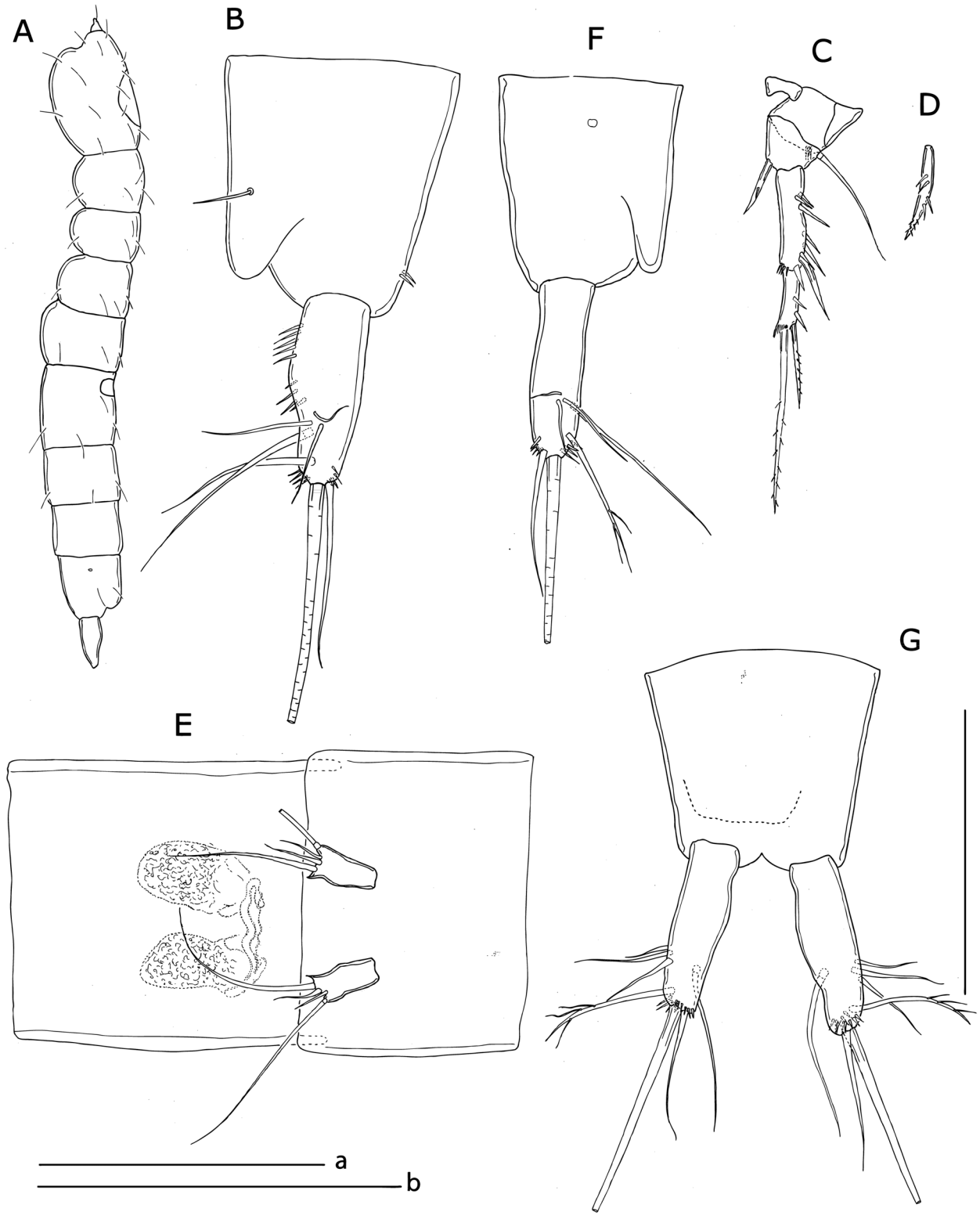


**FIGURE 7.** *Remaneicaris drepanephora* (Kiefer, 1967), female. A, habitus schematic, lateral view; B) telson, and furca, lateral view; C, P3; D) enp, P3; E, P5 and Urs-1, genital double somite; F, telson and furca, lateral view; G, telson and furca, ventral view. Scale bar= 50μm.

bipinate on 7F, as long as seta VI and VII on 7B and shorter than VII in 7F and G, seta VI longer than lateral setae. A1: 7-segmented; number of setae beginning at proximal segment: 0/4/5/2+Ae/1/2/9+Ae. A2: as it is in male. P3 (Fig. 7C): basis with one outer seta, an outer pore and row of spinules on posterior margin; exp 2-segmented, exp-1

with proximal row of spinules, an outer spine, row of spinules before insertion of outer spine, 1 spinule distal to outer spine and row of small spinnules distally on inner margin; exp-2 with 1 outer unipinate spine, 1 bipinate distal seta, 1 spinule medially on outer margin and 1 spinule near the outer spine; enp 1-segmented and spiniform, longer than half of exp-1 with 1 spinule on outer margin. P4: enp (Fig. 7D) dimorphic, spiniform, with 2 anterior spinules on inner margin, 2 posterior spinules on outer margin and some alternated spinules distally. P5 (Fig. 7E): as in male. Genital field with 1 medially located copulatory pore. Gonopore with transverse slit.

***Remaneicaris siankaan* sp. nov.**
(Figures 8–15)

**Holotype:** One dissected male mounted on 3 slides (ECO- CH-Z-09331). **Paratypes:** allotype 1 ♀ on 1 slide; 4 ♂♂ dissected mounted in individual slides. 60♀♂ preserved in 96% ethanol and deposited at the Zooplankton Collections of El Colegio de la Frontera Sur in Chetumal, Mexico (No: ECO- CH-Z-09332). Coll. by Nancy F. Mercado-Salas.

**Etymology.** The species name is noun in apposition that refers to Sian Ka´an Biosphere Reserve in which the specimens were collected; Sian Ka´an in Mayan language means "heaven's door" or "place where heaven begins".

**Type locality.** Aguada Vigía Chico (S1), Sian ka´an Biosphere Reserve, Quintana Roo, Mexico (19°47´00.72´´ N, 87°36´37.1´´W), coll. 20. Sept. 2014 by Nancy F. Mercado-Salas. Samples 96% ethanol preserved. Animals were sorted out from water collected in the leaves of the bromeliad *Tillandsia dasyliriifolia* Baker. Additional material in Table 1.

**Male.** Habitus (Fig. 8A, B and Fig 13B). Length 355µm (measured from tip of rostrum to distal rim of telson). Rostrum not fused to Cph. Cph with 1 integumental window and 1 dorsal pore. One dorsal pore on first and 3rd thoracic somites. Urs-2 with 2 integumental pores and 1 dorsal integumental window (slightly extended laterally). Urs5 with 1 dorso lateral integumental window and ornamented with uneven cuticle over the entire surface, including integumental window. Telson (Fig. 8A, B, D and Fig. 14D, F) with dorsal, continuous row of spinules near to anal operculum; telson ornamented with uneven cuticle over the entire surface. Anal operculum convex, flanked by4 spinules on each side. Furca shorter than telson 2.4 times longer than wide, proximally convex on inner margin, Setae I–III and VII located approximately at ½ of total length, opposite to each other; seta II–IV approximately of same size, seta I about half of length of setae II–IV; seta V the longest, seta VII longer than setae II–IV –approximately 1.7 times longer. Strong spinules on proximal margin of furca. A1 (Fig. 9A, Fig. 15A and D): 8-segmented, haplocer, prehensile, geniculation between segments 3–4 and 6–7;armature formula 0/5/1/1/3+Ae/1/?/7+Ae**.** A2 (Fig. 9B, C): Allobasis with 2 rows of spinules on frontal surface. Exp 1-segmented bearing 1 strong seta, 1-segmented enp with 7 setae and row of small spinules on insertion of apical setae. Mx1 (Fig. 9D): precoxal arthrite with 4 elements (3 claw-like spines and one slender seta), coxa with one seta, basis with 2 endites with 1 and 2 setae (1 seta missing); enp and exp absent. Mx2 (Fig. 9E): precoxa and coxa fused, coxa with 2 endites, proximal endite with 2 setae, distal endite with 2 slender setae, basis with endite drawn into strong chitinized claw, enp 1-segmented, bearing 2 distal setae equal in size. Mxp (Fig. 9F): subchelate, composed of syncoxa, basis, 1-segmented enp and 1 claw-like apical seta. Claw-like apical seta ornamented with small spinules on inner margin. P1 (Fig. 10A, B): basis with short outer seta, row of spinules on insertion of outer seta; distally with 2 spinules at base of enp. Enp 2-segmented, enp-1 1.3 times longer than enp2 and slightly longer than exp-1 and exp-2 together, outer margin with 2 strong spinules at proximal 1/3 and 2 strong unequal spinules at distal 1/3; diagonal row of spinules at distal 1/3, distal hyaline frill; enp-2 with 2 spinules on medial outer margin, inner margin with group of spinules that extends on caudal surface, apical edge with 1 unipinate outer spine and 1 geniculated seta, about 2.7 times longer than outer spine. Exp 3-segmented, exp-1 with 1 unipinate outer spine, outer margin ornamented with 1 strong spinule at middle margin and two smaller spinules at distal 1/3, distal hyaline frill; exp-2 ornamented on outer edge with 1 strong spinule at distal 1/3, two small spinules located proximally to strong spinule and 4 small distal spinules; exp-3 with 4 unipinated elements: 2 outer spines (1 lateral and 1 apical) and 2 geniculated apical setae, innermost the longest one.P2 (Fig. 10C,15E): basis without outer seta, with an anterior pore relatively close to outer margin, row of spinules on outer margin and row of small spinules near to enp insertion. Enp 1 –segmented, about 0.6 times as long as exp-1, armed with one long apical seta, two strong apical spinules and 2 outer spinules on distal half. Exp 3-segmented, exp-2 and exp-3 about same length, exp-1 elongated, approximately

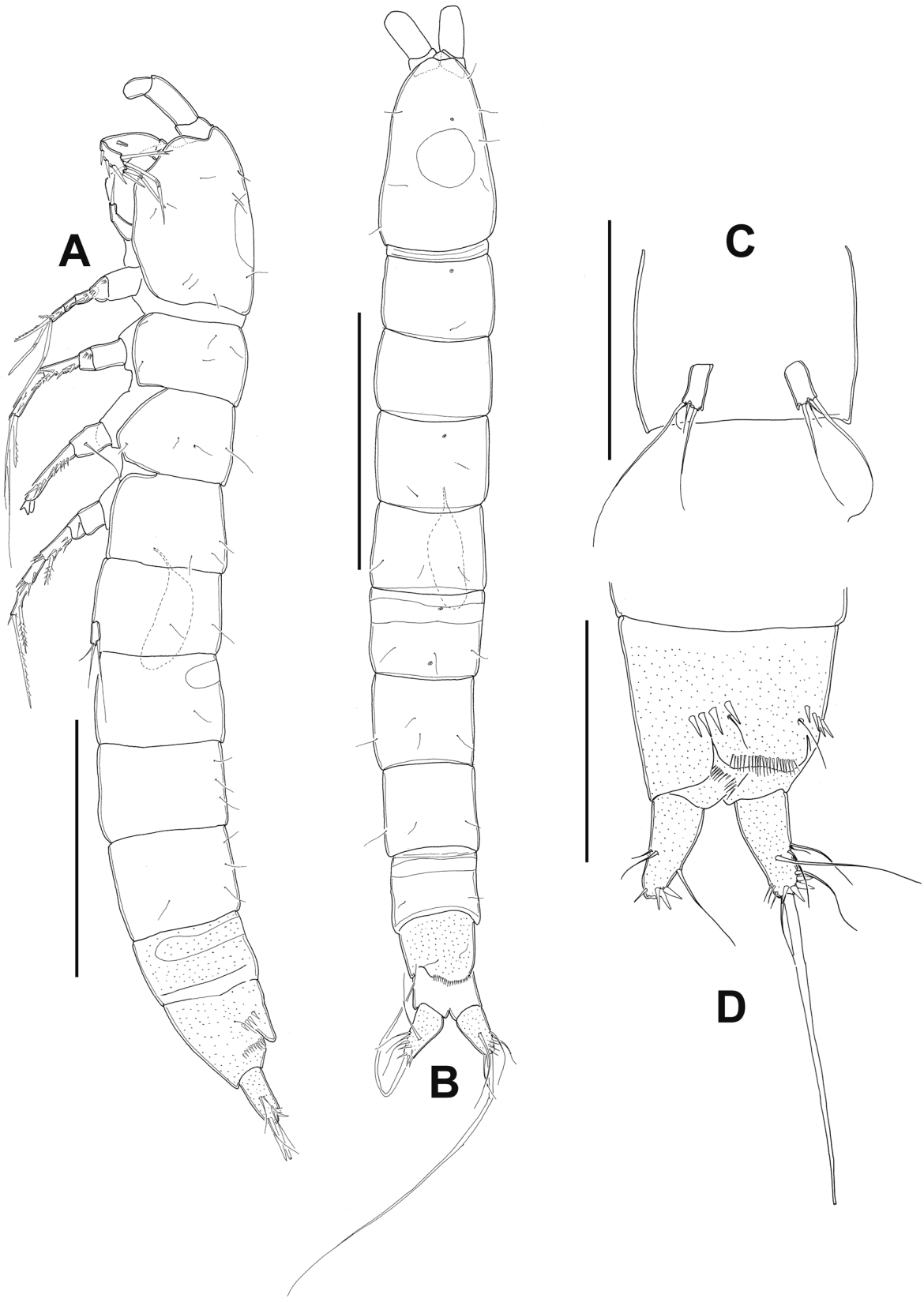


**FIGURE 8.** *Remaneicaris siankaan* **sp. nov.** male. A, habitus, lateral view; B, habitus, dorsal view; C, P5; D, telson and furca, dorso-lateral view Scale bars A, B= 100 µm, C, D=50µm.

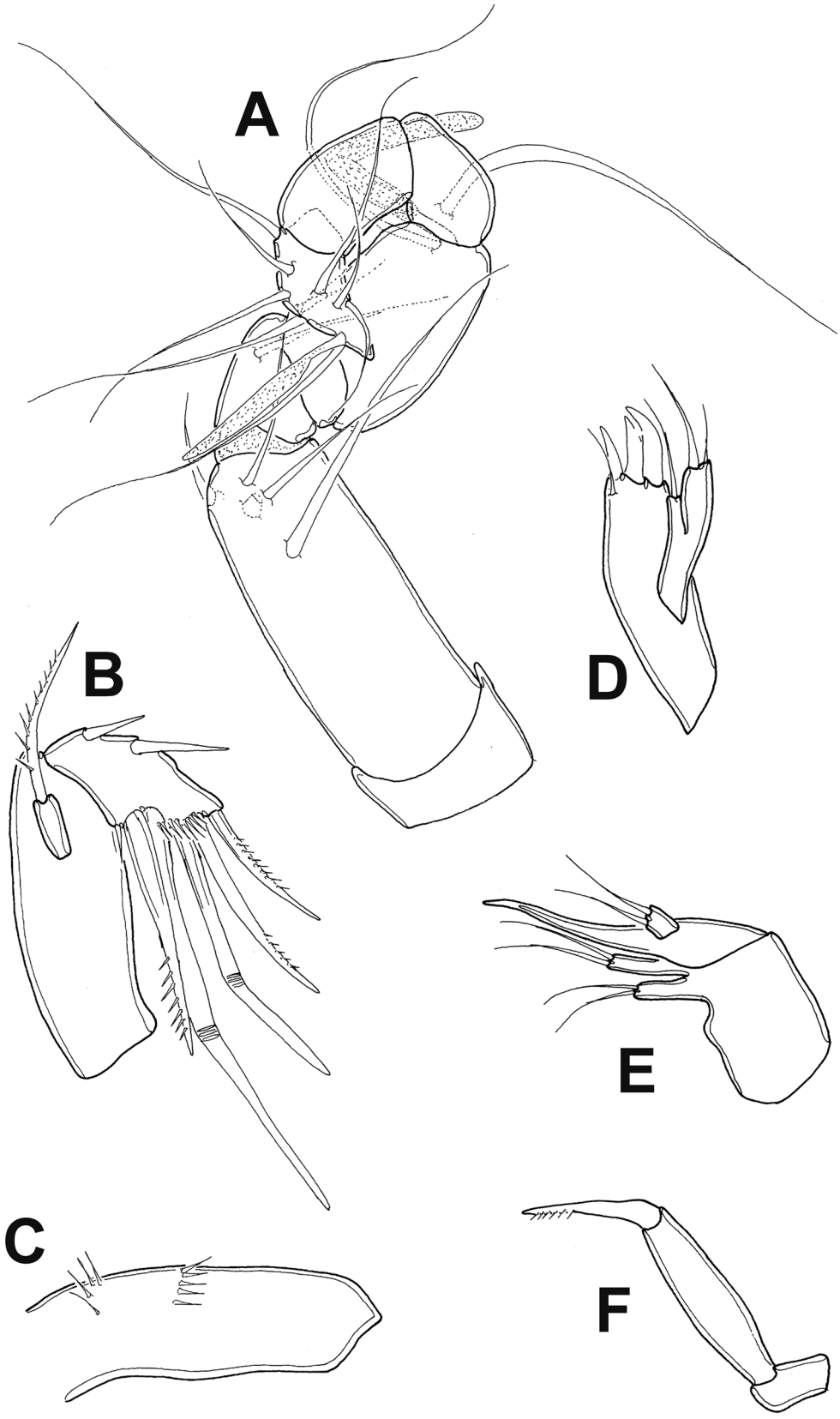


**FIGURE 9.** *Remaneicaris siankaan* **sp. nov.** male. A, A1; B, A2, frontal view; C, A2 allobasis, caudal view; D, Mx1;E, Mx2; F, Mxp. Scale bar = 25 µm.

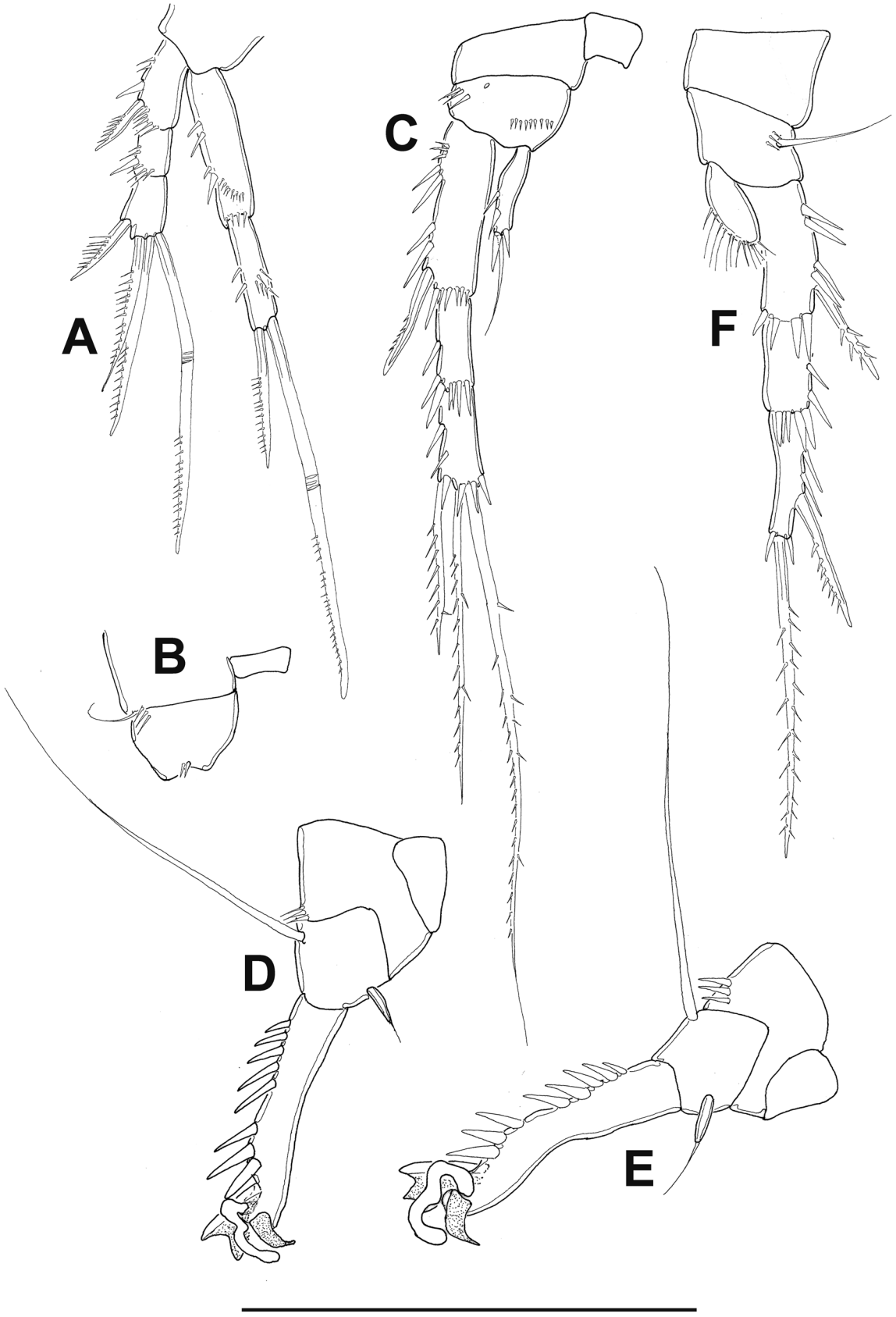


**FIGURE 10.** *Remaneicaris siankaan* **sp. nov.** male. A, enp and exp P1; B, coxa, basis and coxal sclerite P1; C, P2; D, P3; E, P3; F, P4. Scale bar = 50 µm.

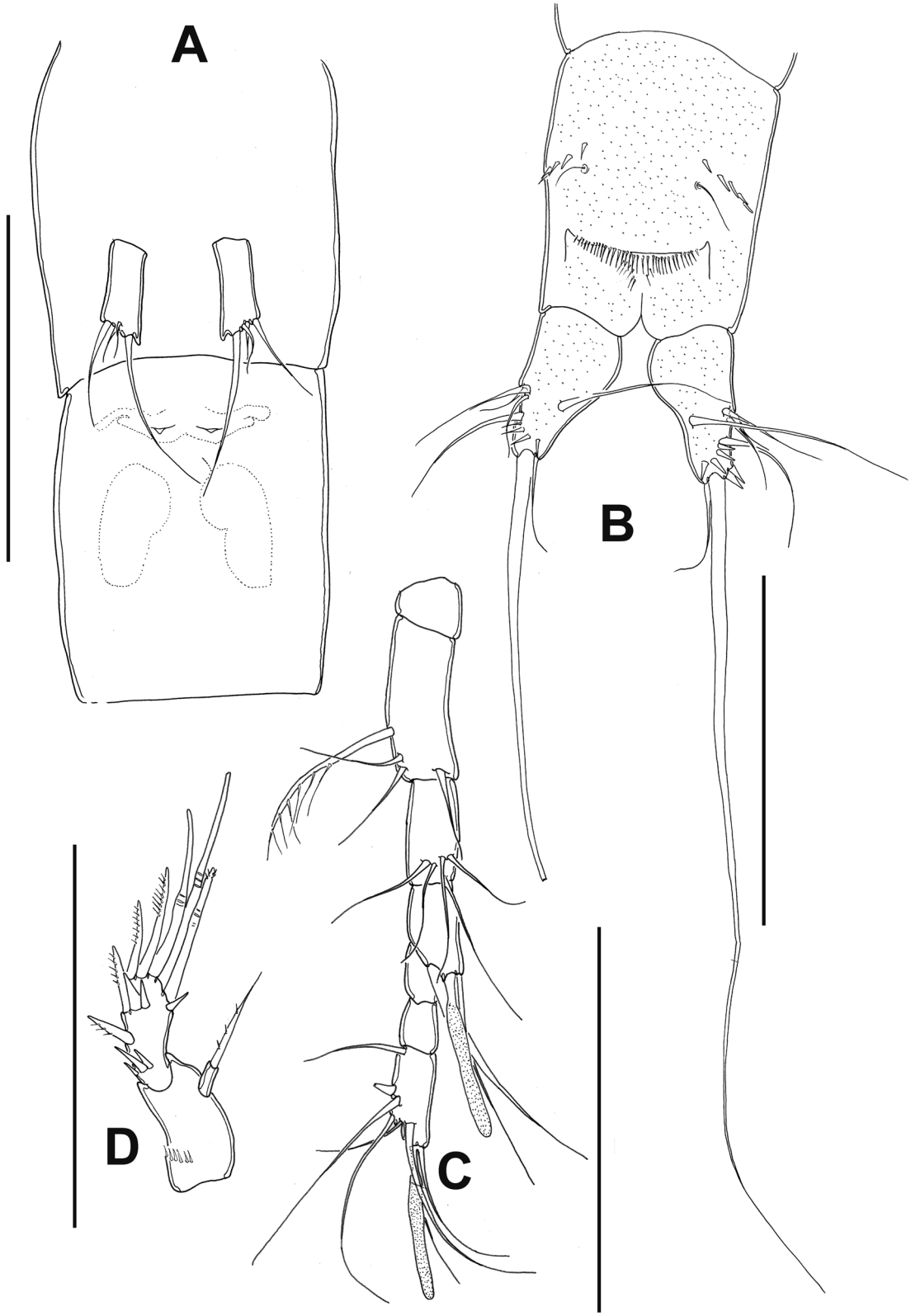


**FIGURE 11.** *Remaneicaris siankaan* **sp. nov.** female. A, P5 and Ur-1, genital double somite; B, telson and furca, dorsal view; C, A1; D, A2. Scale bars = 50μm.

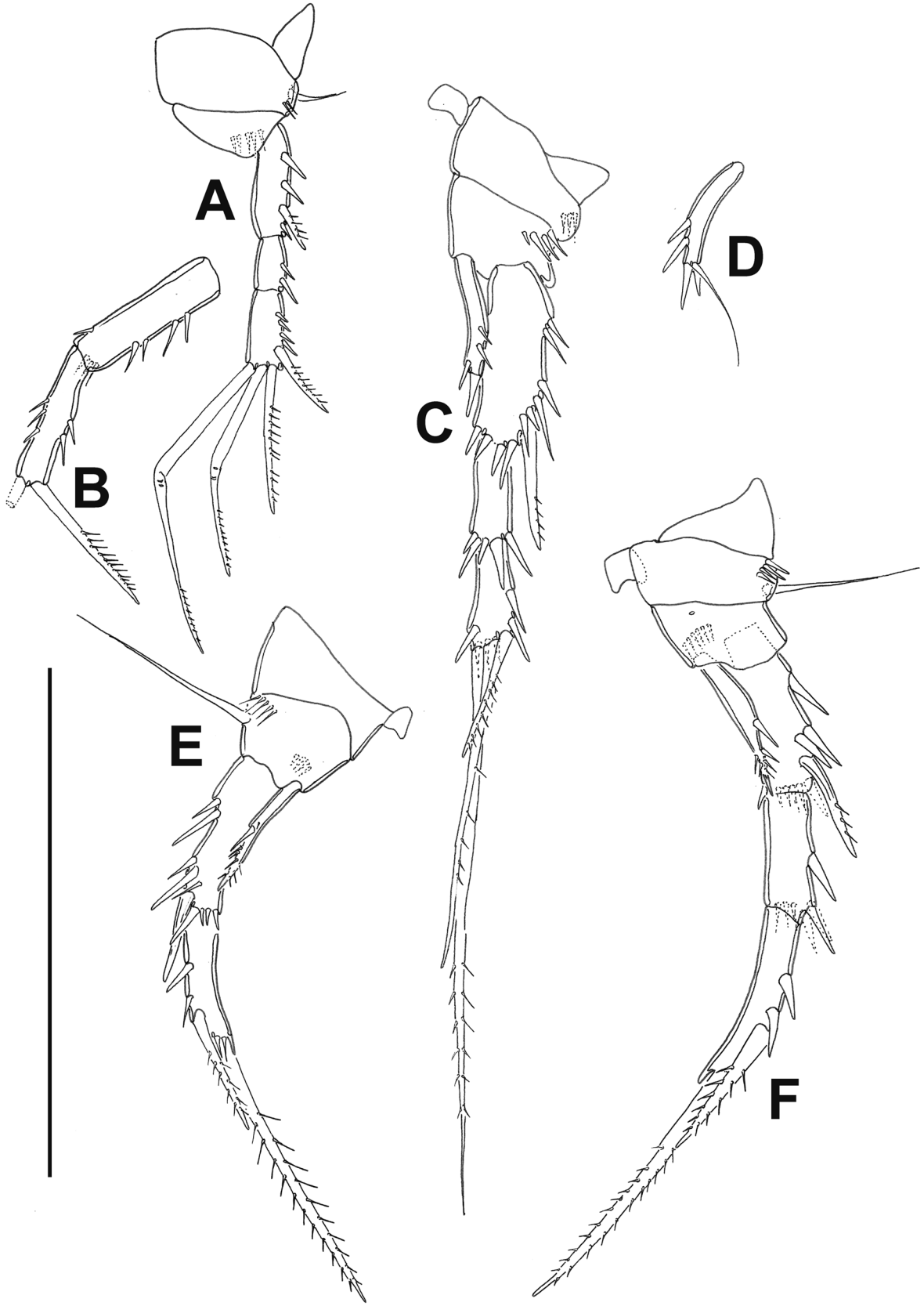


**FIGURE 12.** *Remaneicaris siankaan* **sp. nov.** female. A, P1; B,Enp P1; C, P2; D, enp P2; E, P3; F, P4.


**FIGURE 13** (CLSM_Plate1). *Remaneicaris siankaan* **sp. nov.** confocal laser scanning microscopy images. A, habitus of female, lateral view; B, habitus of male, lateral view. Scale bars = 50µm.

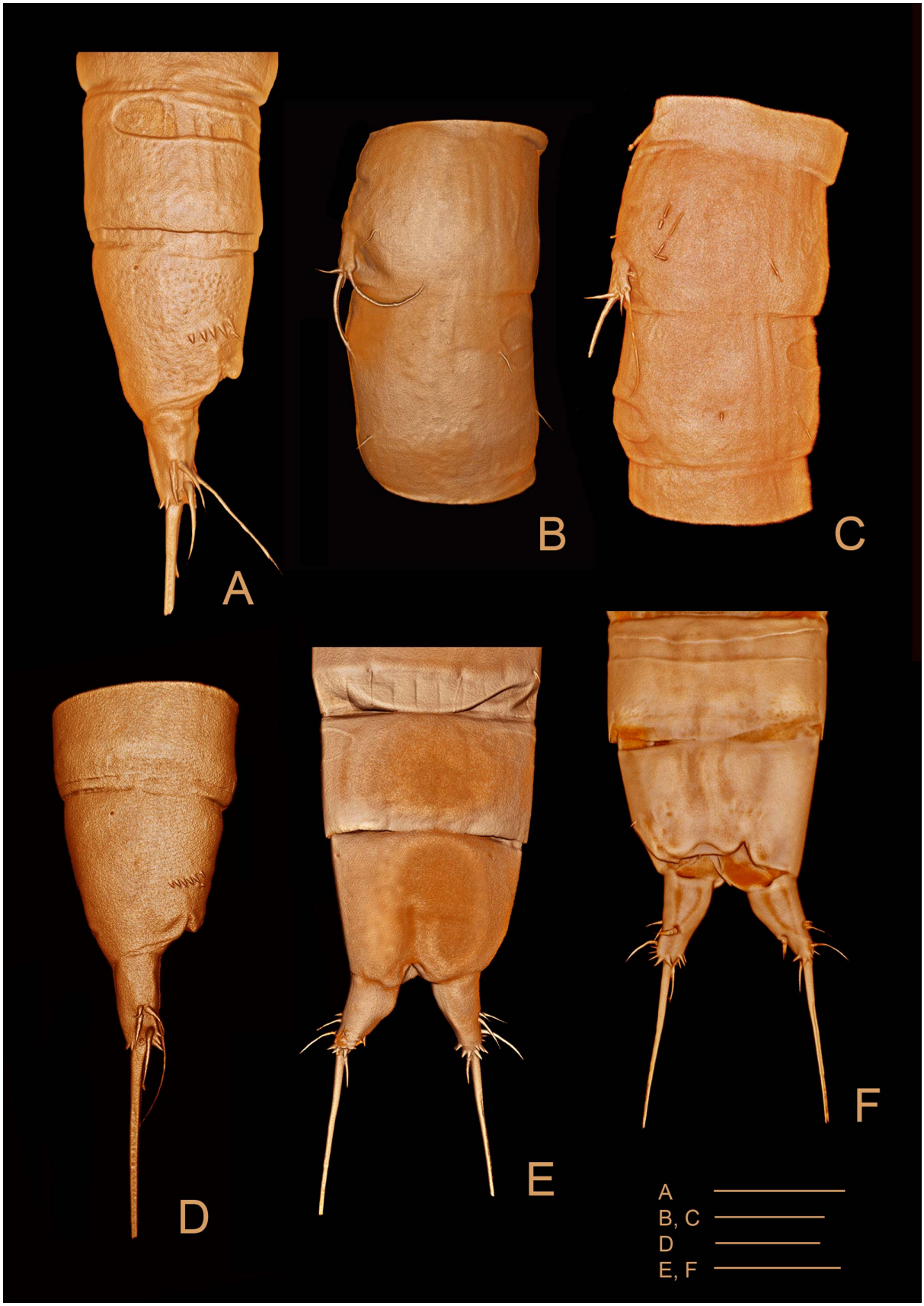


**FIGURE 14** (CLSM_Plate2). *Remaneicaris siankaan* **sp. nov.** three-dimensional representation (Drishti software) based on confocal laser scanning microscopy images. A, B, female. C–F, male. A, Urs-4, telson and furca, lateral view; B. P5 and Urs-1, genital double somite, lateral view; C, Urs-1–2, P5 and P6, lateral view; D, Urs-5, telson and furca, lateral view; E, Urs-5, telson and furca, ventral view; F, Urs-5, telson and furca, dorsal view Scale bars = 50 µm.

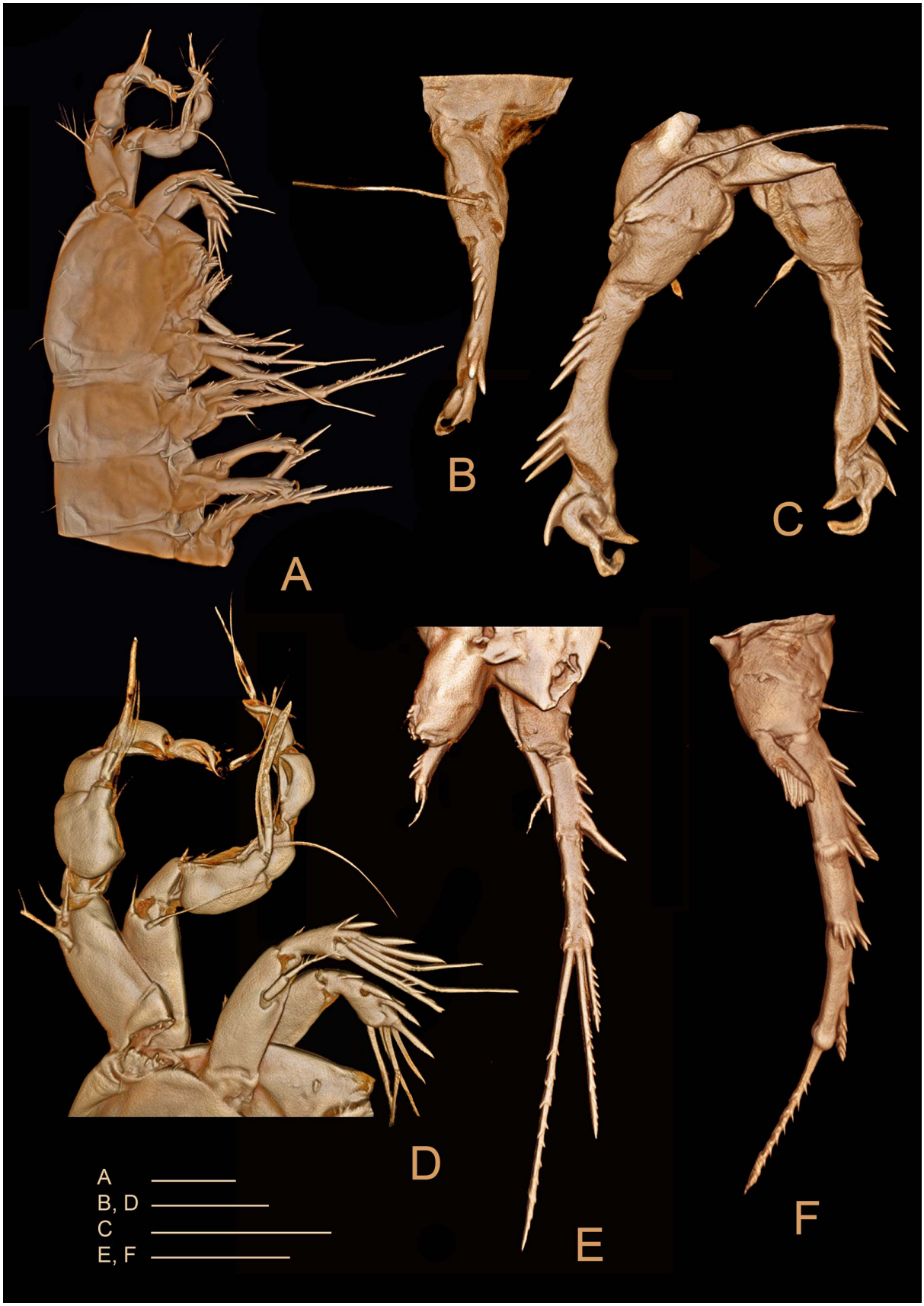


**FIGURE 15** (CLSM_Plate3). *Remaneicaris siankaan* **sp. nov.** three-dimensional representation (Drishti software) based on confocal laser scanning microscopy images. Male. A, Prosome, lateral view; B, exp P3; C, P3; D, A1 and A2; E, P2; F, P4. Scale bars = 50 µm.3

1.6 times longer than exp-2 and exp 3. Exp-1 with 1 outer distal spine, outer margin ornamented with three small spinules and two long strong spinules at proximal 1/3 and 2 strong spinules at distal 1/3, distal hyaline frill; exp-2 without outer spine but ornamented with 3 strongly chitinized spinules, 1 at middle margin and 2 apical, distal hyaline frill; exp-3 with 3 not simetrically bipinnate elements on apical edge, 1 short outer, spine; 1 long medial seta, and 1 longer inner, seta, inner seta the longest one. P3 (Fig. 10D, E and Fig. 15B, C): coxa with row of small spinules near insertion of basis on outer margin, basis with long outer seta. Enp 1-segmented, approximately 1/6 of total length of exp, bearing a small apical seta. Exp 1-segmented, elongated with 5 strong chitinized spinules at proximal half and 3 strong chitinized spinules on distal 2/3, 1 modified spinule on distal 1/3, modified spinule with hyaline lamella along anterior half, appearing as a hitherto unique bifid structure; apophysis triangular, ending in a blade-like hyaline lamella, thumb long, twice curved inwards, ending in a rounded tip. P4 (Fig. 10F and Fig. 15F):, basis with 1 outer seta and row of small spinules on its insertion. Enp 1-segmented, about 0.6 times as long as exp-1, oval-shaped covered with numerous long spinules along inner margin, outer margin bare. Exp 3-segmented, tapering progressively, exp-1 and exp-3 about the same length, exp-2 slightly shorter (0.7 times as long as exp-1 and exp-3); exp-1 with 1 bipinnate outer spine, outer margin with 2 strong spinules at proximal 1/3 and 2 strong spinules near to outer spine insertion, hyaline distal frill, exp-2 bearing 1 strong medial spinule on outer margin and 1 strong spinule at distal 2/3, hyaline distal frill; exp-3 with 1 long bipinate apical seta (about 1.7 times longer than exp-3) and 1 seta, inserted at distal 2/3 of outer margin, outer margin ornamented with two strong spinules located at ½. P5 (Fig. 8C and Fig. 14C): 1-segmented, subcuadrated, 2.5 times longer than wide; without intercoxal plate and with small distal process on inner margin; all setae inserted distally. Innermost seta long, two medial setae about the same length, outermost seta the longest one, (1.7 times longer than innermost seta and 5.7 times longer than medial setae).

**Female**: Habitus (Fig. 13A). Sexually dimorphic in A1, P3, P4, P5 and genital field. Rostrum as in male. Integumental windows in cph ,urs-2 and4 (Fig. 13A, 14A). Telson and furca as in male (Fig. 11B, 14A). A1 (Fig. 11C): 7-segmented; number of setae beginning at proximal segment: 0/4/5/2+Ae/0/1/7+Ae. A2 (Fig. 11D): as in male but weakly ornamented. P1 (Fig. 12A, B) and P2 (Fig. 12 C, D) as in male. P3 (Fig. 12E): basis with 1 outer seta and row of spinules near to insertion of enp; enp 1-segmented and spiniform, with 1 strong spinule at half outer margin and distal spinules. Exp 2-segmented, exp-1 1.2 times longer than exp-2, exp-1 bearing 1apical spine on outer margin and ornamented with two unequal spinules at proximal 2/3 and three unequal spinules at distal 2/3, hyaline distal frill; exp-2 with 1 long bipinated apical seta and 1 shorter seta displaced medially on outer margin, outer margin ornamented with 2 spinules, 1 at ½ and 1 at distal 2/3; P4 (Fig. 12F): exp as in male, weakly ornamented, with enp not oval-shape and bearing stronger spinules. P5 (Fig. 11A and Fig. 14B): 1-segmented, subcuadrated, 2.5 times longer than wide; without intercoxal plate and with small distal process on inner margin; all setae inserted distally. Innermost seta the longest one, two medial setae about the same length, outermost seta long, outermost seta 0.6 times as long as innermost seta and 2.5 times longer than medial setae). Genital field (Fig 11A) is 1 horizontal slit on proximal margin of genital double somite (Fig. 14B).

## Discussion

The genus *Remaneicaris* is a morphologically diverse group. It can be easily identified by the presence of a number of apomorphies (Corgosinho *et al.* 2007a,b, 2010a; Ranga Reddy *et al.* 2014), and some plesiomorphies which cannot be found in other Parastenocarididae species, but appearing only in some potentially related Harpacticoida families (see Martínez Arbizu & Moura 1994; Bruno *et al*. 1998). Within this speciose genus, the correct separation of species into monophyletic groups is based on the subtle spinulation and other ornamentation patterns of the cuticle. For example, some species-groups (viz. *R. argentina*, *R. tridactyla*, *R. persephone*, *R. cordobaensis* and *R. analuizae*) can be well characterized by the shape of the outer row of spinules on the proximal region of the exp-1 of P2 and P4 (Corgosinho *et al.* 2010a). The *R. analuizae*-group can be only well defined by the presence of a hyaline structure on the last segment of the male A1. The *R. argentina*-group can be recognized by the characteristic hyaline margin on the apophysis, the presence of a modified spinule near the thumb of P3 and the absence of an inner row of spinules on the enp-1 of P1 (Corgosinho *et al.* 2010a). Similarly, the *R. persephone* and *R. cordobaensis*-groups, are well supported by the presence of 2 setae or spines on the female P6 (Corgosinho *et al.* 2010a). It is particularly interesting the male P3 in the *R. argentina*-group. In accordance with Noodt (1965), the

thumb is formed by a bifid spine. This could permit some consideration of the possible homology between the thumb seen in the *R. argentina*-group and the real complex and trifid thumb of *R. tridactyla* and *R. paratridactyla* (Corgosinho *et al.* 2007b). However, the mentioned "bifid thumb" of *R. jujuyensis*, *R. argentina* and *R. clandestina* is an observation artifact caused by the insertion of a strong spinule proximally to the thumb, close to the thumb's insertion.

*Remaneicarissiankaan* **sp.nov.** can be easily accommodated within the genus *Remaneicaris* on the basis of the following apomorphies present in both sexes: 1) P4 with exp-3 outer seta at 2/3 of the outer margin, 2) the presence of a long spinule medially on outer margin of exp-2 and 3 of P2 and P4 (Corgosinho & Martínez Arbizu 2005).

The new species can be distinguished from its congeners by having 8-segmented vs. 9-segmented male A1 (Corgosinho *et al.* 2007b). The 8-segmented condition in males is present in other genera within the Parastenocarididae family such as *Murunducaris* Reid, 1994*, Brasilibathynelocaris*, *Simplicaris* Galassi & de Laurentiis, 2004, *Kinnecaris* Jakobi, 1972 (Schminke 2008), *Proserpinicaris* Jakobi, 1972 (Karanovic et al., 2012), *Siolicaris* Jakobi, 1972 (Corgosinho et al 2012), *Himalayacaris* Ranga Reddy et al. 2014, *Indocaris* Ranga Reddy et al 2016, and in many *Parastenocaris* Kessler, 1913 species (ex: *P. trichelata* Reid, 1994; *P. hispanica* Martínez Arbizu, 1997). Here we consider this as a convergent autopomorphic character resulting from the non formation of a short segment after the proximal aesthetasc bearing segment (5th) and the 6th segment of the A1. The new species has 3 segments distal to the proximal aesthetasc bearing segment, instead of 4 as it is usually found in other members of *Remaneicaris* (Corgosinho *et al.* 2007b).

*Remaneicaris siankaan* **sp. nov.** can be easily included within the *R. argentina*-group due to the following characters, which we consider synapomorphic for this monophylum: 1) the presence of a hyaline membrane on apophysis, (2) a modified spinule on the distal margin of the exp1 of male P3, juxtaposed to the thumb insertion, and (3) the absence of an inner row of spinules on the inner margin of enp-1 of P1 (Corgosinho *et al.* 2007b, 2010a). In *R. siankaan* **sp. nov.** character 2 is represented by a strong modified spinule with a hyaline membrane attached only to the anterior half, appearing as a hitherto unique bifid structure. In other members such as *R. drepanephora, R. argentina* and *R. jujuyensis* the entire inner margin of the spinule is hyaline, its shape and size differing among the species.

Additionally, the species belonging to the *R. argentina*-group share the absence of a row of spinules on the inner margin of enp-1 of P1, which convergently appears in *R. ignotus*, and the absence of an inner row of spinules on exp-2 of P4 is considered plesiomorphic, and this character is also shared with the basal *R. ignotus* and *R. meyerabichi* (Corgosinho *et al.* 2007a, 2010a).

Within *Remaneicaris,* only *R. paraguayensis* and *R. divae* share the hyaline apophysis on P3. However, these species belong to different monophyletic groups, respectively *R. tridactyla*-group and *R. analuizae*-group. A closer observation of the characters of male P3 revealed that in *R. divae*, the apophysis is a hyaline bud at the distal rim of straight P3 and the thumb is a very long and straight spine, without the adjacent modified spinule. In *R. paraguayensis*, the hyaline margin surrounds the whole rounded apophysis and without having a modified spinule at the distal rim of exp1 of P3. In the *R. argentina*-group, on the contrary, the apophysis is very characteristic in shape, with a well developed hyaline margin, which is inwardly turned (commonly with a "pointed" edge) at the end of a straight exp, conferring to it a final angle of approximately 90° with the main exp axis. Thus, the presence of this character within *Remaneicaris*, outside the *R. argentina*-group should be interpreted as a homoplasy.

Within the *argentina*-group, *R. argentina*, *R. drepanephora*, *R. jujuyensis, R. hurdi* and *R. siankaan* **sp. nov.** are closely related to each other, sharing the presence of a hyaline margin on the modified spinule, near the thumb. The modified spinule does not have any hyaline margin in *R. palaciosi* and *R. clandestina.* It is important to mention the close relationship between *R. jujuyensis* and *R. hurdi*. Both species seem to share the same morphology of the male P3, especially a very long and blade-shaped enp and a strong, curved and pointed thumb preceding a very characteristic hyaline margin on the apophysis. Unfortunately, due to the absence of the type of *R. hurdi* and the incomplete description provided by Jakobi & Silva (1962), it is really difficult to say if *R. jujuyensis* and *R. hurdi* are the same species or very closely related species.

According to Noodt (1965), the species from the *R. argentina*- group should be closely related to *R. icoaraci.* However, this species belongs to a larger monophyletic group composed by the *R. tridactila*-group, *R. cordobaensis*-group and *R. persephone*-group, with which it shares a very peculiar ornamentation of the basis of male P4, as well as the presence of a modified seta on the last segment of the male A1 (Corgosinho *et al.* 2010a; figure 12, group D).

The new species also presents a characteristic dimorphism in the P5 in that the outermost apical seta is longer than the innermost seta in the males whereas the innermost seta is about 1.6 times longer than the outermost one in the females. Within the *R. argentina*-group, the P5 dimorphism is only shared with *R. argentina* and *R. jujuyensis* (see Noodt, 1965).

The presence and location of integumental windows and their value in the reconstruction of the phylogeny of some Parastenocarididae have been largely discussed (Reid 1994; Corgosinho & Martínez 2005; Corgosinho *et al.* 2007a, b; 2010a; Schminke 2009; Reddy et al. 2014) and a parsimonious hypothesis about their transformations is yet to be established. In the genus *Remaneicaris*, only the basal species *R. ignotus* has one dorsal window each on Cph and Urs-2–5. The remaining *Remaneicaris* species share the presence of one dorsal window on the Cph, one dorsal window on the Urs-2 (divided into two parts in species related to *R. persephone*), and one lateral window on the Urs-5; only in *R. analuizae* one lateral window has been observed on the Urs-4–5. *Remaneicaris siankaan* **sp. nov.** together with *R. palaciosi* and *R. meyerabichi* have one dorsal integumental window on the Urs-5, extending from the dorsal surface to the lateral margins in the new species. *Remaneicaris siankaan* **sp. nov.** shares with the basal *R. ignotus* the presence of sclerotized uneven cuticle. In *R. siankaan* sp. nov, it is present on the Urs-5 and telson, and in *R. ignotus* the whole body is covered by a heavily sclerotized pitted cuticle. This character is not shared by other members of the *R. argentina*-group.

**The *Parastenocaris ahaggarica* problem.** All *Remaneicaris* species share as a synapomorphy of the subdistal position of the outer seta on exp-3 of P4, as well as some clear plesiomorphies such as the presence of enp on male P3 and two setae (instead of only one) on the first endite of Mx2. Outside *Remaneicaris*, only *P. ahaggarica* from Algeria, have both the aforementioned characters, and also shares with *R. argentina* and *R. drepanephora* the characteristic enp of male P4, the shape of P5, the apparent hyaline margin on the apophysis of P3 of males and the modified distal spinule on the exp-1 of the same limb and therefore, could be included in *Remaneicaris*, within the *R. argentina*-group. However, the presence of a long spinule on the inner margin of enp 1 of P1 rises some questions about the close relationship of *P. ahaggarica* with *R. argentina* and *R.drepanephora*, since within *Remaneicaris* a row of spinules on the inner margin of P1 enp-1 is absent in the *R. argentina*-group only and constitute what Corgosinho *et al.* (2010a) consider a very distinctive autapomorphy for this monophylum. Additionally, nothing is as yet known about the relative position of its P5 and intercoxal sclerite, and also the integumental windows in *P. ahaggarica*.At the moment, and considering the aberrant Mx1 described by Bozic (1978) for *P. ahaggarica* (which we tend to consider erroneous) together with the lack of detailed information about other key characters, it is premature to include *P. ahaggarica* within *Remaneicaris*. The North-African species may well belong to the sister-group lineage of *Remaneicaris* and represent a still undescribed genus. The family Parastenocarididae is present in all continents, with the exception of Antartica, Tasmania and New Zealand (Schminke 1981). The close relationship of *P. ahaggarica* to *Remaneicaris*, either within the genus or as a sister-taxon, would extend the biogeographic presence of this basal taxa to the African continent and the lineage should then be considered Gondwanan rather than Neotropical. Supporting evidence was published recently by Corgosinho *et al.* (2012) who revised the genus *Siolicaris*, extending its geographical distribution from South America to India and Ranga Reddy *et al.* (2014, 2016), who proposed a close relationship of *Remaneicaris* with the indian *Himalayacaris* and *Indocaris*.

**Ecology and distribution.** Species of the *R. argentina*-group occur in Central and South America, with most of them having been reported from the austral region of South America (Fig. 16; full yellow circle *R. siankaan*; other *R. argentina*-group species A, B, E, K, J, N). This pattern is more due to the lack of sampling campaigns in great part of South and Central America rather than a real biogeographic trend, as evidenced by the presence of many new species recently discovered by the first author in Central Brazil. These discoveries are still under study and are the result of extensive field study in the hydrographic basins of the rivers Tocantins, São Francisco, Jequitinhonha, Paraná and Paraguay, financed by the project SISBIOTA (CNPq 563318/2010-4/ FAPESP 2010/ 52318-6) (Corgosinho unpubl.). The most common habitat for the members of the genus *Remaneicaris* is the interstitial hyporheic waters. However, the new species is described from the water accumulated in the bromeliad *Tillandsia dasyliriifolia* and it is also reported from other environments such as moist soil, leaf litter, the littoral zone of the local "aguadas", temporal wetlands, and from underground water collected from wells, also in the Sian ka´an Reserve (observ. pers. NFMS). *Murunducaris juneae* Reid, 1994 was first discovered in a wet campo marsh near Brasília, in Brazil (Reid 1994). Members of the family Parastenocarididae previously recorded inhabiting phytotelmata are: *Parastenocaris incerta* Chappuis, 1931 from *Nepenthes ampullaria* Jack, 1835 in Sumatra and *Parastenocaris staheli* Menzel, 1916*)* from *Livinstonia* sp. in Suriname.

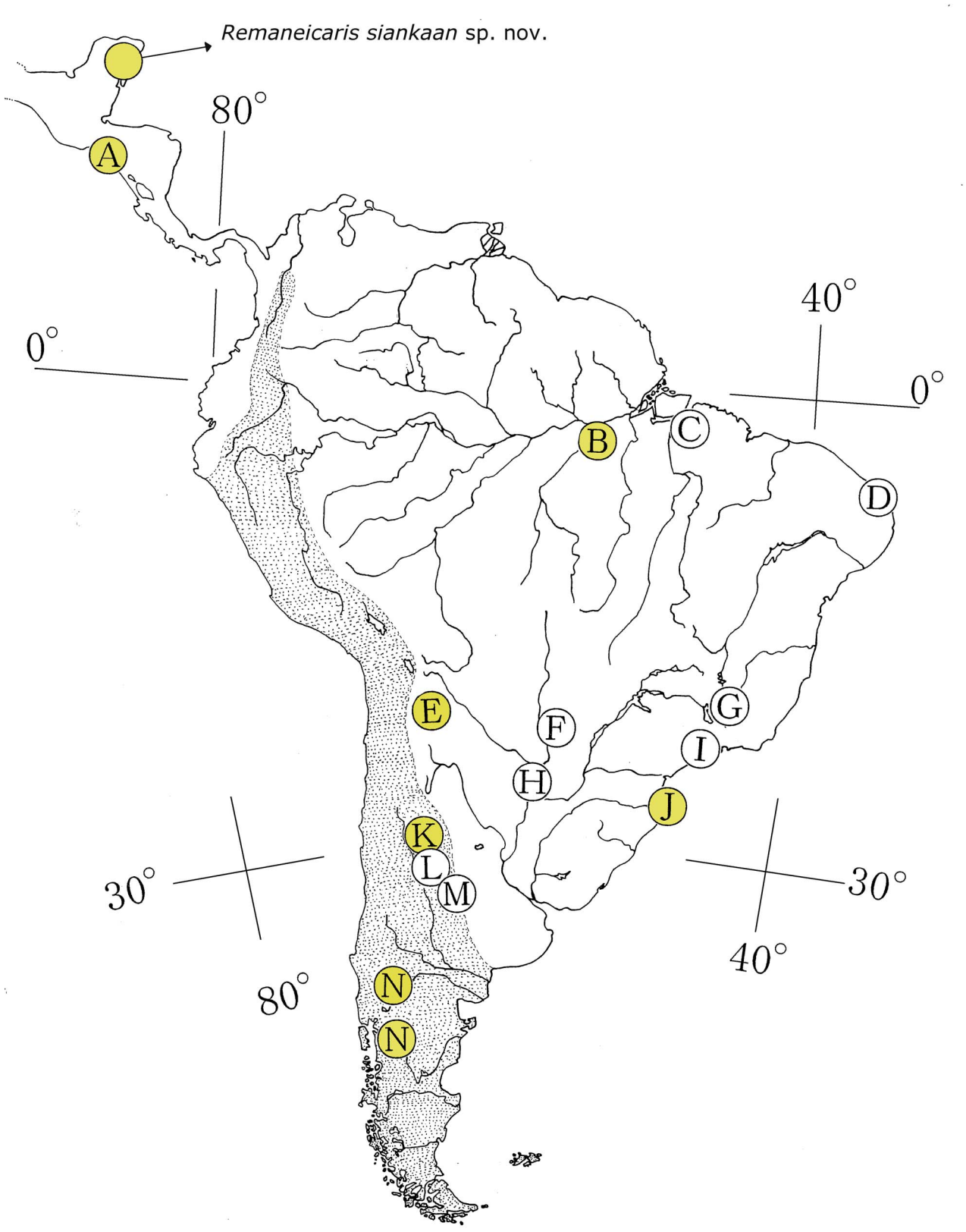


**FIGURE 16.** Geographical distribution of *Remaneicaris,* yellow circles represent records of the *R. argentina*-group.

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