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NEW BENTHOPELAGIC CALANOIDS (CRUSTACEA: COPEPODA) FROM DEEP ATLANTIC WATERS

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ABSTRACT

Two new genera and species of benthopelagic clausocalanoid copepods are described from collections taken at abyssal depths close to the sea bed in the tropical Atlantic. *Procenognatha semisensata* gen. et sp. nov. and *Ranthaxus vermiformis* gen. et sp. nov. both share the presence of sensory setae on maxilla and maxilliped with all other members of bradfordian copepods of Clausocalanoidea, but do not fit the diagnosis of any of these genera. *Procenognatha* differs from other bradfordians by the swollen basal half of the proximal posterior seta on the maxillule praecoxal arthrite and by having three sclerotized terminal setae on the maxilla endopod. *Ranthaxus* is distinguished by the presence of worm-like sensory setae on maxillule, maxilla, basis and endopod segment 5 of maxilliped and by well-developed, elongated worm-like sensory setae of maxilliped syncoxa.

Key words: Atlantic, benthopelagic, Copepoda, deep water, new taxa, *Procenognatha* gen. nov., *Ranthaxus* gen. nov.

НОВЫЕ БЕНТОПЕЛАГИЧЕСКИЕ ВЕСЛОНОГИЕ (CRUSTACEA: CALANOIDA) ИЗ ГЛУБОКОВОДНОЙ АТЛАНТИКИ

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РЕЗЮМЕ

Два новых вида и рода бентопелагических копепод из надсемейства Clausocalanoidea описаны из коллекций, собранных с абиссальных глубин в непосредственной близости от дна в тропической Атлантике. Как и все представители брэдфордовских семейств Clausocalanoidea, *Procenognatha semisensata* gen. et sp. nov. и *Ranthaxus vermiformis* gen. et sp. nov. характеризуются наличием сенсорных щетинок на максилле и максиллипеде, однако не соответствуют диагнозу ни одного из родов этого надсемейства. *Procenognatha* отличается от остальных брэдфордовских родов формой задней проксимальной щетинки прекоксального артрита максиллулы (вздута у основания) и склеротизированными терминальными щетинками эндоподита максиллы. *Ranthaxus* характеризуется наличием только червевидных сенсорных щетинок на максиллуле, максилле, основании и базисе 5-го сегмента эндоподита максиллипеды и очень хорошо развитыми и удлиненными червевидными сенсорными щетинками синкоксы максиллипеды.

Ключевые слова: Атлантика, бентопелагические, Copepoda, глубоководные, новые таксоны, *Procenognatha* gen. nov., *Ranthaxus* gen. nov.

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INTRODUCTION

Many of the benthopelagic calanoid copepod genera described during recent decades belong to the so-called bradfordian taxa of the superfamily Clausocalanoidea (Markhaseva et al. 2008). Bradfordian calanoids are distinguished from all other families by the presence of sensory setae on maxilla and maxilliped; there are seven families, viz. Diaixidae, Tharybidae, Scolecitrichidae, Parkiidae, Phaennidae, Kyphocalanidae, and Rostrocalanidae. The name "bradfordian" was proposed (Ferrari and Steinberg 1993) to honor Janet Bradford-Grieve, who was the first to recognize the taxonomic significance of the different kinds of sensory setae on the maxilla endopod (Bradford 1973). Two new benthopelagic bradfordian genera and species presented in this paper were obtained from the samples collected from the abyss of the tropical Atlantic with an epibenthic sledge (Brenke 2005) during the German expedition DIVA–II (Latitudinal Gradients of Deep-Sea Biodiversity in the Atlantic Ocean) conducted in 2005 as part of CeDAMar (Census of the Diversity of Abyssal Marine Life) project.

Each new deep-sea expedition adds new information on the diversity of near-bottom calanoid copepods. For example, 2 new clausocalanoidean families (Rostrocalanidae and Kyphocalanidae) and 4 genera (*Caudacalanus* Markhaseva et Schulz, 2008, *Prolutamator* Markhaseva et Schulz, 2008, *Kyphocalanus* Markhaseva et Schulz, 2009 and *Rostrocalanus* Markhaseva, Schulz et Martinez Arbizu, 2008) with 7 species have recently been described from samples taken during DIVA–I cruise in 2000. Both new genera, *Procenognatha* gen. nov. and *Ranthaxus* gen. nov., belong to the ancestral lineage of bradfordian families and although their family placement among bradfordians is not easy to determine, they are placed in Diaixidae *sensu* Markhaseva and Ferrari (2005). The establishment of the new clausocalanoidean genera contributes to the biodiversity of the deep-water benthopelagic calanoid fauna, whereas the structure and composition of their sensory setae add to a surprisingly high diversity of setation types both of the maxilla and the maxilliped in bradfordian taxa.

METHODS AND TERMINOLOGY

Copepod specimens were collected during FS *Meteor* expedition DIVA–II in 2005. Sampling was carried out close to the sea bed (0–1.3 m above bottom) at abyssal depths between 5138 and 5168 m in the tropical Atlantic using a closing epibenthic sledge (Brenke 2005). Specimens were fixed in 96% ethanol and later stained by adding chlorazol black E dissolved in 70% ethanol. Oral parts and swimming legs were dissected and figures were made in glycerin using a *camera lucida*.

The following abbreviations are used in the descriptions: P1–P5 – swimming legs 1 to 5; scl – sclerotized (setae); w – worm-like (sensory setae); br – brush-like (sensory setae). Free segments of the antennule are designated by Arabic numerals, ancestral segments by Roman numerals; one seta and one aesthetask on a segment of the antennule are designated as: 1s + 1ae. Maxilla segments are labelled using the notation proposed by Ferrari and Ivanenko (2008; earlier terms are given in parentheses for easier understanding) and the syncoxa of the maxilliped is considered to have three praecoxal endites and one coxal endite (Ferrari and Markhaseva 2000a,b; Ferrari and Ivanenko 2001). Type specimens are deposited at the Zoological Museum Hamburg, University of Hamburg (holotypes, paratypes, ZMH) and the Zoological Institute of the Russian Academy of Sciences, Saint Petersburg (paratypes, ZIN).

SYSTEMATICS

Superfamily Clausocalanoidea Giesbrecht, 1893

Family Diaixidae Sars, 1902

Genus *Procenognatha* gen. nov.

Description. Female. Small copepods; cephalosome and pediger 1 fused, pedigers 4 and 5 incompletely separate; posterior corners of prosome prolonged and obtusely rounded. Rostrum present as a poorly developed plate with 2 filaments. Antennule of 24 free segments. Coxa of antenna with 1 seta; basis with 2 setae; endopodal segment 1 with 2 setae; exopod 8-segmented with 1, 3, 1, 1, 1, 1, 1, and 3 setae. Gnathobase of mandible with needle-like spinules along cutting edge bearing 8 teeth; basis with 4 setae, 1 of which very small; endopod segment 1 with 2 setae; endopod segment 2 with 9 setae; exopod 5-segmented with 1,1, 1, 1, and 2 setae. Praecoxal endite of maxillule with 9 terminal elements, coxal endite with 3 setae, coxal epipodite with 9 setae; proximal basal endite with 4 setae; distal basal endite with 5 setae; exopod with 7 setae. Proximal praecoxal endite of maxilla with 5 setae, proximal basal endite with all 4 setae sclerotized; endopod with 3 sclerotized terminal setae, 1 thick brush-like seta, 3 thin brush-like setae, 1 very short, slender seta with poorly developed brush apically and 1 long plumose seta with poorly developed brush-like head. Syncoxa of maxilliped with 1, 2, 3 setae on praecoxal endites. P1–P4 of typical clausocalanoidean setation and segmentation. P5 uniramous, 3-segmented; distal segment with 2 spines and 2 spine-like unarticulated extensions terminally.

Male. Small copepods; cephalosome and pediger 1 fused, pedigers 4 and 5 incompletely separate; posterior corners of prosome obtusely rounded. Rostrum present as a poorly developed plate with 2 filaments. Left antennule of 23 free segments. Right antennule of 22 segments, with traces of geniculation. Antenna, mandible, maxillule, maxilla, maxilliped and P1 to P4 similar to those of female. P5 biramous; left leg longer than right, endopods poorly developed on both legs; exopods 3-segmented on both sides.

Type species. *Procenognatha semisensata* sp. nov., here designated.

Etymology. The generic name is derived from the Greek *pro* meaning prior to and *Cenognatha*, the name of a closely allied genus, and refers to a more primitive morphology of the new genus compared to that of *Cenognatha* Bradford-Grieve, 2001.

Differential diagnosis. The new genus is defined by: 1) praecoxal arthrite of maxillule with proximalmost posterior seta swollen in its basal part (vs. not swollen in other bradfordians); the latter character is an apomorphy of the genus; 2) maxilla endopod with 3 sclerotized terminal setae (vs. worm-like sensory setae in remaining bradfordian genera); 3) maxilla endopod with 9 setae (composition: 3scl+1scl/br+5br). The male is distinguished by the right antennule with traces of geniculation.

Remarks. A high number and unique combination of plesiomorphic characters exhibited by *Procenognatha semisensata* suggest that this species is the most primitive among bradfordian taxa. The following combination of characters distinguishes *Procenognatha* from all other bradfordian genera: 1) ancestral setation of antenna exopod (1, 1–1–1, 1, 1, 1, 1, 1 and 3); 2) maxilla endopod with a total number of 9 setae; 3) presence of 3 sclerotized setae on maxilla endopod terminally, a unique plesiomorphy for bradfordians; 4) syncoxa of maxilliped with ancestral setation formula (1, 2, 3); 5) male antennule with traces of geniculation, oral parts not reduced, and biramous P5.

The new genus and *Cenognatha,* a closely related genus, share the following combination of characters: 1) short rostrum with 2 filaments; 2) biramous right P5 in the male, and 3) a similar setation and segmentation pattern of the oral parts. *Procenognatha* gen. nov. is distinguished from *Cenognatha* by rounded posterior corners of the prosome (vs. extended into 2 spines in *Cenognatha*) and the details of setation of oral parts: 1) endopod segment 1 of mandible with 2 setae (vs. 3 setae in *Cenognatha*); 2) maxillule endopod with 12 setae and maxillule exopod with 7 setae (vs. 7, 9 or 11; and 9–10 setae in *Cenognatha,* respectively); 3) setal number (9) and composition of maxilla endopod plus distal basal endite setae (vs. 7–8 setae in *Cenognatha*).

Procenognatha semisensata **sp. nov.**

(Figs. 1–8)

Holotype. Adult female, dissected, body length 2.60 mm (ZMH K-42155); tropical Atlantic, 00°45´N, 05°35´W, station 89, 20 March 2005, above the sea bed at depth of 5141 m.

Paratypes. 1 adult female, dissected, body length 2.50 mm; 3 adult males, body length 1.95–2.25 mm (ZMH K-42156), same data as for holotype; 1 adult female, dissected, body length 2.55 mm; 1 adult male, body length 2.05 mm (ZIN 91093), same data as for holotype. 1 adult male, partly dissected, body length 2.10 mm (ZIN 91094); tropical Atlantic, 00°08´S, 02°30´W, station 64, 15 March 2005, above the sea bed at depth of 5050 m.

Additional material. 1 adult female, body length 2.75 mm; tropical Atlantic, 00°01´S, 02°29´W, station 63, 15 March 2005, above the sea bed at depth of 5058 m. 2 adult males, body length 2.20 mm; tropical Atlantic, 00°08´S, 02°30´W, station 64, 15 March 2005, above the sea bed at depth of 5050 m. 1 adult female, body length 2.50 mm; tropical Atlantic, 00°39´S, 06°19´W, station 90, 23 March 2005, above the sea bed at depth of 5169 m.

Description. Adult female, total length 2.50–2.75 mm; prosome 3.7–4.0 times as long as urosome. Rostrum (Fig. 1C–D) as a poorly developed plate with 2 filaments. Cephalosome (Fig. 1A–B) and pediger 1 fused, pedigers 4 and 5 incompletely separate; posterior corners prolonged into rounded lobes extending to mid-length of genital double-somite (Fig. 1E–H). Genital double-somite slightly asymmetrical, more prominent on the right in dorsal view (Fig.

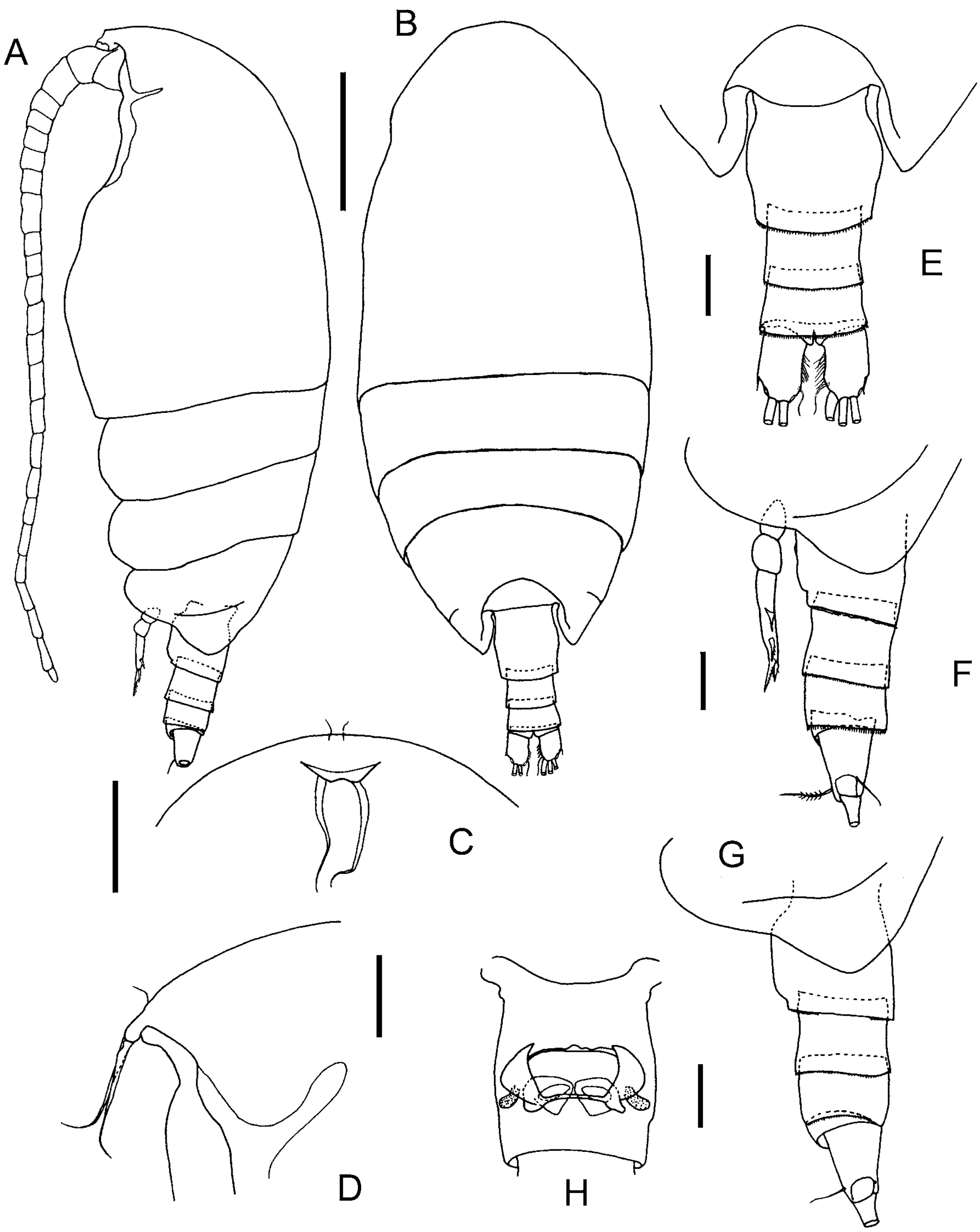

Fig. 1. *Procenognatha semisensata* gen. et sp. nov., female: A – habitus, lateral; B – habitus, dorsal; C – rostrum, ventral; D – rostrum, lateral; E – posterior prosome and urosome, dorsal; F, G – posterior prosome and urosome, lateral; H – genital double-somite, ventral. A, B, E, G, H – holotype, C, D, F – paratype. Scale bars: 0.5 mm = A–B; 0.1 mm = C–H.

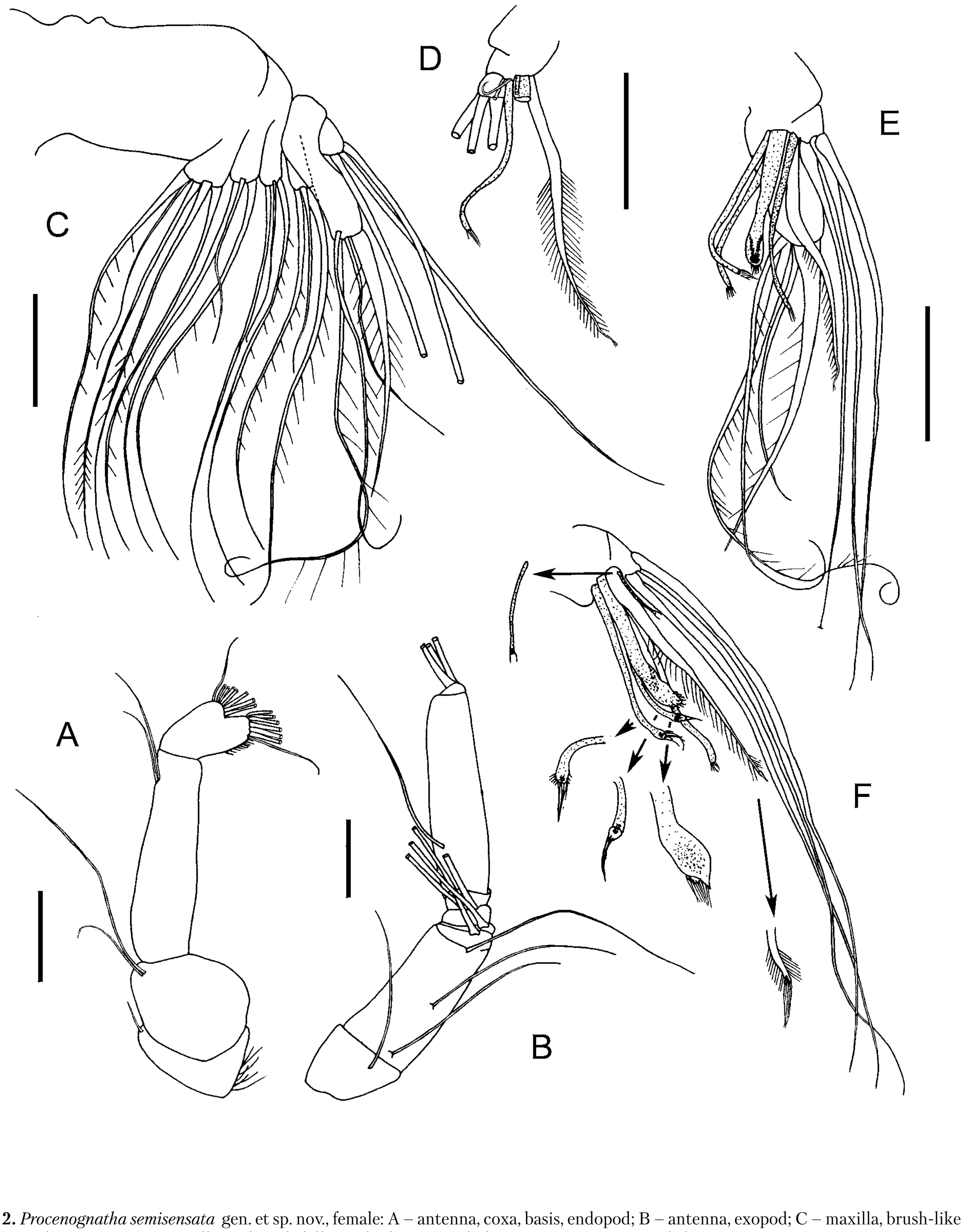

Fig. 2. *Procenognatha semisensata* gen. et sp. nov., female: A – antenna, coxa, basis, endopod; B – antenna, exopod; C – maxilla, brush-like setae not shown; D, E, F – maxilla, endopod, different limbs. A–E – holotype; F – paratype. Scale bars = 0.1 mm.

1E). Genital double-somite and urosome somites 2 and 3 with fringe of spinules along posterior borders. Caudal rami (Fig. 1E–F) with 4 terminal plus 1 small dorsolateral and 1 small ventral seta each.

Antennule (Fig. 6A–B) longer than prosome, of 24 free segments; armature as follows: I – 3s, II–IV – 6s + 1ae, V – 2s + 1ae, VI – 2s, VII – 2s + 1 ae, VIII – 1s+?, IX – 2s + 1ae; X–XI – 4s + 1ae, XII to XIII – 1s each; XIV – 1s + ?, XV – 1s, XVI – 2s, XVII to XIX – 1s each, XX – 2s, XXI – 1s + 1ae, XXII to XXIII – 1s each, XXIV to XXVI – 2s each, XXVII–XXVIII incompletely separate with 5s + 1ae, respectively.

Antenna (Fig. 2A–B), coxa with 1 seta; basis with 2 setae; endopodal segment 1 with 2 setae, endopodal segment 2 with 15 setae; exopod 8-segmented with 1, 3, 1, 1, 1, 1, 1 and 3 setae.

Mandible (Fig. 3A–B), gnathobase cutting edge with 8 teeth; exopod of 5 segments with 1,1,1,1 and 2 setae; endopod segment 1 with 2 setae, endopod segment 2 with 9 setae; basis with 4 setae, 1 of which very small.

Maxillule (Fig. 3C–D), praecoxal arthrite with 9 terminal spines, 4 posterior setae and 1 anterior seta, proximalmost posterior seta swollen in its first half (marked by arrow in Fig. 3D); coxal endite with 3 setae, coxal epipodite with 9 setae; proximal basal endite with 4 setae, distal basal endite with 5 setae; endopod with 12 setae, exopod with 7 setae (right limb of one of paratypes with 9 setae).

Maxilla (Fig. 2C–F), praecoxal endite bearing 5 setae, coxal (previously considered as distal praecoxal endite) with 3 setae; basal endites (previously considered as coxal endites) with 3 setae each; lobe of proximal endopodal segment (previously considered as proximal basal endite) with 4 setae, all sclerotized. Endopod with 9 setae, 3 terminal setae sclerotized and 6 brush-like setae of different morphology: the longest, poorly sclerotized, seta plumose from one side, with poorly developed brush-like head, 1 short sensory seta, with poorly developed brush on top, and 4 well-developed brush-like sensory setae (1 thick and 3 thin).

Maxilliped (Fig. 3E), syncoxa with 1 sclerotized seta on proximal praecoxal endite, 2 sclerotized setae on middle endite, and 3 setae on distal praecoxal endite, of them the distalmost with poorly developed brush-like head; coxal endite with 3 setae and small attenuation. Basis with 3 medial setae plus 2 setae distally of incorporated endopod segment 1; endopod of 5 free segments with 4, 4, 3, 3+1 and 4 setae.

P1 (Figure 4A–B), basis with only slightly curved medial distal seta; endopod 1-segmented with 3 medial and 2 terminal setae; lateral lobe well-developed, rounded; exopod 3-segmented, segment 1 with lateral spine, segment 2 with lateral spine and medial seta, segment 3 with lateral spine, 3 medial setae and terminal spine.

P2 to P4 biramous with 3-segmented exopods, endopod 2-segmented in leg 2 and 3-segmented in legs 3 to 4. P2 to P4 with finely serrated terminal spine on exopod segment 3.

P2 (Fig. 4C), coxa with medial seta; basis with semicircular row of spinules on posterior surface distomedially; endopod segment 1 with 1 medial seta and 1 posterior spinule laterally; segment 2 with 2 medial, 2 terminal and 1 lateral setae and furnished with scattered spinules on posterior surface. Exopod segment 1 with lateral spine, medial seta and 1 posterior spinule, segment 2 with lateral spine and medial seta, segment 3 with 3 lateral spines, 4 medial setae and terminal spine.

P3 (Fig. 4D), coxa with medial seta; endopod segment 1 with medial seta and 1 posterior spinule laterally, segment 2 with 1 medial seta and 3 posterior spinules laterally, segment 3 with 2 medial, 2 terminal and 1 lateral setae and tiny posterior spinules; exopod segment 1 with lateral spine, medial seta and 1 posterior spinule, segment 2 with lateral spine and medial seta, segment 3 with 3 lateral spines, 4 medial setae and terminal spine.

P4 (Fig. 4E), coxa with medial seta; endopod segment 1 with medial seta and few tiny posterior spinules laterally, segment 2 with 1 medial seta and tiny posterior spinules, segment 3 with 2 medial, 2 terminal and 1 lateral setae and tiny posterior spinules; exopod segment 1 with lateral spine and medial seta, segment 2 with lateral spine and medial seta, segment 3 with 3 lateral spines, 4 medial setae and terminal spine.

P5 (Fig. 3F–G) uniramous, symmetrical, 3-segmented with 1 lateral and medial spine each and 2 spine-like unarticulated and unequal extensions terminally.

Adult male, total length 1.95–2.30 mm, prosome 2.98–4.1 times as long as urosome. Rostrum (Fig. 5C) as in female. Cephalosome (Fig. 5A, C) and pediger 1 fused, pedigers 4 and 5 incompletely separate; posterior corners prolonged into rounded lobes (Fig.

Fig. 3. *Procenognatha semisensata* gen. et sp. nov., female: A – mandible, B – mandible, gnathobase, cutting endge; C – maxillule; D – maxillule, praecoxal arthrite. A, C, E – holotype, B, D – paratype. Scale bars = 0.1 mm.

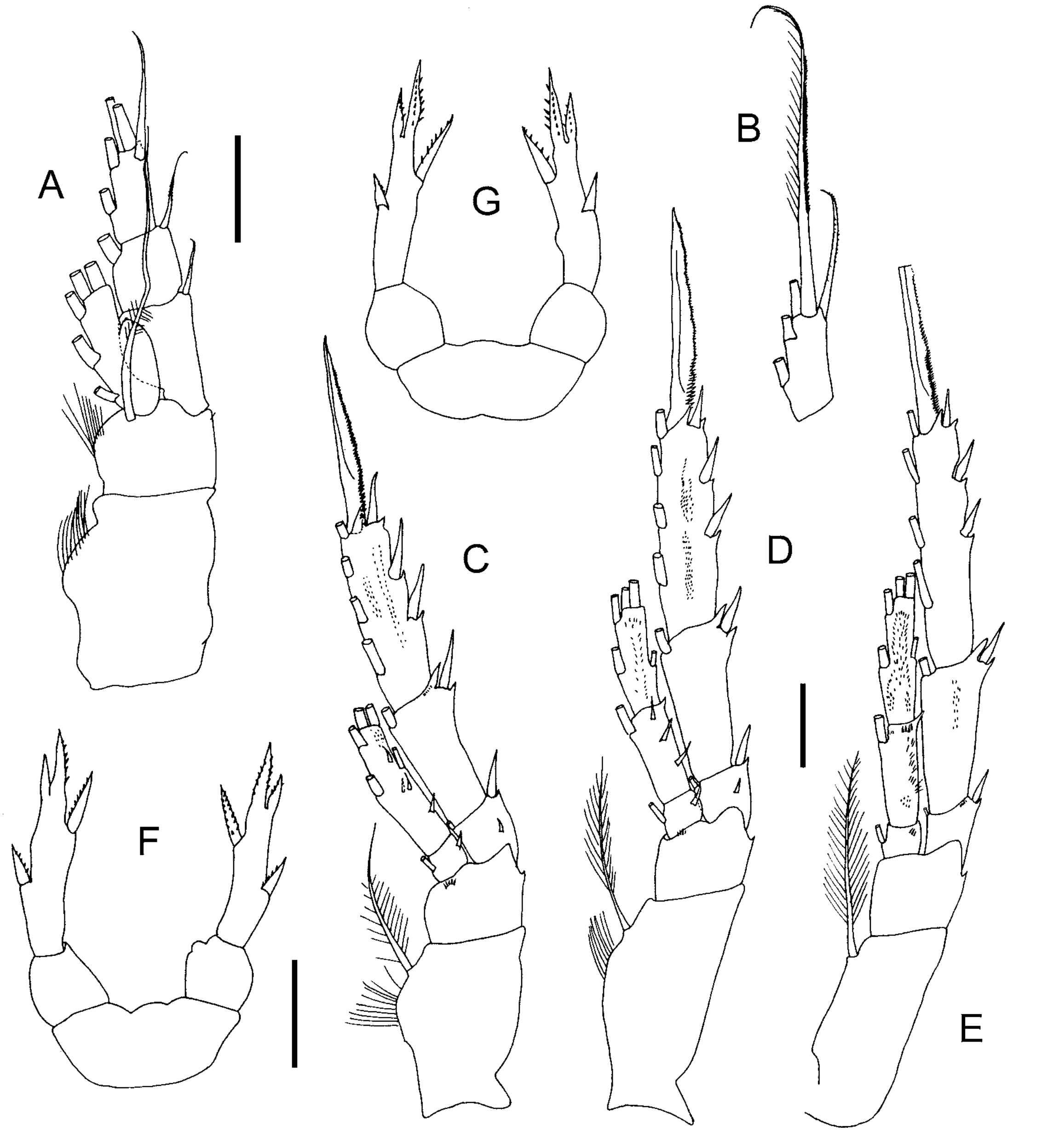

Fig. 4. *Procenognatha semisensata* gen. et sp. nov., female: A – P1; B – P1, exopod segment 3; C – P2; D – P3; E – P4; F–G – P5. A, E,

5A, D). Caudal rami (Fig. 5A–B) with 4 terminal plus 1 small dorsolateral and ventral setae each.

Antennule nearly as long as body. Left antennule (Fig. 6C–D) of 23 free segments, armature as follows: I – 1s + 1ae, II–IV – 6s + 2ae, V – 2s + 2ae, VI – 2s + 1ae, VII – 2s + 2ae, VIII – 2s + 1ae, IX – 1s + 1ae + ?; X–XII – 5s + 3ae, XIII – 1s + ?; XIV – 2s + 1ae, XV – 1s + 1ae, XVI – 2s + 1ae, XVII – ? + 1ae, XVIII – 2s + ?, XIX – 1s + 1ae, XX – 1s + 1ae, XXI – 1s + 1ae, XXII to XXIII – 1s each, XXIV – 2s, XXVI – 2s + 1ae, XXVII–XXVIII 6s + 1ae.

Right antennule (Fig. 7A–D) of 22 free segments, with traces of geniculation (proximal excavation on each of segments XVIII to XXII–XXIII, marked by

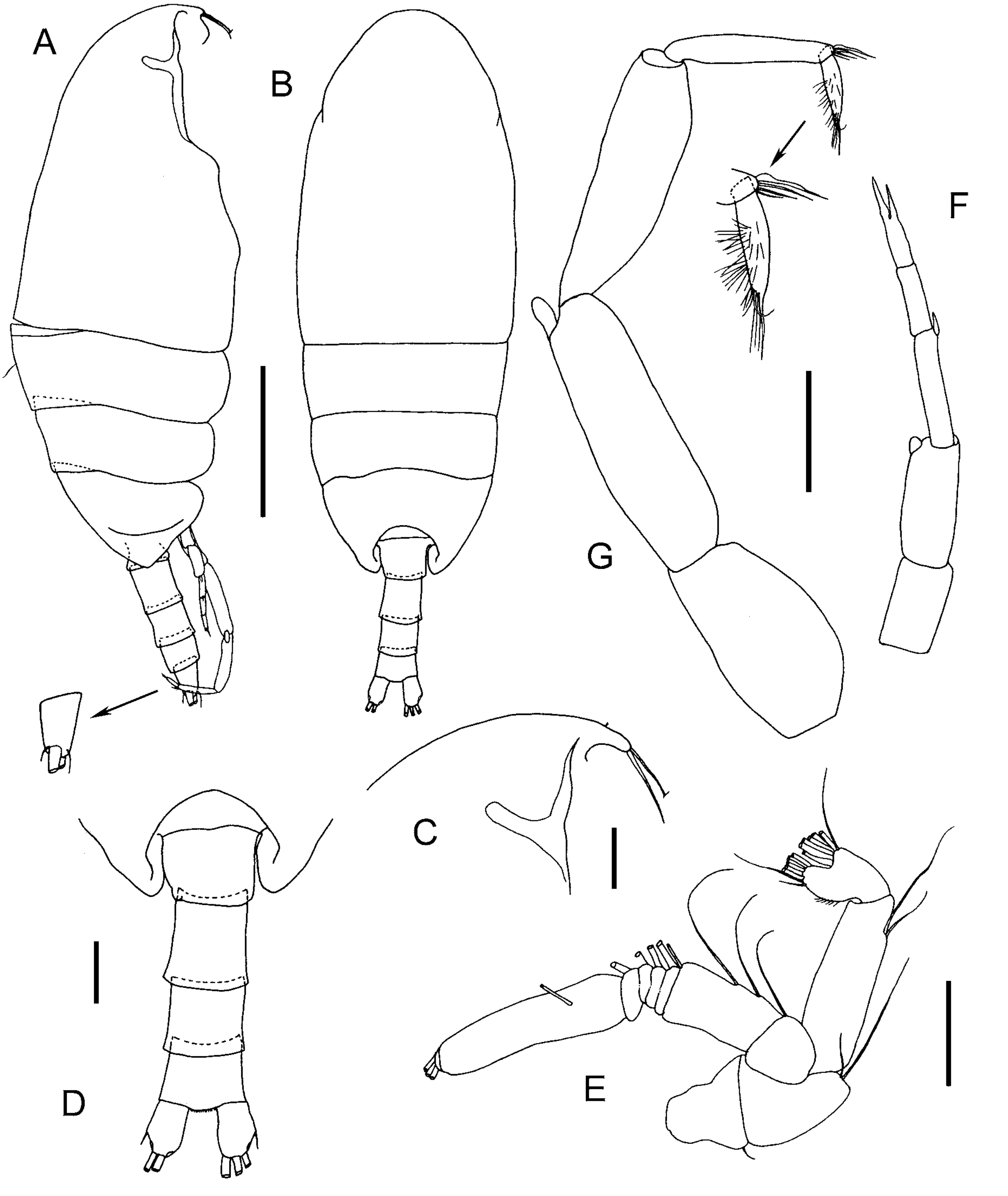

Fig. 5. *Procenognatha semisensata* gen. et sp. nov., male, paratype: A – habitus, lateral; B – habitus, dorsal; C – rostrum, lateral; D – posterior prosome and urosome, dorsal; E – antenna; F – P5 right; G – P5 left. Scale bars: 0.5 mm = A, B; 0.1 mm = C–G.

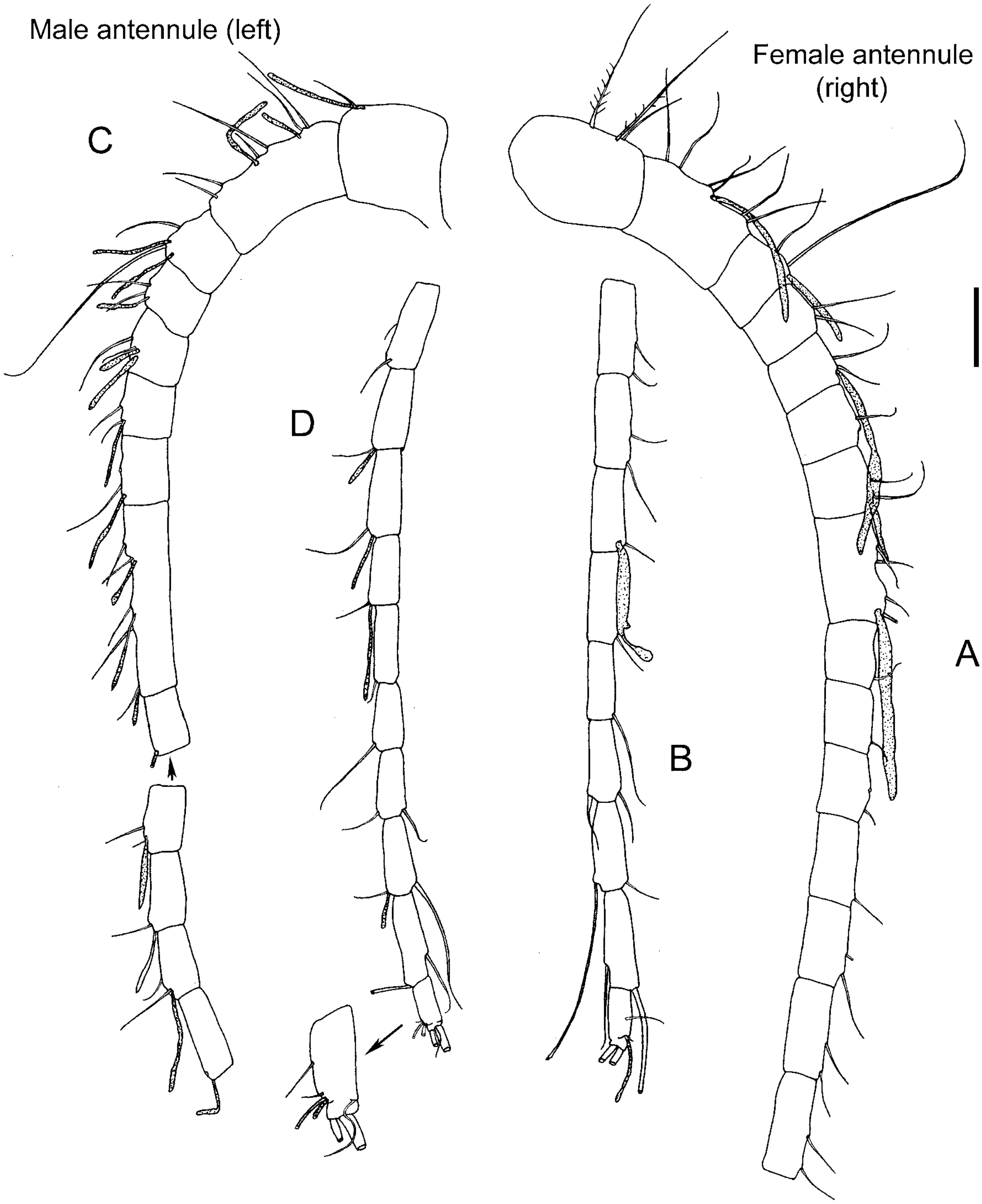

Fig. 6. *Procenognatha semisensata* gen. et sp. nov., female, paratype: A – antennule, segments I–XVIII; B – antennule, segments XIX–XXVIII; male, paratype, C – left antennule, segments I–XVII; D – left antennule, segments XVIII–XXVIII. Scale bar = 0.1 mm.

arrows in Fig. 7), and additional medial spine-like seta present on each of XVII to XX segments; armature as follows: I – 1s + 1ae, II–IV – 6s + 4ae, V – 2s + 2ae, VI – 2s + 1ae, VII – 2s + 2ae, VIII – 2s + 1ae, IX – 2s + 1ae; X–XII – 5s + 4ae, XIII – 1s + 1ae; XIV – 2s + 1ae, XV – 1s + 1ae, XVI – 2s + 1ae, XVII – 2s + 1ae, XVIII – 2s + 1ae, XIX – 2s + 1ae, XX – 2s + 1ae, XXI – 1s + 1ae, XXII–XXIII – 2s, XXIV – 2s + 1ae, XXV – 2s + 1ae, XXVI – 2s, XXVII–XXVIII 5s + 2ae.

Antenna (Fig. 5E), mandible (Fig. 8A–B), maxillule (Fig. 8C–D), maxilla (Fig. 8E–F), maxilliped (Fig. 8G), P1 (Fig. 8H–I) and P2–P4 similar to those of female.

P5 (Figure 5G) biramous, exopods 3-segmented on both sides, endopods bud-like, rudimentary. Left leg longer than right; exopod segment 2 with spinules distally, exopod segment 3 ornamented with posterior and terminal spinules. Right leg, exopodal segment 1 with lateral distal spine, segment 3 with 2 slightly unequal terminal attenuations.

Etymology. The specific name is derived from the Latin *semi* meaning half and *sensus* meaning sensory, and refers to the unique composition of sensory and sclerotized setae of the maxilla endopod.

Genus *Ranthaxus* gen. nov.

Description. Female. Small copepods; cephalosome and pediger 1 fused, pedigers 4 and 5 fused; posterior corners of prosome prolonged into short points. Rostrum present as a well-developed bifurcate plate with filaments. Antennule of 24 free segments, segments 19 and 20 (XXII–XXIII) short, aesthetasc of segment 18 (XXI) very long. Coxa of antenna with 1 seta, basis with 2 setae; endopodal segment 1 with 2 setae; exopod 8-segmented with 1, 3, 1, 1, 1, 1, 1 and 3 setae. Gnathobase of mandible bearing 8 teeth; basis with 4 setae; endopod segment 1 with 3 setae, endopod segment 2 with 9 setae; exopod 5-segmented with 1, 1, 1, 1 and 2 setae. Praecoxal endite of maxillule with 9 terminal elements, coxal endite with 2 setae, coxal epipodite with 9 setae; proximal basal endite with 4 setae; distal basal with 4 setae, 1 of which worm-like sensory; endopod with 11 setae, 1 of which sensory; exopod with 8 setae. Proximal praecoxal endite of maxilla with 5 setae, distal praecoxal endite and both coxal endites with 3 setae, 1 of which sensory; proximal basal endite with 4 setae, 2 of which sensory; endopod with 6 worm-like sensory setae, 4 long and 2 short. Syncoxa of maxilliped with 1 long, worm-like sensory seta on proximal praecoxal endite, 2 setae, 1 worm-like on middle praecoxal endite, and 3 setae, 1 long, worm-like sensory seta on distal praecoxal endite; endopod segment 1 incorporated into basis, with 2 setae, 1 of which sensory, worm-like; 1 of 4 setae of terminal endopod segment sensory and worm-like, all other elements on endopod sclerotized. P1–P4 of typical clausocalanoidean setation and segmentation. P5 uniramous, 3-segmented; distal segment with 2 spine-like unarticulated extensions terminally.

Male unknown.

Type species. *Ranthaxus vermiformis* sp. nov., here designated.

Etymology. The generic name *Ranthaxus* is an anagram of *Xantharus* Andronov, 1981, which was the first bradfordian genus to be distinguished by very short articulated segments 19 and 20 (XXII, XXIII) and a very long aesthetasc on segment 18 (XXI) of the antennule.

Differential diagnosis. The following combination of derived characters define the genus: 1) one worm-like sensory seta is present additionally to sclerotized setae on maxillule distal basal endite and endopod (vs. sensory setae absent on distal basal endite in other bradfordians); 2) maxilla endopod plus distal basal endite with 4 long plus 2 short worm-like sensory setae (vs. 6 worm-like sensory setae of equal length in *Rostrocalanus* Markhaseva, Schulz et Martinez Arbizu, 2008); 3) very long worm-like sensory seta on maxilliped distal praecoxal endite, reaching the distal part of basis (vs. worm-like seta short or absent on distal endite in other bradfordians); 4) maxilliped endopod segment 1 (endopodal segment incorporated into basis) and terminal segment of endopod with one of setae on each segment transformed into sensory and worm-like setae (vs. sensory setae absent from endopod in other bradfordians).

Remarks. The new genus is closely related to *Xantharus* and *Paraxantharus* Schulz, 2006 and shares with both genera the same number of setae on most of endites and segments of oral parts (Table 1). However, the new genus is well distinguished from these genera by the presence of worm-like sensory setae on maxillule, maxilliped basis and endopod, a smaller number (6) of sensory setae on maxilla endopod, and by very long worm-like sensory setae on maxilliped syncoxa. The new genus shares an apomorphy with *Xantharus* in that antennule segments 19 and 20 (XXII and XXIII) are markedly reduced

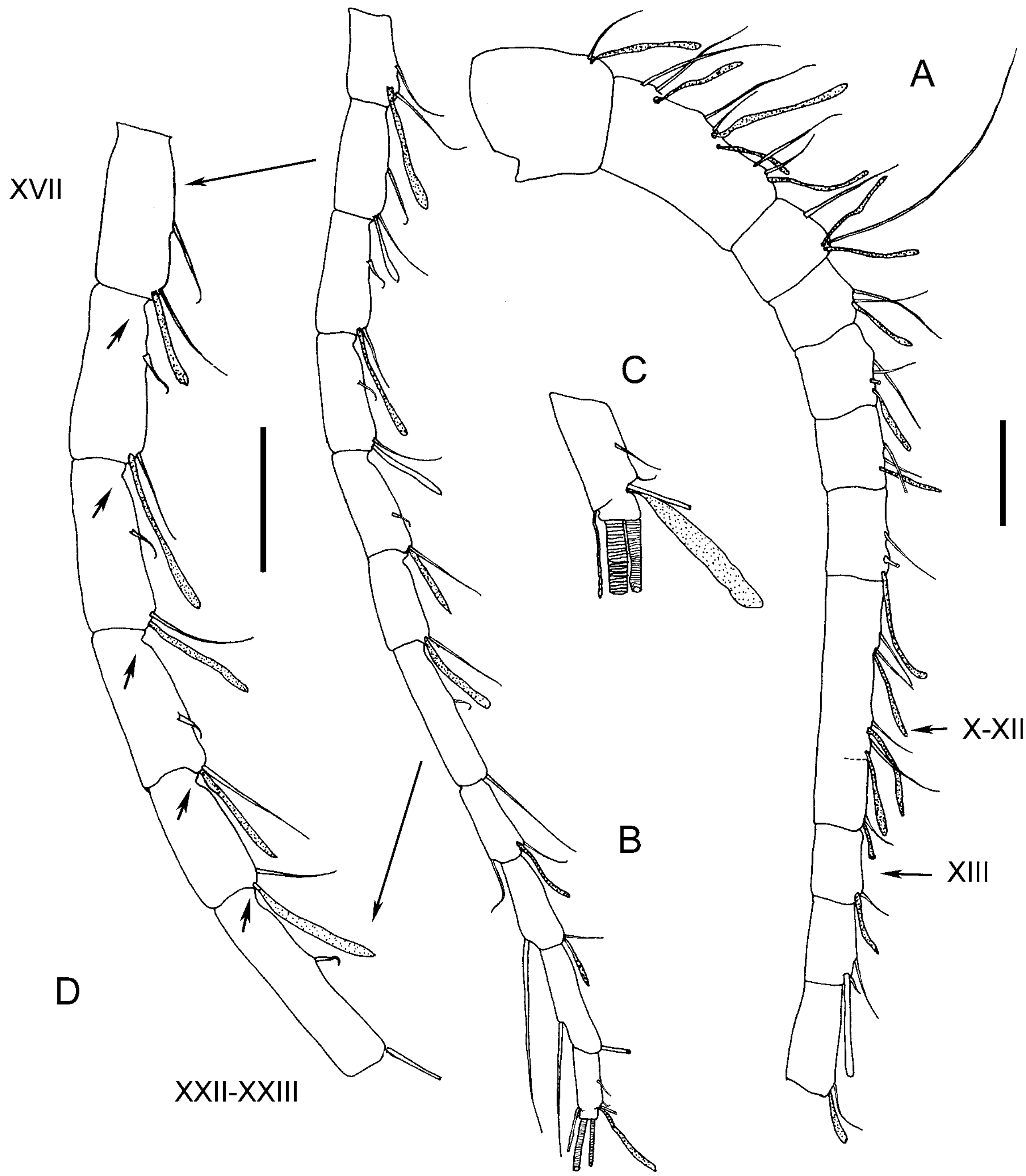

Fig. 7. *Procenognatha semisensata* gen. et sp. nov., male, paratype, right antennule: A – segments I–XV; B – segments XVI –XXVIII; C – segments XVII – XXII, enlarged. Scale bars = 0.1 mm.

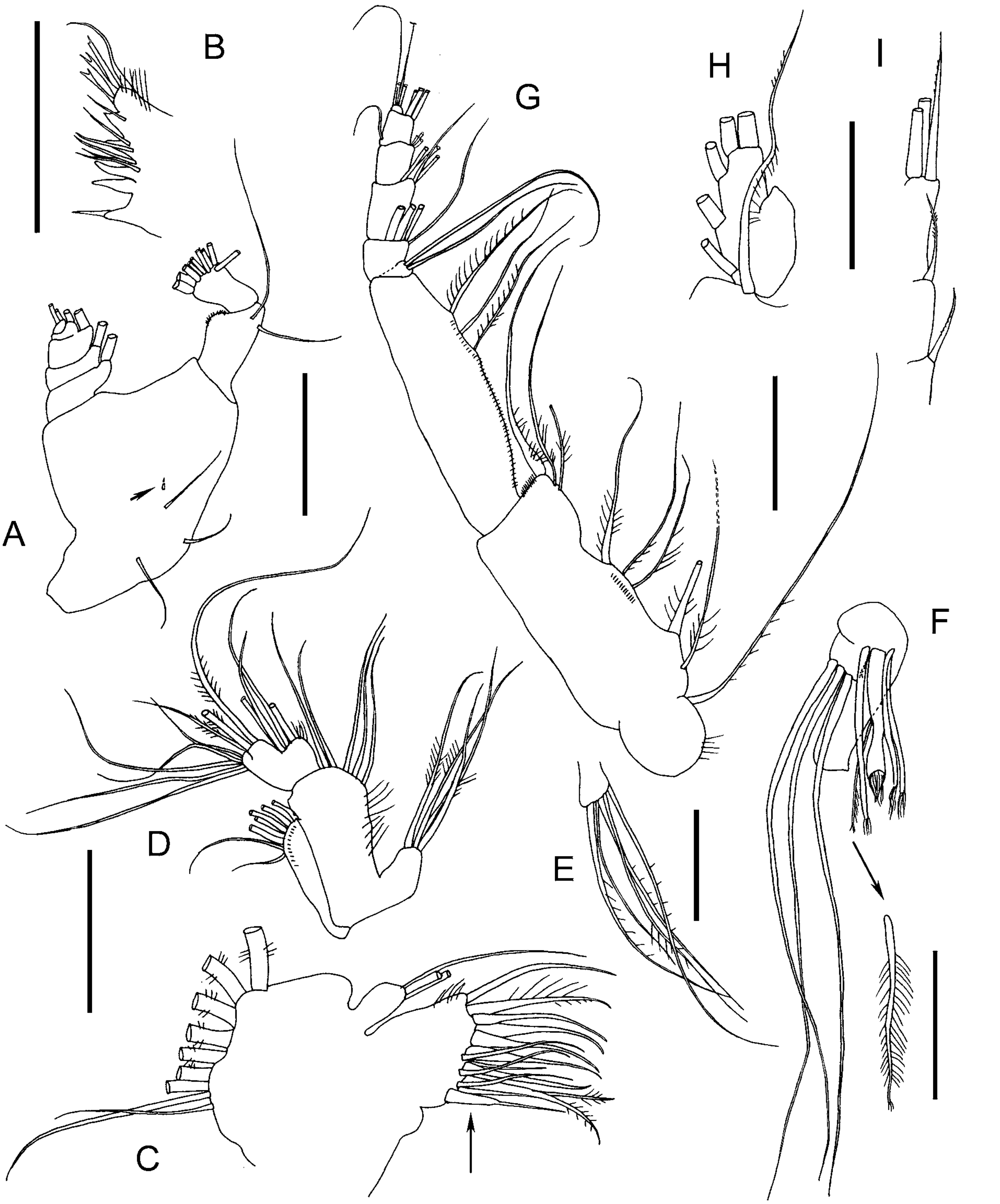

Fig. 8. *Procenognatha semisensata* gen. et sp. nov., male, paratype: A – mandible, palp; B – mandible, gnathobase, cutting endge; C – maxillule, praecoxal arthrite and coxa; D – maxillule, basis, endopod and exopod; E – maxilla, proximal praecoxal endite; F – maxilla, endopod and distal basal endite, setae of distal basal endite not figured; G – maxilliped; H – P1, endopod; I – P1, lateral spines of exopod segments 1–3. Scale bars = 0.1 mm.

Table 1. Selected character states of *Xantharus* and *Paraxantharus* females. Data on *Xantharus* are from: Andronov 1981, Schulz 1998, Schulz and Kwasniewski 2004, Bradford-Grieve 2005. Data on *Paraxantharus* are from Markhaseva 2010. *Abbreviations*: br – brush-like, scl – sclerotized, w – wormlike sensory setae.

Character		*Xantharus*	*Paraxantharus*	*Ranthaxus* gen. nov.
Antennule	aesthetasc on segment 18 (XXI)	very long, exceeding terminal segment 24 (XXVII–XXVIII)	of moderate length, reaching /the middle length of segment 22 (XXV)	very long, exceeding terminal segment 24 (XXVII–XXVIII)
	length/size of articulated segments 18 (XXI) and 19 (XXII)	segment 19 (XXII) markedly reduced in size compared to segment 18 (XXI)	segment 19 (XXII) not markedly reduced in size compared to segment 18 (XXI)	segment 19 (XXII) markedly reduced in size compared to segment 18 (XXI)
Antenna[1]	coxa	1	1	1
	basis	2	2	2
	endopod segment 1	2	2	2
	endopod segment 2	8+6(7)	7+7	7+6
	exopod setation	0, 0-0-1, 1,1,1,1,1,3	1, 1-1-1, 1,1,1,1,1,3	1, 1-1-1, 1,1,1,1,1,3
Mandible	basis	3-4	4	4
	endopod segment 1	3	3	3
	endopod segment 2	9	9	9
	exopod setation	1,1,1,1,2	1,1,1,1,2	1,1,1,1,2
Maxillule	praecoxal arthrite	9+3	9+4+1	9+2
	coxal endite	2	2	2
	proximal basal endite	4	3	4
	distal basal endite	4	4	4 (1 sensory)
	endopod	10–11	11	11(1 sensory)
	exopod	8	8	8
	epipodite	9	9	9
Maxilla	proximal praecoxal endite	4–5	5	5
	distal praecoxal endite	3	3	3 (1 sensory)
	proximal coxal endite	3	3	3 (1 sensory)
	distal coxal endite	3	3	3 (1 sensory)
	proximal basal endite	4	4	4 (2 sensory)
	endopod	8-9 (3w+5br, or 3w+5br+1scl)	9 (3w+5br+1scl)	6w
Maxilliped	praecoxal endites of syncoxa	1scl, 2scl, 3(2scl+1br)	1scl, 2(1scl+1w), 3(2sc+1w)	1w, 2(1scl+1w), 3(2sc+1w)
	endopod segment 1 incorporated into basis	2scl	2scl	1scl+1w
	endopod segments 2–6	4, 3-4, 3, 2-3+1, 4	4, 4, 3, 3+1, 4	4, 4, 3, 3+1, 4

[1] Here and below number of setae.

in size compared to segment 18 (XXI) and in a very long aesthetasc on segment 18 (XXI), but it differs in the primitive type of exopod setation of antenna (1, 1–1–1, 1, 1, 1, 1, 1, and 3), which *Ranthaxus* shares with *Paraxantharus* (Table 1). The presence of sensory setae on the distal praecoxal endite and coxal endites of maxilla is shared with *Puchinia* Vyshvartzeva, 1989. However, *Puchinia* is not allied to the new genus, because its morphology is very different in a number of characters, such as: worm-like setae absent from maxillule and maxilliped basis; 3 worm-like plus 5 brush-like setae (8 setae) present on maxilla endopod, maxilliped syncoxa with 1, 2 and 2 setae of normal length on praecoxal endites (original observation); and one-segmented P5.

***Ranthaxus vermiformis* sp. nov.**
(Figs. 9–13)

Holotype. Adult female, dissected, body length 1.20 mm (ZMH K–42164); tropical Atlantic, 00°01´S, 02°29´W, station 63, 15 March 2005, above the sea bed at depth of 5058 m.

Description. Female, total length 1.20 mm, prosome 3.8 times as long as urosome. Cephalosome (Fig. 9A–B) and pediger 1 fused, pedigers 4 and 5 fused; posterior corners of prosome prolonged into short points. Rostrum present as a well-developed bifurcate plate with filaments (Fig. 9C–D). Genital double-somite and urosome somites 2 and 3 with fringe of stout spinules along posterior borders. Caudal rami (Fig. 9H) with 4 terminal plus 1 dorsolateral and ventral setae each, ventral seta located more laterally from medial edge of ramus.

Antennule slightly shorter than prosome (Fig. 10A–B), of 24 free segments, armature as follows: I – 3s, II–IV – 6s + 1ae, V – 2s + 1ae, VI – 2s, VII – 2s + 1 ae, VIII – 2s, IX – 2s + 1ae; X–XI – 4s + 1ae, XII to XIII – 1s each; XIV – 2s + 1ae, XV – 1s, XVI – 2s+1ae, XVII – 1?, XVIII – 2s, XIX – 1s, XX – 2s, XXI – 1s + 1 very long ae, XXII to XXIII – 1s each, both segments comparatively short, XXIV to XXVI – 2s each, XXVII–XXVIII incompletely separate with 5s + 1ae.

Antenna (Fig. 10C), coxa with 1 seta; basis with 2 setae; endopodal segment 1 with 2 setae, endopodal segment 2 with 13 setae; exopod 8-segmented with 1, 3, 1, 1, 1, 1, 1, and 3 setae.

Mandible (Fig. 10D–E), gnathobase cutting edge with 8 teeth; exopod of 5 segments with 1,1,1,1 and 2 setae; endopod segment 1 with 3 setae, endopod segment 2 with 9 setae; basis with 4 setae.

Maxillule (Fig. 11A–B), praecoxal arthrite with 9 terminal spines and 2 posterior setae; coxal endite with 2 setae, coxal epipodite with 9 setae; proximal basal endite with 4 setae, distal basal endite with 4 setae, 1 of which sensory; endopod with 11 setae, 1 of which sensory; exopod with 8 setae.

Maxilla (Fig. 11C–D), praecoxal endite bearing 5 setae, coxal (previously considered as distal praecoxal) and basal endites (previously considered as proximal and distal coxal endites) with 3 setae each, 1 of which worm-like sensory; lobe of proximal endopodal segment (previously considered as proximal basal endite) with 4 setae, 2 of which worm-like. Endopod with 6 sensory setae, all worm-like, 4 long and 2 short.

Maxilliped (Fig. 12A), syncoxa with 1 worm-like seta on proximal praecoxal endite, this element long, reaching middle length of basis; 2 setae on middle endite, 1 short sclerotized and 1 worm-like of medium size and 3 setae on distal praecoxal endite, of these 2 short sclerotized and 1 long worm-like seta, exceeding middle length of basis; coxal endite with 3 setae. Basis with 3 medial setae and 2 distal setae (belonging to endopod and incorporated into basis), 1 of distal setae sensory and worm-like; endopod of 5 free segments with 4, 4, 3, 3+1, and 3 sclerotized plus 1 worm-like sensory setae on distal segment.

P1 (Figure 11E), basis with medial distal seta curved; endopod 1-segmented with 3 medial and 2 terminal setae; lateral lobe well-developed, ornamented with tiny spinules along lateral margin; exopod 3-segmented, segment 1 with lateral spine, segment 2 with lateral spine and medial seta, segment 3 with lateral spine, 3 medial setae and terminal spine.

P2 to P4 biramous with 3-segmented exopods, endopod 2-segmented in leg 2 and 3-segmented in legs 3 to 4. P2 to P4 terminal spine of exopod segment 3 coarsely serrated. P2 (Fig. 13A–B), coxa with medial seta; basis without setae; endopod segment 1 with 1 medial seta, segment 2 with 2 medial, 2 terminal and 1 lateral setae and furnished with scattered spinules on posterior surface. Exopod segment 1 with lateral spine, medial seta, segment 2 with lateral spine and medial seta, segment 3 with 3 lateral spines, 4 medial setae and terminal spine.

P3 (Fig. 13C), coxa with medial seta; basis without seta; endopod segment 1 with medial seta, segment 2 with 1 medial seta and tiny posterior spinules, seg-

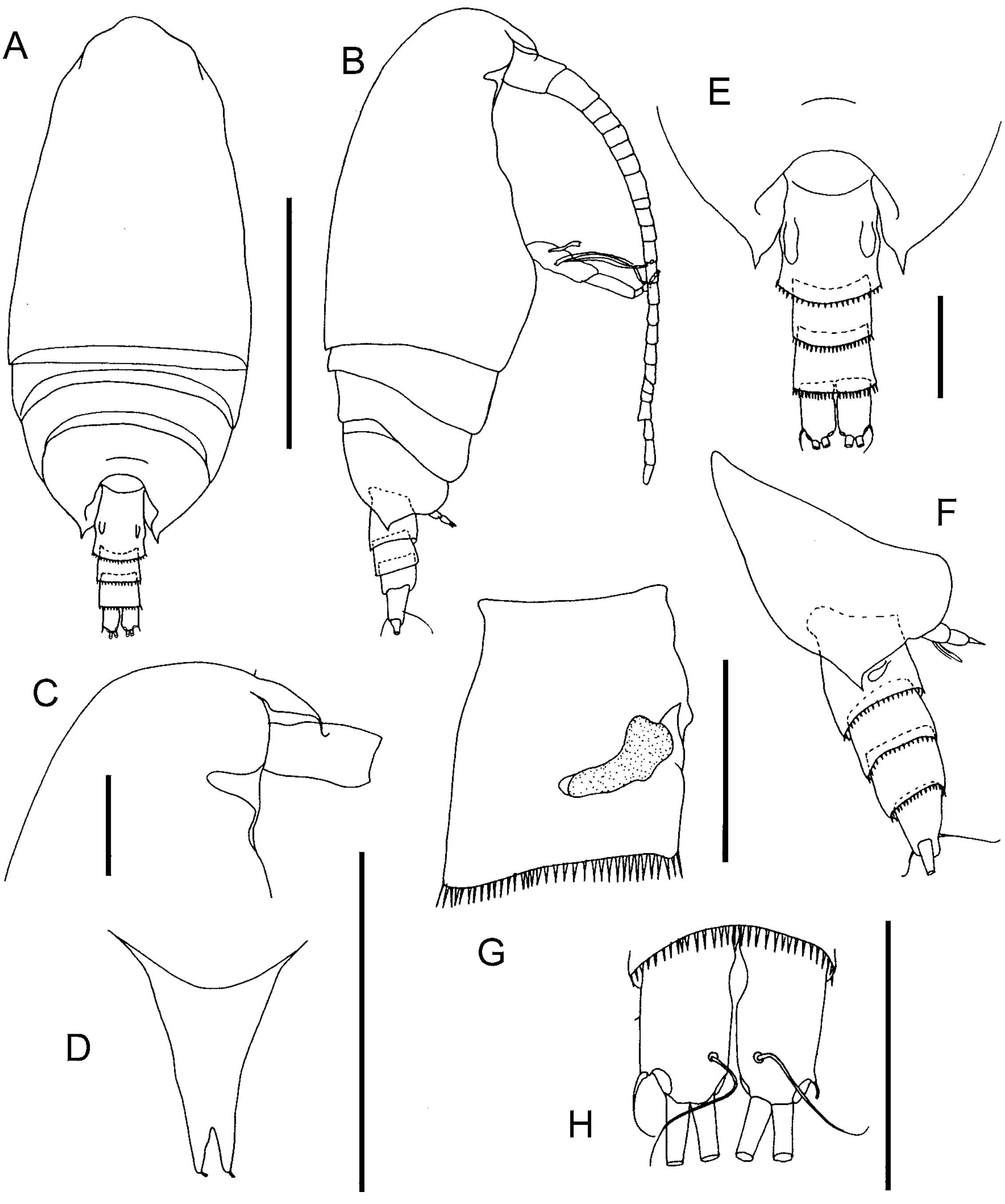

Fig. 9. *Ranthaxus vermiformis* gen. et sp. nov., female, holotype: A – habitus, dorsal; B – habitus, lateral; C – rostrum, lateral; D – rostrum, ventral; E – posterior prosome and urosome, dorsal; F – posterior prosome and urosome, lateral; G – genital double-somite, lateral; H – caudal rami, dorsal. Scale bars: 0.5 mm = A, B; 0.1 mm = C–H.

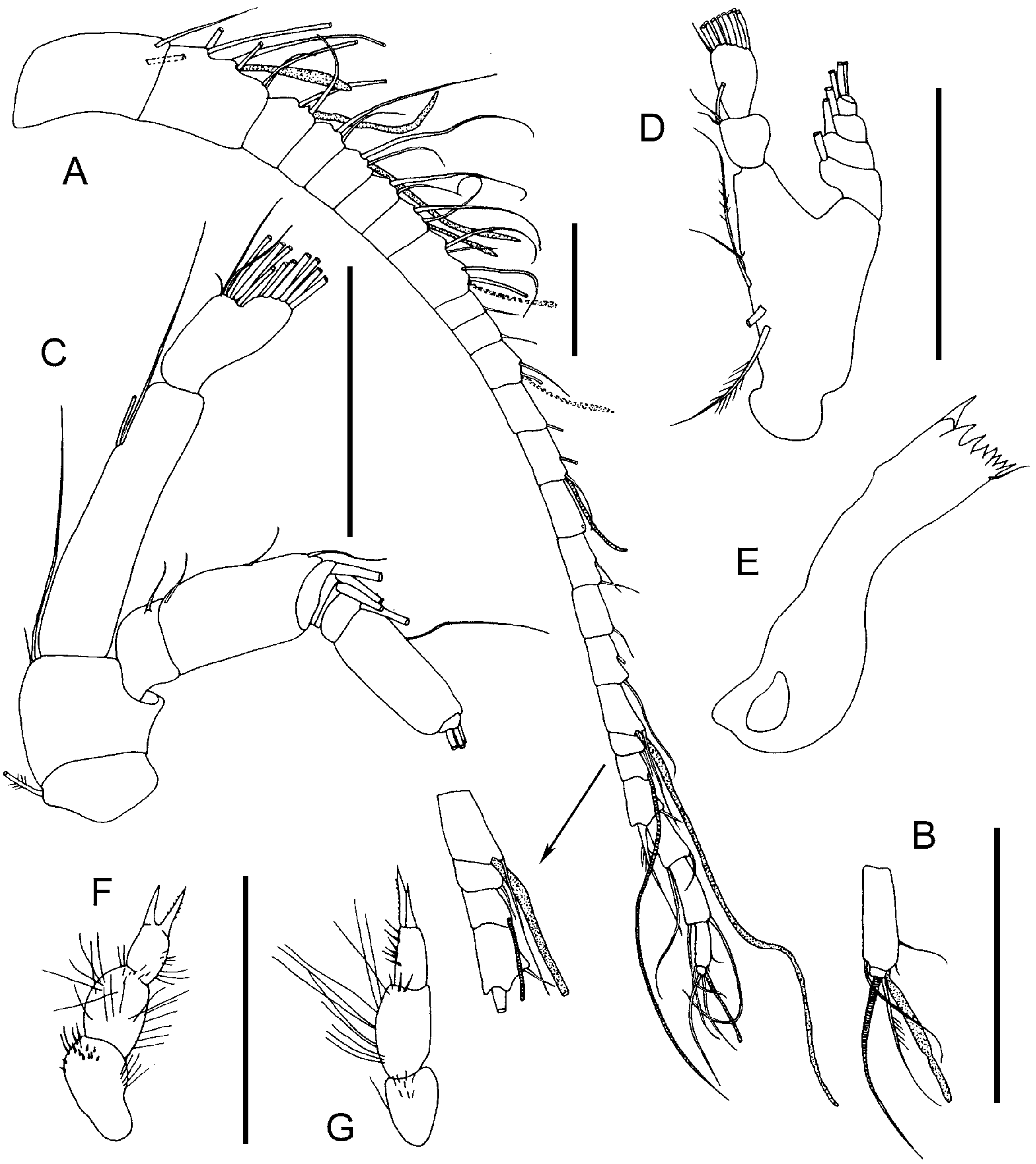

Fig. 10. *Ranthaxus vermiformis* gen. et sp. nov., female, holotype: A – antennule; B – antennule, segment 24 (XXVII–XXVIII); C – antenna; D – mandible, palp; E – mandible, gnathobase; F – P5, left, dorsal; G – P5, right, lateral. Scale bars = 0.1 mm.

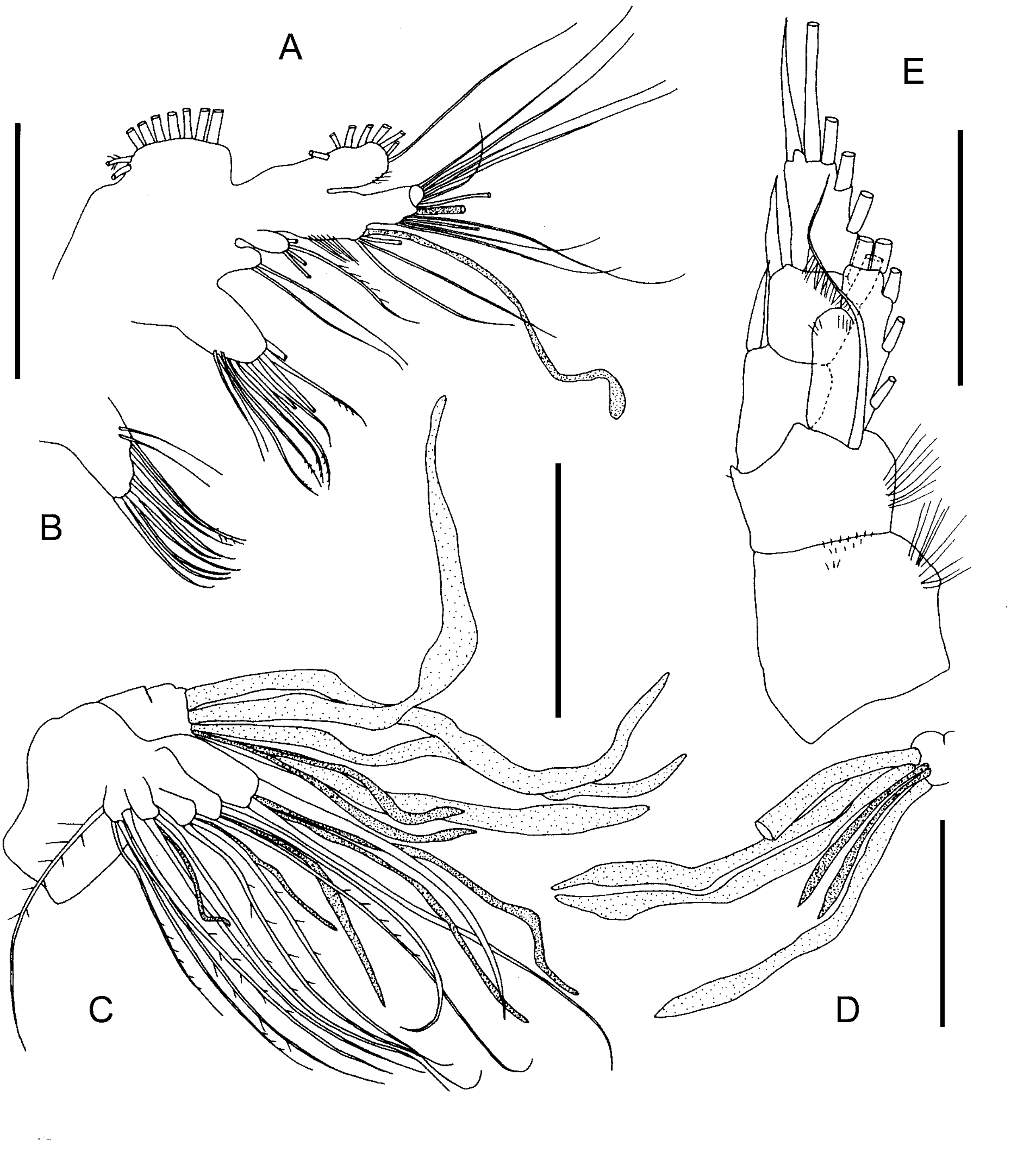

Fig. 11. *Ranthaxus vermiformis* gen. et sp. nov., female, holotype: A – maxillule; B – maxillule, praecoxal arthrite; C – maxilla; D – maxilla, endopod; E – P1. Scale bars = 0.1 mm.

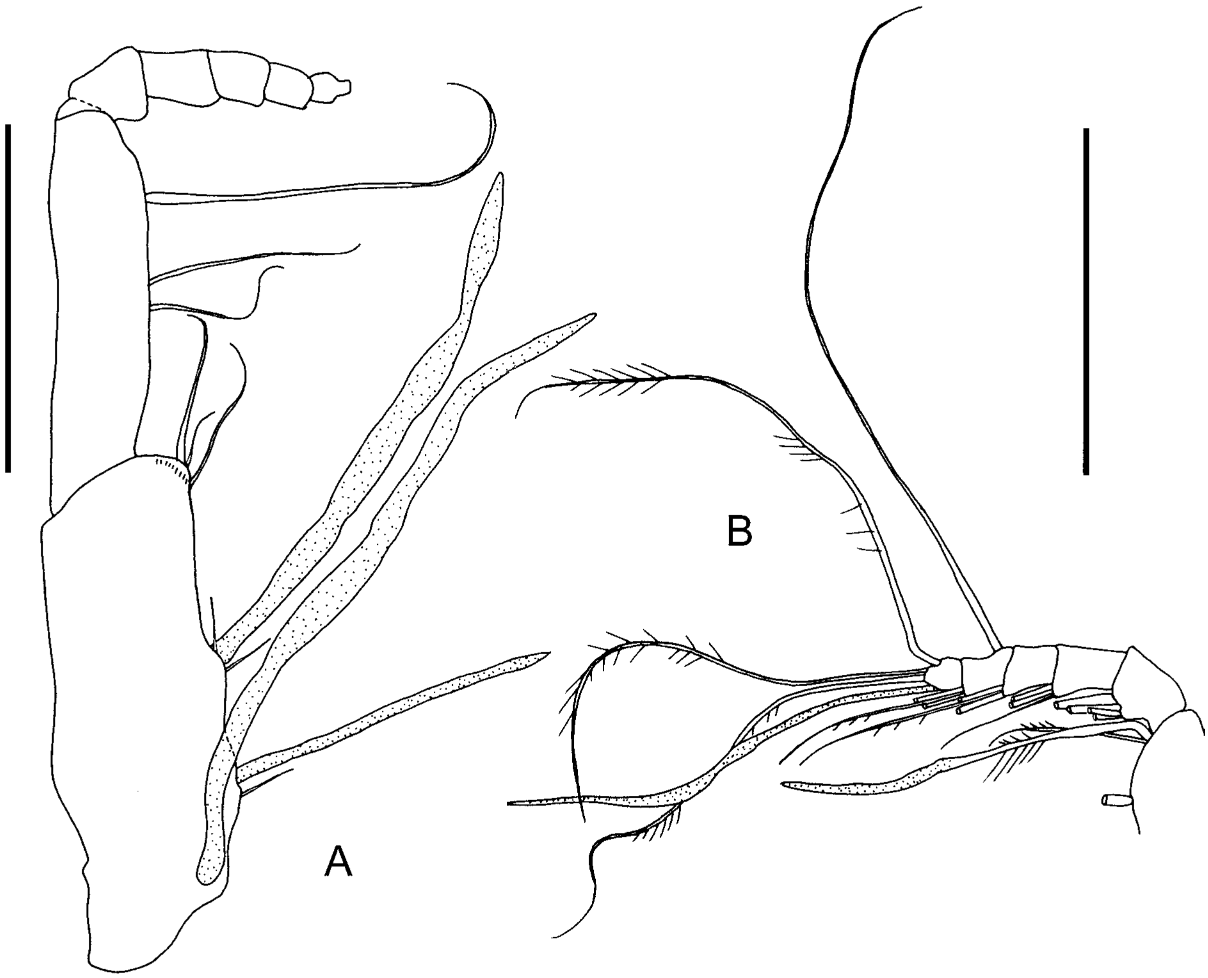

Fig. 12. *Ranthaxus vermiformis* gen. et sp. nov., female, holotype: A – maxilliped, setation of endopod is not given; B – maxilliped, endopod. Scale bars = 0.1 mm.

ment 3 with 2 medial, 2 terminal and 1 lateral setae and tiny posterior surface spinules; exopod segment 1 with lateral spine and medial seta, segment 2 with lateral spine and medial seta, segment 3 with 3 lateral spines, 4 medial setae and terminal spine.

P4 (Fig. 13D–E), coxa with medial seta; basis without seta; endopod segment 1 with medial seta, segment 2 with 1 medial seta, segment 3 with 2 medial, 2 terminal and 1 lateral setae; exopod segment 1 with lateral spine and medial seta, segment 2 with lateral spine and medial seta, segment 3 with 3 lateral spines, 4 medial setae and terminal spine; coxa, basis, and segments 2–3 of endo- and exopod ornamented with tiny spinules on posterior surface.

P5 (Fig. 10F–G) uniramous, symmetrical, 3-segmented, segment 1 with patch of tiny spinules, segment 2 with long spinules, segment 3 covered with spinules of moderate length and 2 spine-like unarticulated and unequal extensions terminally.

Male unknown.

Etymology. The specific name is derived from the Latin *vermes* meaning worm, and refers to the structure of all of the sensory setae on maxilla endopod.

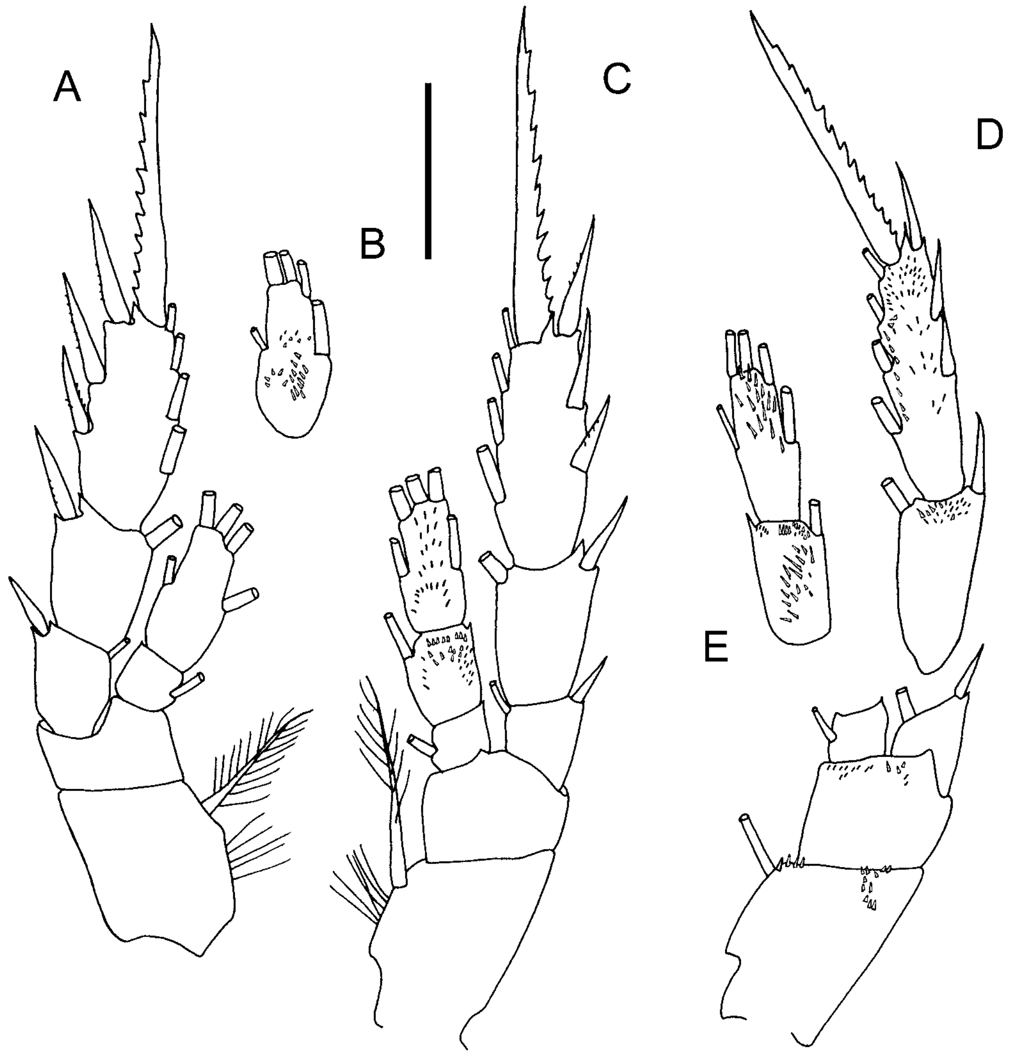

Fig. 13. *Ranthaxus vermiformis* gen. et sp. nov., female, holotype: A – P2, anterior; B – P2, endopod segment 2, posterior; C – P3, posterior; D – P4, right leg, coxa, basis, endopod segment 1 and exopod, posterior; E – P4, left leg, endopod segments 2–3. Scale bars = 0.1 mm.

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