



Description of three new species of *Bradyidius* (Copepoda: Calanoida), the new aetideids from the deep Pacific Ocean, with notes on the genera *Bradyidius* and *Aetideopsis*

ELENA L. MARKHASEVA^{1*} & JASMIN RENZ²

¹Laboratory of Marine Research, Zoological Institute, Russian Academy of Sciences, Universitetskaya nab. 1, St. Petersburg 199034, Russia.

²German Center for Marine Biodiversity Research (DZMB), Senckenberg am Meer, Martin-Luther-King Platz 3, 20146 Hamburg, Germany. [✉ jasmin.renz@senckenberg.de](mailto:jasmin.renz@senckenberg.de); [🌐 https://orcid.org/0000-0002-2658-445X](https://orcid.org/0000-0002-2658-445X)

*Corresponding author. [✉ markhaseva@yahoo.com](mailto:markhaseva@yahoo.com); [🌐 https://orcid.org/0000-0002-6325-0395](https://orcid.org/0000-0002-6325-0395)

Abstract

Three new aetideid species, *Bradyidius abyssalis* **sp. nov.**, *Bradyidius parabyssalis* **sp. nov.**, and *B. kurilokamchaticus* **sp. nov.** are described from female specimens collected near the seafloor in the abyss of the Pacific and Atlantic Oceans. Specimens of *Bradyidius parabyssalis* **sp. nov.** were obtained in both the Atlantic and Pacific Oceans (Argentine Basin, area of the Meteor Seamount and the Kurile-Kamchatka Trench). *Bradyidius abyssalis* **sp. nov.** was found only in the Atlantic Ocean, (Brazil and Guinea Basins and area of the Meteor Seamount) and *Bradyidius kurilokamchaticus* **sp. nov.** was recorded from the Kurile-Kamchatka Trench of the Pacific Ocean. Three new herein described *Bradyidius* species constitute the first documented records of the genus from the abyss of the World Ocean. In addition, three *Bradyidius* species from the Weddell Sea, the Atlantic Ocean and the Kurile-Kamchatka Trench, are briefly described without biological names due to their bad condition. *Bradyidius parabyssalis* **sp. nov.** and *B. abyssalis* **sp. nov.** are distinguished from all known congeners by the presence of 3 setae at the basis of the mandible and morphological details of the prosome posterior corners and P1. They show close resemblance to each other but differ in body size, rostrum structure, P4 coxa armament and length of the setae of the antennule ancestral segment I and the mandible basis. *Bradyidius kurilokamchaticus* **sp. nov.** shares with *B. curtus* Markhaseva, 1993, *B. pacificus* (Brodsky, 1950) and *B. arnoldi* Fleminger, 1957 a rostrum with non-divergent or parallel points, but differs from these species in the size, the well developed lateral spine on exopod segment 1, in the number of setae at the antenna exopod segment 1 and some morphological details of the prosome posterior corners. Characters that define the genus *Bradyidius* Giesbrecht, 1897 from *Aetideopsis* Sars, 1903, i.e. the shape of lateral spines of P1 exopod segments 1 and 2; the endopod of P2 segmentation and the setation of the antennule ancestral segments XII, XV and XVII are discussed.

Key words: Clausocalanoidea, *Bradyidius*, taxonomy, benthopelagic, biogeography

Introduction

Recent calanoid copepod collections obtained in the deep waters in the vicinity of the sea bed have added new and rare species to the list of the benthopelagic fauna of the Aetideidae, however, only one new species of the genus *Bradyidius* was described in recent decades (e.g., Schulz & Markhaseva 2000; Schulz 2002; Bradford-Grieve 2003; Ohtsuka *et al.* 2005; Markhaseva & Schulz 2006, 2008; Markhaseva *et al.* 2017a, b).

Currently the genus *Bradyidius* Giesbrecht, 1897 includes 16 species: *Bradyidius angustus* (Tanaka, 1957), *B. armatus* Giesbrecht, 1897, *B. arnoldi* Fleminger, 1957, *B. capax* Bradford-Grieve, 2003, *B. curtus* Markhaseva, 1993, *B. hirsutus* Bradford, 1976, *B. luluae* Grice, 1972, *B. pacificus* (Brodsky, 1950), *B. plinoi* Campaner, 1978, *B. rakuma* (Zvereva, 1977), *B. saanichi* Park, 1966, *B. similis* (Sars, 1902), *B. spinifer* Bradford, 1969, *B. styliformis* Othman & Greenwood, 1987, *B. subarmatus* Markhaseva, 1993, and *B. tropicus* (Wolfenden, 1905) (Markhaseva, 1996; Bradford-Grieve, 2003).

Bradyidius is a cosmopolitan genus with the northernmost record in the Barents Sea and the southernmost

record in the Antarctic (Vervoort, 1952; personal data herein); however, only five species, *B. angustus*, *B. armatus*, *B. luluae*, *B. pacificus*, and *B. similis* were registered from the several localities, while the other species are usually only known from a single occurrence (Razouls *et al.*, 2005–2020; Markhaseva, 1996).

Many species of the genus are near-bottom dwellers. A documented benthopelagic inhabitation is reported for *B. armatus*, *B. capax*, *B. luluae*, *B. plinoi*, *B. rakuma*, *B. similis*, and *B. subarmatus* (Sars, 1902; Matthews, 1964; Grice, 1972; Johannessen, 1976; Zvereva, 1977; Campaner, 1978; Markhaseva, 1993; Markhaseva & Schnack-Schiel, 2003; Bradford-Grieve, 2003). Although congeners of the above mentioned species were collected in the pelagial, several species can be connected with the near-bottom in their mode of life. E.g., *B. hirsutus* was captured below the surface, however, in a locality with a total depth of 3 m, and *B. spinifer* was sorted from an integrated haul from 600m to the surface where the net touched the bottom during sampling (Bradford, 1969, 1976). Some species, e.g., *B. similis* were found in both kinds of samples - from the near-bottom environment as well as in the pelagic hauls (Shih *et al.*, 1981; Markhaseva, 1996).

Ten *Bradyidius* species are shallow-water inhabitants, never found below 250m (*B. arnoldi*, *B. curtus*, *B. hirsutus*, *B. plinoi*, *B. rakuma*, *B. saanichi*, *B. similis*, *B. styliiformis*, and *B. subarmatus*). According to published data, *Bradyidius armatus* is predominantly an inhabitant of the near-bottom and pelagic shelf or upper slope environments, (Sars, 1902; Matthews, 1964; Markhaseva, 1996 and unpublished personal data). A reference for its presence in a pelagic haul from 3000m was given by Wolfenden (1911). Depth preferences are difficult to give for *B. angustus*, *B. pacificus* and *B. spinifer*, all obtained in pelagic hauls from 600–1000m to the surface. Two *Bradyidius* species were found and described as upper slope (299m and 452m, *B. capax*) and slope (295–560m and 1500m, *B. luluae*) near-bottom dwellers (Grice, 1972; Johannessen, 1976; Markhaseva & Schnack-Schiel, 2003; Bradford-Grieve, 2003), but no *Bradyidius* species have yet been recorded from the abyss.

This is the first time that species of *Bradyidius* are described from abyssal depths (between 2500 and 5399 m). The species were collected during expeditions DIVA 2–3 and KuramBIO 1 carried out between 2005 and 2012. *Bradyidius abyssalis* **sp. nov.** is described from the Atlantic Ocean (Brazil and Guinea Basins and the Meteor Seamount area), and *Bradyidius kurilokamchaticus* **sp. nov.** is reported from the Pacific Ocean (Kurile-Kamchatka Trench). One new species, *Bradyidius parabyssalis* **sp. nov.**, was found from both, the Atlantic (Argentine basin and the area of the Meteor Seamount) and the Pacific Ocean (Kurile-Kamchatka Trench). Three species of *Bradyidius* were in poor condition and could not be attributed to any species of the genus. They are presented herein without biological names. These were collected from the Weddell Sea in the ANDEEP 2 (ANTarctic benthic DEEP-sea biodiversity) expedition in 2005, from the Atlantic Ocean in the DIVA 2 (Latitudinal Gradients of Deep-Sea Biodiversity in the Atlantic Ocean) expedition in 2005 and from the Kurile-Kamchatka Trench in the KuramBIO 2 (Kurile-Kamchatka Biodiversity Study) expedition in 2016 (Table 1).

With the herein described new species *B. abyssalis* **sp. nov.**, *B. parabyssalis* **sp. nov.** and *B. kurilokamchaticus* **sp. nov.**, the genus *Bradyidius* now contains 19 species with biological names.

Material and methods

Collection and descriptions. Specimens of *Bradyidius abyssalis* **sp. nov.** (6 females), *Bradyidius parabyssalis* **sp. nov.** (5 females), *Bradyidius kurilokamchaticus* **sp. nov.** (3 females) and 4 females of the genus *Bradyidius* without a given biological name were sorted from deep-water near-bottom collections of the World Ocean (Table 1). Collections were obtained between 2005 and 2016 during expeditions ANDEEP 2, DIVA 2–3, and KuramBIO 1–2, which incorporated a deep benthopelagic sampling program using an epibenthic sledge (Brenke 2005).

The material was fixed in either 96% pure ethanol or 4% buffered formalin and later stained by adding a solution of chlorazol black E dissolved in 70% ethanol/30% water. Oral parts and legs were dissected in glycerine and figures were prepared using a *camera lucida*.

The following abbreviations are used in the descriptions: A1, antennule, A2, antenna, Mdp, mandibular palp; Mx1, maxillule, Mx2, maxilla; Exp, exopod, Exp 1–3, exopod segments 1–3; Enp, endopod; Enp 1–3, endopod segments 1–3; P1–P5, legs 1–5. Articulating segments of the antennules are designated by Arabic numerals, ancestral segments by Roman numerals. One seta and 1 aesthetasc on a segment of the antennule are designated as 1s + 1ae, “1?” indicates that a setal element was broken so that its identity on antennule could not be determined and only the scar at the location of its attachment was counted. The number of antennule segments follows Huys & Bosxhall

TABLE 1. List of recorded specimens of *Bradyidius*.

Expedition	Species name	Station	Date	Locality	Depth (m)
DIVA 2 ME 63 2	<i>Bradyidius abyssalis</i>	Sta. 64	15.03.2005	00°13.27'S, 02°29.91'W Guinea Basin	5055
	<i>Bradyidius</i> sp. C	Sta. 89	20.03.2005	00°42.95'N, 05°31.29'W Guinea Basin	5141
DIVA 3, ME 79 1	<i>Bradyidius parabyssalis</i>	Sta. 533	15.07.2009	36°00.20'S, 49°01.96'W Argentine Basin	4602
	<i>Bradyidius abyssalis</i>	Sta. 554	22.07.2009	26°34.70'S, 35°12.79'W Brazil Basin	4485
	<i>Bradyidius abyssalis</i>	Sta. 561	23.07.2009	26° 34.78'S, 35°13.90'W Brazil Basin	4484
	<i>Bradyidius abyssalis</i>	Sta. 636	18.08.2009	29°19.24'N, 28°37.94'W Meteor Seamount	4338
	<i>Bradyidius parabyssalis</i>	St. 676	20.08.2009	31°44.58'N, 28°12.26'W Meteor Seamount	2560
ANDEEP II ANT XIX 3	<i>Bradyidius</i> sp. A	Sta. 074	20.02.2005	71°18.42'S, 13°58.21'W Weddell Sea	1032
KuramBio I, SO 223	<i>Bradyidius kurilokamchaticus</i>	Sta. 2–10	03.06.2012	46°14.77'N, 155°32.79'E Kurile-Kamchatka Trench	4859
	<i>Bradyidius</i> sp. B	Sta. 3–9	05.08.2012	47°14.66'N, 154°42.88'E Kurile-Kamchatka Trench	4987
	<i>Bradyidius parabyssalis</i>	Sta. 7–10	17.08.2012	43°01.82'N, 152°58.55'E Kurile-Kamchatka Trench	5223
	<i>Bradyidius kurilokamchaticus</i>	Sta. 9–12	24.08.2012	40°34.49'N, 150°59.85'E Kurile-Kamchatka Trench	5399
	<i>Bradyidius parabyssalis</i>	Sta. 12-4	31.08.2012	39°42.78'N, 147°09.55'E Kurile-Kamchatka Trench	5224
KuramBio II SO 250	<i>Bradyidius</i> sp. B	Sta. 85	15.09.2016	45°01.73'N, 151°03.48'E Kurile-Kamchatka Trench	5228

(1991). The antennal exopod setation formula is given according to Markhaseva & Ferrari (2006) and Markhaseva *et al.* (2014). Maxilla segments are labeled after Ferrari & Ivanenko (2008) as: praecoxal endite; coxal endite; basal endites; enditic-like lobe of proximal endopodal segment. The syncoxa of the maxilliped is presumed to have 3 praecoxal endites and 1 coxal endite after Ferrari & Markhaseva (2000 a, b) and Ferrari & Ivanenko (2001). The the body length was measured to the nearest 0.05 mm.

The type material and additional specimens are deposited in Senckenberg Museum Frankfurt (SMF), Germany and the Zoological Institute, Russian Academy of Sciences, St. Petersburg (ZIN).

Taxonomy

Superfamily Clausocalanoidea Giesbrecht, 1893

Family Aetideidae Giesbrecht, 1893

Genus *Bradyidius* Giesbrecht, 1897

Bradyidius abyssalis sp. nov.

(Figs 1–4)

Holotype. Adult female, dissected, body length 2.80 mm. SMF 37266/1-4 (slides) and 37267 (vial) (Senckenberg). Collected above the sea bed at Sta. 636, Meteor Seamount, 29° 19.24' N 28° 37.94' W, on 18 August 2009 by the DIVA 3 expedition, Meteor cruise ME 79–1, at a depth of 4338 m.

Paratype. One adult female, partly dissected, body length 2.45 mm. ZIN, 91149 the same label data as for holotype.

Additional material. Four females from the Atlantic Ocean: 1 female, body length 2.90 mm, collected in the Guinea Basin, Sta. 64 (specimen 1), 15 March 2005, 00°13.27' S 002°29.91' W, by the DIVA 2 expedition, Meteor cruise ME 63–2, at a depth of 5055 m; 2 females, both body length 2.90 mm, collected in the Brazil Basin, Sta. 554 (specimen 2), 22 July 2009, 26°34.70' S 35°12.79' W, by the DIVA 3 expedition, Meteor cruise ME 79–1, at a depth of 4485 m; 1 female, body damaged, not measured, collected in the Brazil Basin, Sta. 561 (specimen 3), 23 July 2009, 26°34.78' S 35°13.90' W, by the DIVA–3 expedition, Meteor cruise ME 79–1, at a depth of 4484 m;

Description. Female. Body length 2.45–2.90 mm. Prosome 3.20–3.35 times as long as urosome (Fig. 1A–B). Rostrum (Fig. 1D–E) two-pointed, divergent. Cephalosome and pedigerous somite 1 partly fused and pedigerous somites 4–5 separate; posterior corners of prosome prolonged into short points, covering the proximal third of genital double-somite (Fig. 1A–B, F–G). Urosome of 4 somites. Genital double-somite symmetrical, anterior third in dorsal view with lateral swellings and in lateral view with dorsal swelling (Fig. 1F–G). Spermathecae narrow-elongate and oval-widened in the distal part (Fig. 1F). Caudal rami with 1 lateral seta, 1 ventral seta, and 4 terminal setae (Fig. 1F–G).

Antennule (Fig. 2A–D) reaching pedigerous somite 4, of 24 articulating segments; armature as follows: I–2s (holotype, paratype and additional specimens 2 and 3), or 3s in additional specimen 1, II–IV–6s+1ae, V–2s+1ae, VI–2s, VII–2s+1ae, VIII and IX–2s each, X–XI–4s+1ae, XII and XIII–2s each, XIV–1s+1? in holotype and 2s+1ae in paratype, XV–2s, XVI–2s+1ae, XVII to XX–2s each, XXI–2s in holotype and 2s+1ae in paratype, XXII and XXIII–1s each, XXIV–2s+1ae, XXV–XXVI–2s each, XXVII–XXVIII–4s+1ae in holotype and 5s+1ae in paratype.

Antenna (Fig. 2E–F), coxa with 1 seta, basis with 2 setae; exopod of 8 segments, setation formula 1,1-1-1, 1, 1, 1, 1, 1, and 3 setae, endopod segment 1 with 2 setae, endopod segment 2 with 8 + 7 setae.

Mandible (Fig. 2G–I), gnathobase with 7 teeth; basis with 3 setae, middle seta small; exopod 5-segmented with 1, 1, 1, 1, and 2 setae; endopod segment 1 with 3 setae, segment 2 with 9+2 setae.

Maxillule (Fig. 3A–B), praecoxal arthrite with 9 terminal spiniform setae, 4 posterior and 1 anterior setae, coxal endite with 5 setae; coxal epipodite with 7 long+2 short setae; proximal basal endite with 4 setae, tubercle with pore and small denticles along the distal border present, distal basal endite with 5 setae; endopod with 15 setae (16 setae in paratype); exopod with 10 setae.

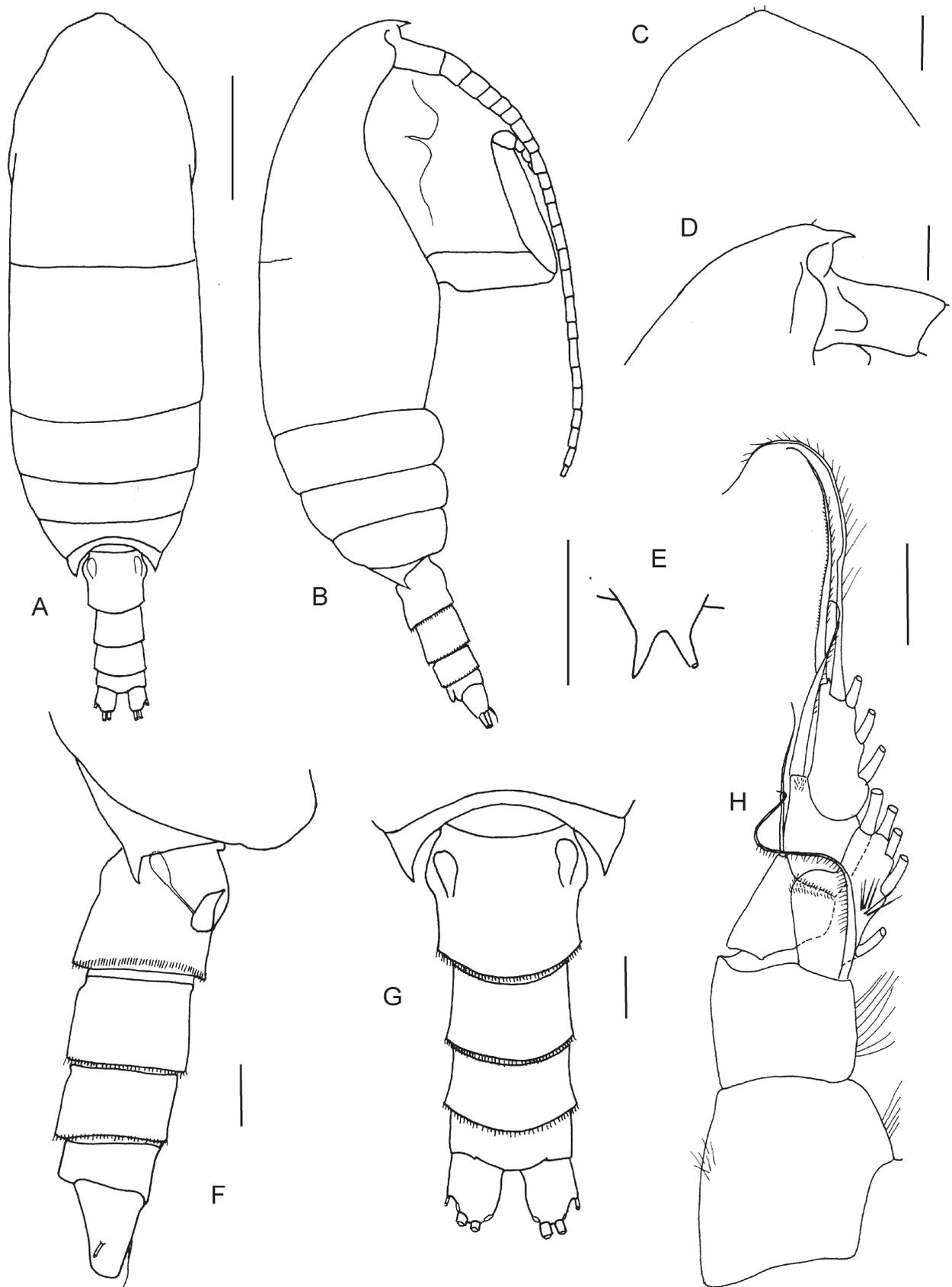


FIGURE 1. *Bradyidius abyssalis* sp. nov. Female, holotype. A, habitus, dorsal view; B, habitus, lateral view; C, prosome, anterior dorsal view; D, prosome anterior and rostrum, lateral view; E, rostrum; F, posterior prosome and urosome, lateral view; G, posterior prosome and urosome, dorsal view; H, P1. Scale bars: A–B 0.5 mm, C–H 0.1 mm.

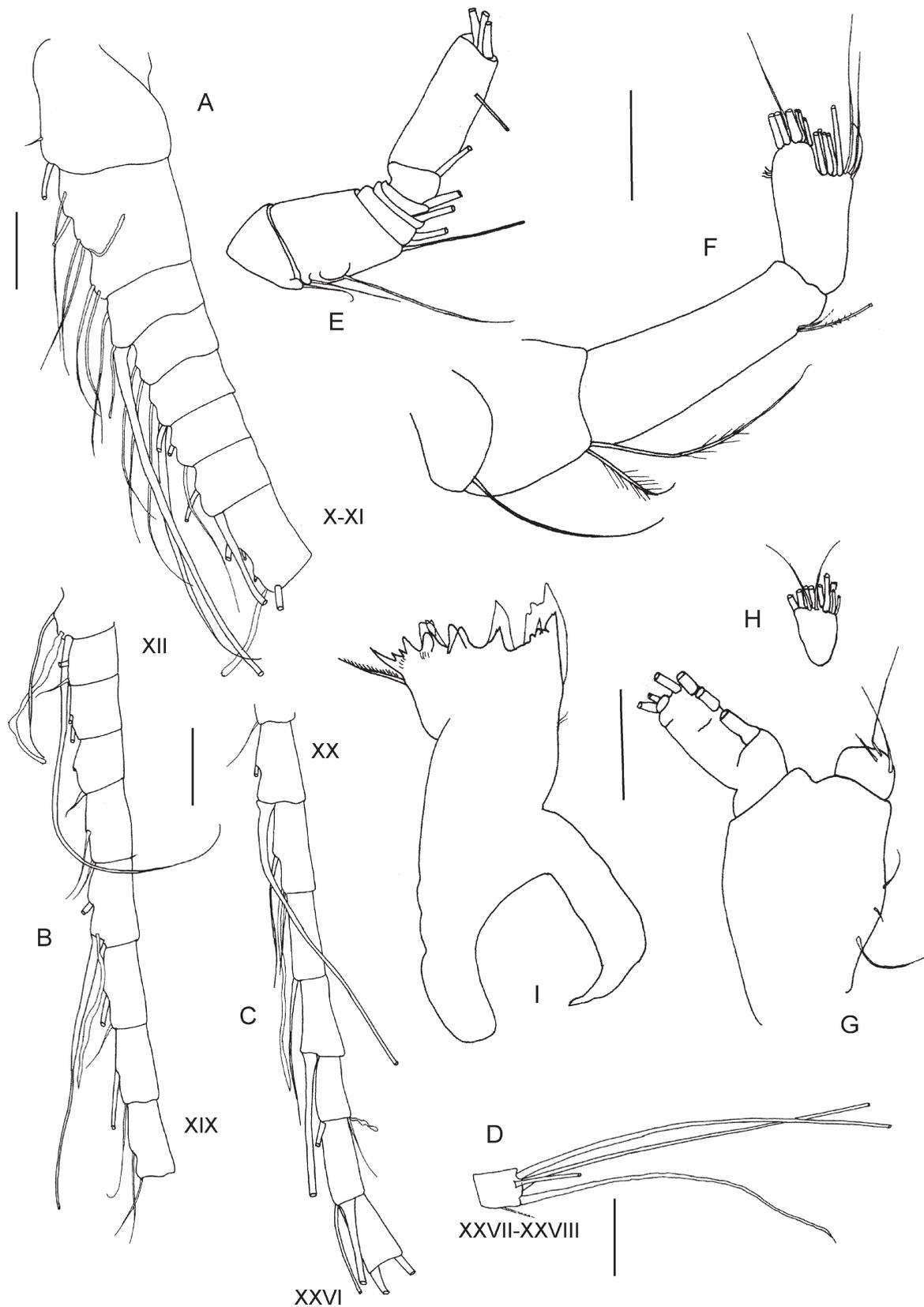


FIGURE 2. *Bradyidius abyssalis* sp. nov. Female, holotype. A, antennule, ancestral segments I–XI; B, antennule, ancestral segments XII–XIX; C, antennule, ancestral segments XX–XXVI; D, antennule, ancestral segments XXVII–XXVIII; E, antenna exopod; F, antenna, coxa, basis and endopod; G, mandible, palp, endopod segment 1; H, mandible, endopod segment 2; I, mandible, gnathobase. Scale bars 0.1 mm.

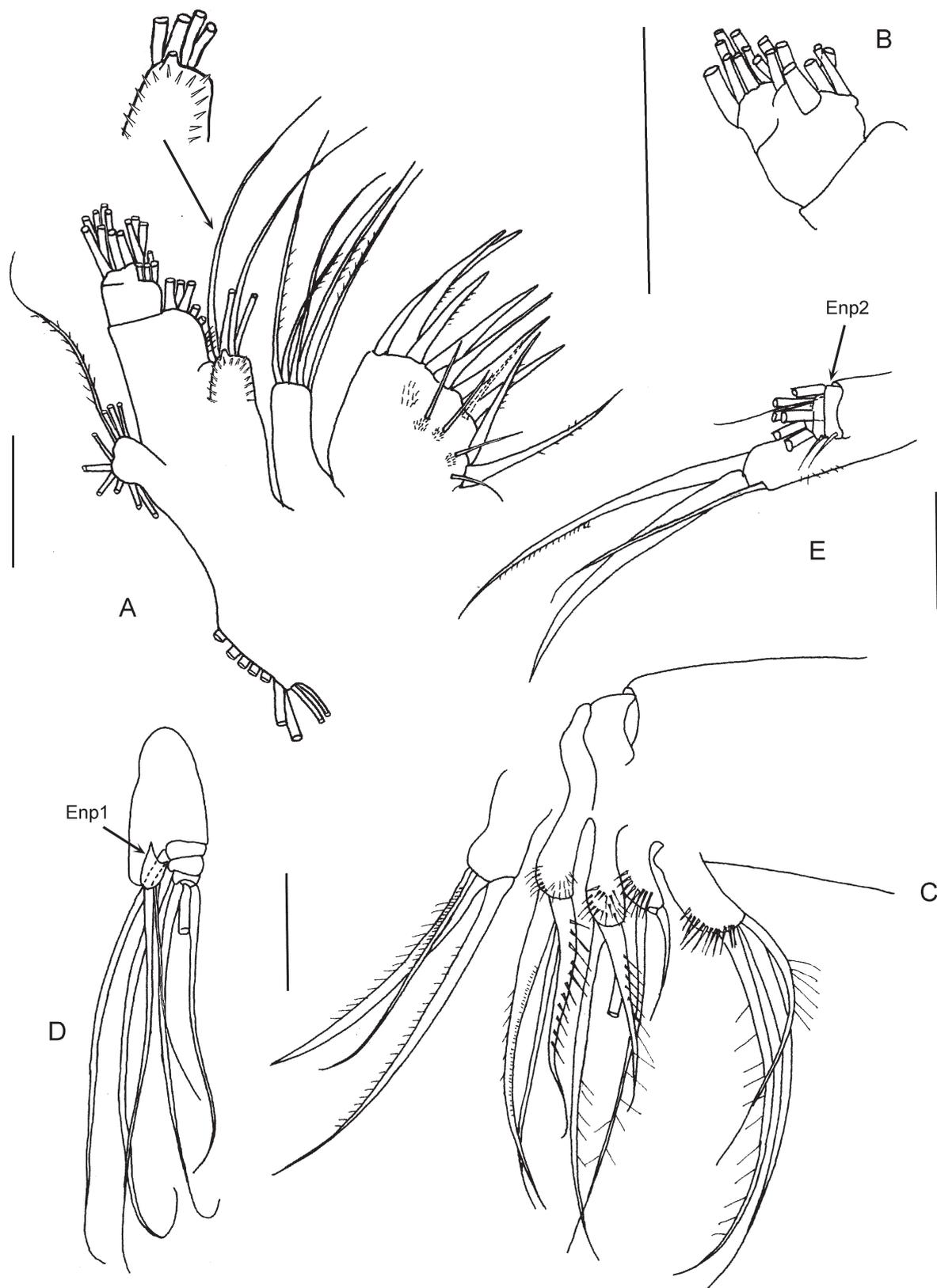


FIGURE 3. *Bradyidius abyssalis* sp. nov. Female, holotype. A, maxillule; B, maxillule, endopod segments 1–3; C, maxilla, endopod not figured, scar indicates that a setal element was broken at coxal endite; D–E, enditic lobe of endopod and endopod in different views. Scale bars 0.1 mm.

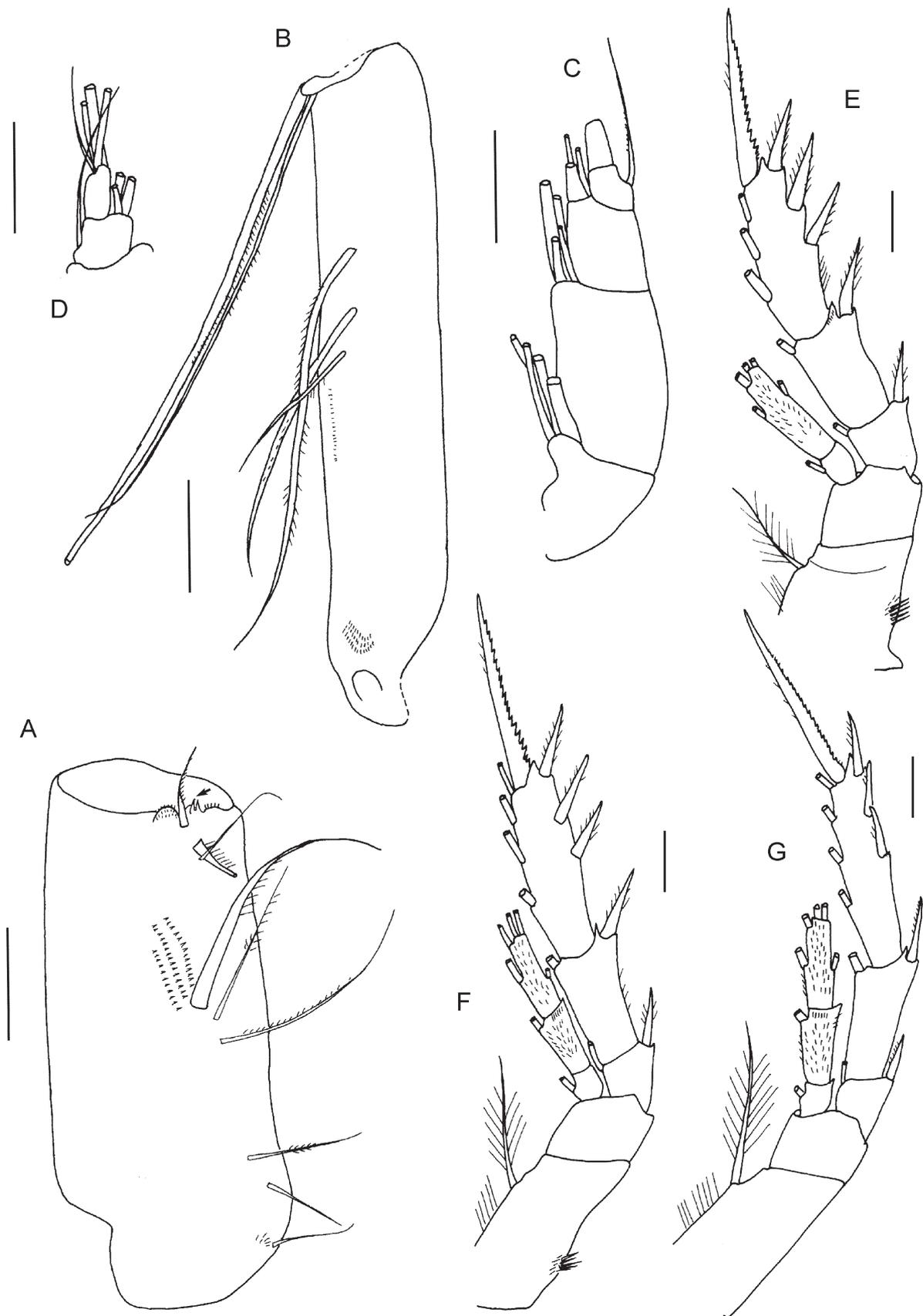


FIGURE 4. *Bradyidius abyssalis* sp. nov. Female, holotype. A, maxilliped, syncoxa; B, maxilliped, basis and endopod segment 1; C, maxilliped, endopod, terminal setae of endopod not figured; D, maxilliped, endopod segments 5–6; E, P2; F, P3; G, P4. Scale bars 0.1 mm.

Maxilla (Fig. 3C–E), praecoxal to basal endites with 3 setae each, all endites decorated with spinules; enditic-like lobe of proximal endopod segment with 3 setal elements, two of them thicker, spine-like; endopod with 9 (2+2+2+3) setae.

Maxilliped (Fig. 4A–D), syncoxa with 1 seta on proximal praecoxal endite, 2 setae on middle praecoxal endite and 3 setae on distal praecoxal endite; coxal lobe with 3 setae and tubercle with a deep notch (arrowed at Fig. 4A). Basis with 3 setae. Endopod 6-segmented with 2, 4, 4, 3, 3+1, and 4 setae, first segment very small and fused to basis.

Legs. P1 (Fig. 1H), coxa with lateral spinules; basis with medial distal seta curved with setules; endopod 1-segmented with lateral lobe, its lateral margin with spinules and anterior surface with distal spinules; exopod segment 1 with lateral setiform spine and segments 2 and 3 with 1 lateral spine each; lateral setiform spine of exopod segment 1 exceeding the base of the lateral spine at the exopod segment 2 and nearly reaching the base of exopod segment 3 third medial seta.

P2–P4 (Fig. 4E–G), coxa with 1 medial seta, P2–P3 coxa with lateral spinules, at P4 coxa lateral spinules absent; basis without seta; endopod 2-segmented in P2, 3-segmented in P3–P4; posterior surface spinules present on P2 endopod segment 2 and P3–P4 endopod segments 2 and 3.

P5 absent.

Male unknown.

Type locality. 29° 19.24' N 28° 37.94' W.

Etymology. The species name “*abyssalis*” refers to the depth of the species’ habitat within the Atlantic Ocean.

Remarks. Differences from known congeners are given in the remarks of the next species.

***Bradyidius parabyssalis* sp. nov.**

(Figs 5–6)

Holotype. Adult female, dissected, body length 3.25 mm. SMF 37264/1-3 (slides) and 37265 (vial) (Senckenberg). Collected above the sea bed at Sta. 533, in the Argentine Basin, 36° 00.20' S 49° 01.96' W, on 15 July 2009 by the DIVA 3 expedition, Meteor cruise ME 79–1, at a depth of 4602 m.

Paratype. One adult female, partly dissected, body length 3.10 mm (poor condition). ZIN, 91150. Collected above the sea bed at Sta. 676, Meteor Seamount 31° 44.58' N 28° 12.26' W, on 20 August 2009 by the DIVA 3 expedition, Meteor cruise ME 79–1, at a depth of 2560 m.

Additional material. One female (specimen 1), from the Pacific Ocean, body length 3.10 mm, collected above the sea bed in the Kurile-Kamchatka Trench, at Sta. 7–10 on 17 August 2012, 43°01.82' N 152°58.55' E, by the KuramBio 1 expedition, Sonne cruise SO 223, at a depth of 5223 m; 2 females (specimens 2 & 3), damaged, not measured, collected above the sea bed in the Kurile-Kamchatka Trench, at Sta. 12–4 on 31 August 2012, 39°42.78' N 147°09.55' E, by the KuramBio 1 expedition, Sonne cruise SO 223, at a depth of 5224 m.

Description. Female. Body length 3.10–3.25 mm. Prosome 3.7 times as long as urosome. Rostrum (Fig. 5A–D) two-pointed, divergent, excavation between points with two tubercles. General body view including the posterior corners length (Fig. 5E–F) as in *B. abyssalis* sp. nov. Genital double-somite symmetrical, in its anterior half with lateral swellings in dorsal view and dorsal swelling in lateral view (Fig. 5E–J). Spermathecae visible in holotype only and narrow-elongate and rounded in distal part (Fig. 5E–F). Caudal rami with 1 lateral seta, 1 ventral seta, and 4 terminal setae (Fig. 5E–F).

Antennule (Fig. 5K–L) totally retained in holotype only. Ancestral segment I retained in all specimens possesses 3 setae, the distal seta is the longest, proximal are shorter and nearly equal in length. Antennule of holotype reaching pedigerous somite 5, of 24 articulating segments setal numbers at the segments II–XXVIII as in *B. abyssalis* sp. nov.

Antenna (Fig. 6A), as in *B. abyssalis* sp. nov.

Mandible (Fig. 6B–D), as in *B. abyssalis* sp. nov., except for middle basal seta is longer.

Maxillule (Fig. 5M), maxilla and maxilliped as in *B. abyssalis* sp. nov.

Legs. P1–P4 (Fig. 5N, 6E–G) as in *B. abyssalis* sp. nov., except for P4 coxa with lateral spinules.

P5 absent.

Type locality. 36° 00.20' S 49° 01.96' W.

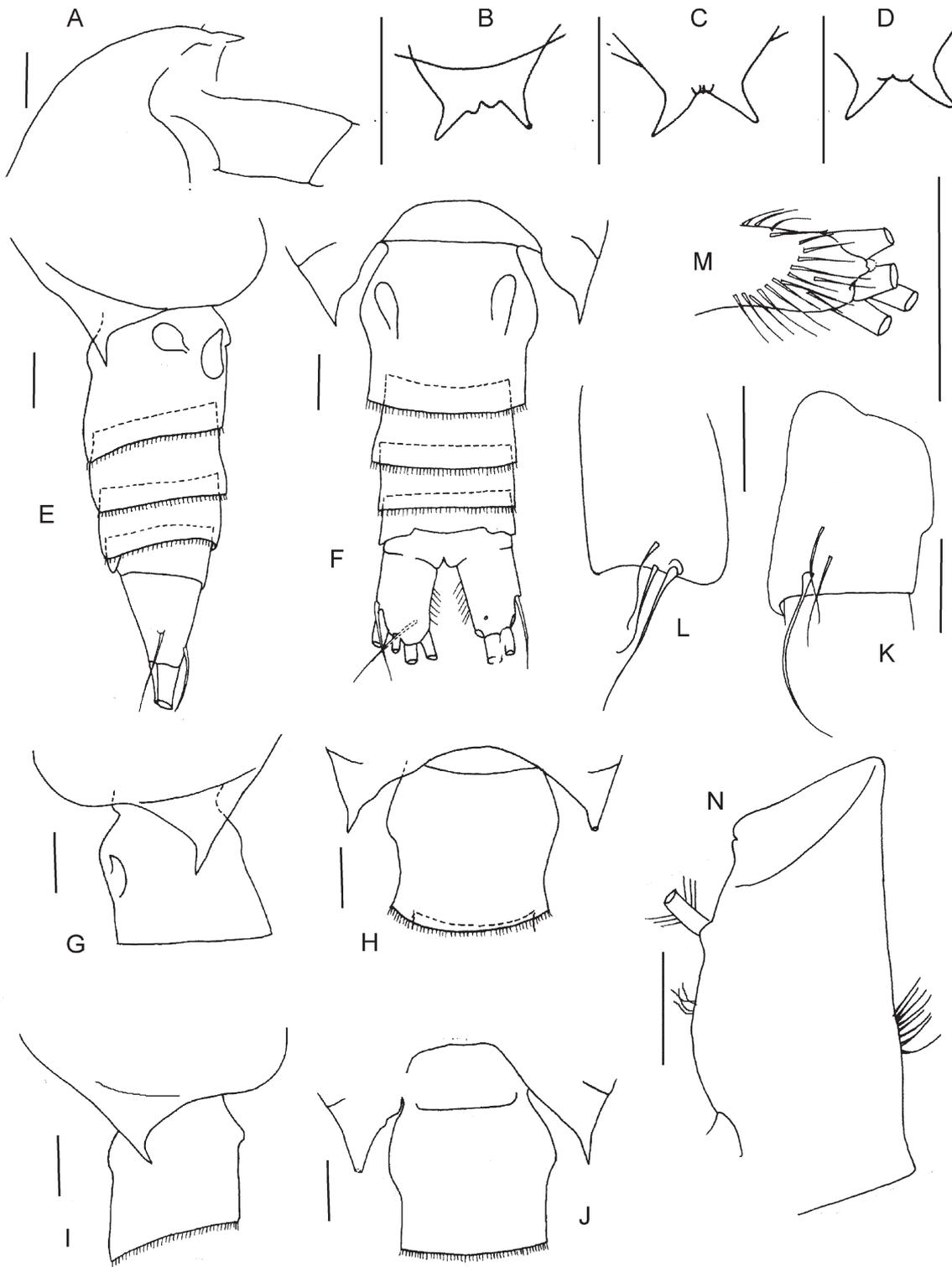


FIGURE 5. *Bradyidius parabyssalis* sp. nov. Female. A, prosome anterior and rostrum, lateral view; B, rostrum, ventral view; C, rostrum, ventral view; D, rostrum, ventral view; E, holotype, posterior prosome and urosome, lateral view; F, posterior prosome and urosome, dorsal view; G, posterior prosome somite and genital double-somite, lateral view; H, posterior prosome somite and genital double-somite, dorsal view; I, posterior prosome somite and genital double-somite, lateral view; J, posterior prosome somite and genital double-somite, dorsal view; K, antennule, ancestral segment I; L, antennule, ancestral segment I; M, maxillule, proximal basal endite; N, P4, basis. Scale bars: 0.1 mm. A–B, E–F, K, M–N, holotype; G–H, paratype; C, I–J, L, specimen 1; D, specimen 2.

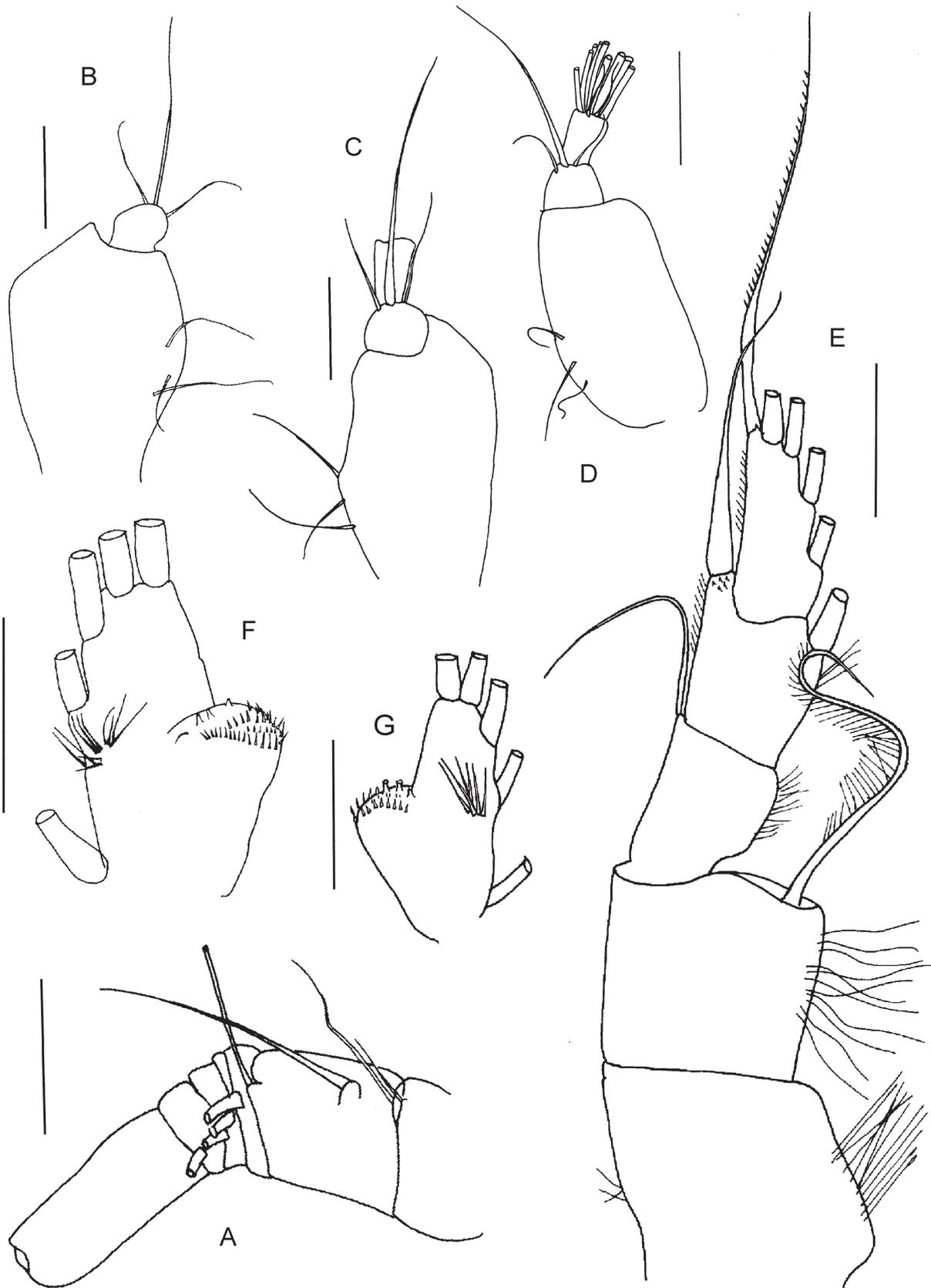


FIGURE 6. *Bradyidius parabyssalis* sp. nov. Female. A, antenna, exopod; B, mandible, palp and endopod segment 1; C, mandible, palp and endopod segment 1; D, mandible, palp and endopod; E, P1; F, P1, endopod; G, P1, endopod. Scale bars: 0.1 mm. A–B, E, G, specimen 1; C, F, holotype; D, paratype.

Etymology. The species name “*parabyssalis*” refers to the close similarity of the species to the above described species “*abyssalis*”.

Remarks. The species *Bradyidius parabyssalis* sp. nov. and *B. abyssalis* sp. nov. share the general habitus and the main morphological features of oral parts and swimming legs. *B. parabyssalis* sp. nov. differs from *B. abyssalis* sp. nov. in the following characters: 1) body size over 3.00 mm (vs 2.45–2.90 mm in *B. abyssalis* sp. nov.); 2) two tubercles present in excavation between rostral points (vs tubercles between rostral points absent in *B. abyssalis* sp. nov.); 3) antennule ancestral segment I with 3 setae and proximal setae about twice shorter than the distal seta (vs antennule ancestral segment I usually with 2 setae and proximal seta much more than twice shorter than distal seta in *B. abyssalis* sp. nov.); 4) mandible basal middle seta is well developed (vs this seta is vestigial in *B. abyssalis* sp. nov.), and 5) P4 coxa with lateral spinules (vs lateral spinules absent in *B. abyssalis* sp. nov.).

The combination of the following characters distinguish *B. parabyssalis* sp. nov. and *B. abyssalis* sp. nov. from other species of the genus: 1) the species are the only known representatives of *Bradyidius*, that possess 3 setae at the basis of the mandible (vs a single seta present in *B. hirsutus* and 2 setae in the other congeners); 2) both new species possess a long lateral spine on the P1 exopod segment 1 reaching, or exceeding the base of lateral spine at the exopod segment 2 and reaching, or exceeding the base of the second medial seta on the exopod segment 3 (this character is shared with *B. luluae* and *B. spinifer*, vs in the other congeners if this spine reaching, or exceeding the base of lateral spine at the exopod segment 2, then it is not reaching the base of the first medial seta on the exopod segment 3), and 3) both new species share the short posterior corners of the prosome, not reaching the middle length of the genital double-somite (this character is shared with *B. curtus* vs posterior corners of prosome reaching or exceeding the middle length, the posterior third, or posterior border of the genital double-somite in the other congeners) (Bradford, 1969, 1976; Grice, 1972; Markhaseva, 1996 and personal data herein).

***Bradyidius kurilokamchaticus* sp. nov.**

(Figs 7–9)

Holotype. Adult female, dissected, body length 2.50 mm. SMF 37268/1-3 (slides) and 37269 (vial) (Senckenberg). Collected above the sea bed in the Pacific Ocean, Kurile-Kamchatka Trench at Sta. 2–10, 46° 14.76' N 155° 32.81' E, on 3 August 2012 by the KuramBio 1 expedition, Sonne cruise SO 223, at a depths of 4859 m.

Paratype. One adult female, partly dissected, body length 2.55 mm. ZIN, 91151. Collected above the sea bed in the Kurile-Kamchatka Trench at Sta. 9–12, 40°34.49' N 150°59.85' E on 24 August 2012 by the KuramBio 1 expedition, Sonne cruise SO 223, at a depth of 5399 m.

Additional material. One adult female in a very poor condition, dissected, body length 2.40 mm, same label data as for the holotype.

Description. Female. Body length 2.40–2.55 mm. Prosome 4.02 times as long as urosome (Fig. 7A–B). Rostrum two-pointed, not divergent in holotype (Fig. 7C, E), abnormal in paratype (Fig. 7D, F). Cephalosome and pedigerous somite 1 and pedigerous somites 4–5 incompletely separate; posterior corners prolonged into short points, reaching the posterior third of the genital double-somite (Fig. 7A–B, G–J). Urosome of 4 somites. Genital double-somite symmetrical, with lateral swellings in its anterior half (dorsal view) (Fig. 7G–J). Spermathecae narrow-elongate and oval (holotype), or oval-widened in the distal part (Fig. 7G, I). Caudal rami with 1 lateral seta, 1 ventral seta, and 4 terminal setae (Fig. 7G–J).

Antennule broken in all specimens, armature of the ancestral segment I as: 3s in holotype and 2s in paratype, armature of retained ancestral segments from II to XIV given after holotype and of ancestral segments XV–XVII after paratype as follows: II–IV–6s+1ae, V–2s+1ae, VI–2s, VII–2s+1ae, VIII and IX–2s each, X–XI–4s, XII and XIV–2?, XV–1s+1?, XVI–2s+1ae, XVII–1s+1?.

Antenna (Fig. 8A), after holotype, coxa with 1 seta, basis with 2 setae; exopod of 8 segments, setation formula 1,1-1-1, 1, 1, 1, 1, 1, and 3 setae, endopod segment 1 with 2 setae, endopod segment 2 with 7+7 setae.

Mandible (Fig. 8B–C), after holotype, gnathobase with 7 teeth; basis with 2 setae; exopod 5-segmented with 1, 1, 1, 1, and 2 setae; endopod segment 1 with 2 setae, segment 2 with 9+2 setae.

Maxillule, after holotype, praecoxal arthrite with 9 terminal spiniform setae, 4 posterior and 1 anterior setae, coxal endite with 5 setae; coxal epipodite with 7 long+2 short setae; proximal basal endite with 4 setae, tubercle is hardly visible, distal basal endite with 5 setae; endopod with 16 setae; exopod with 10 setae.

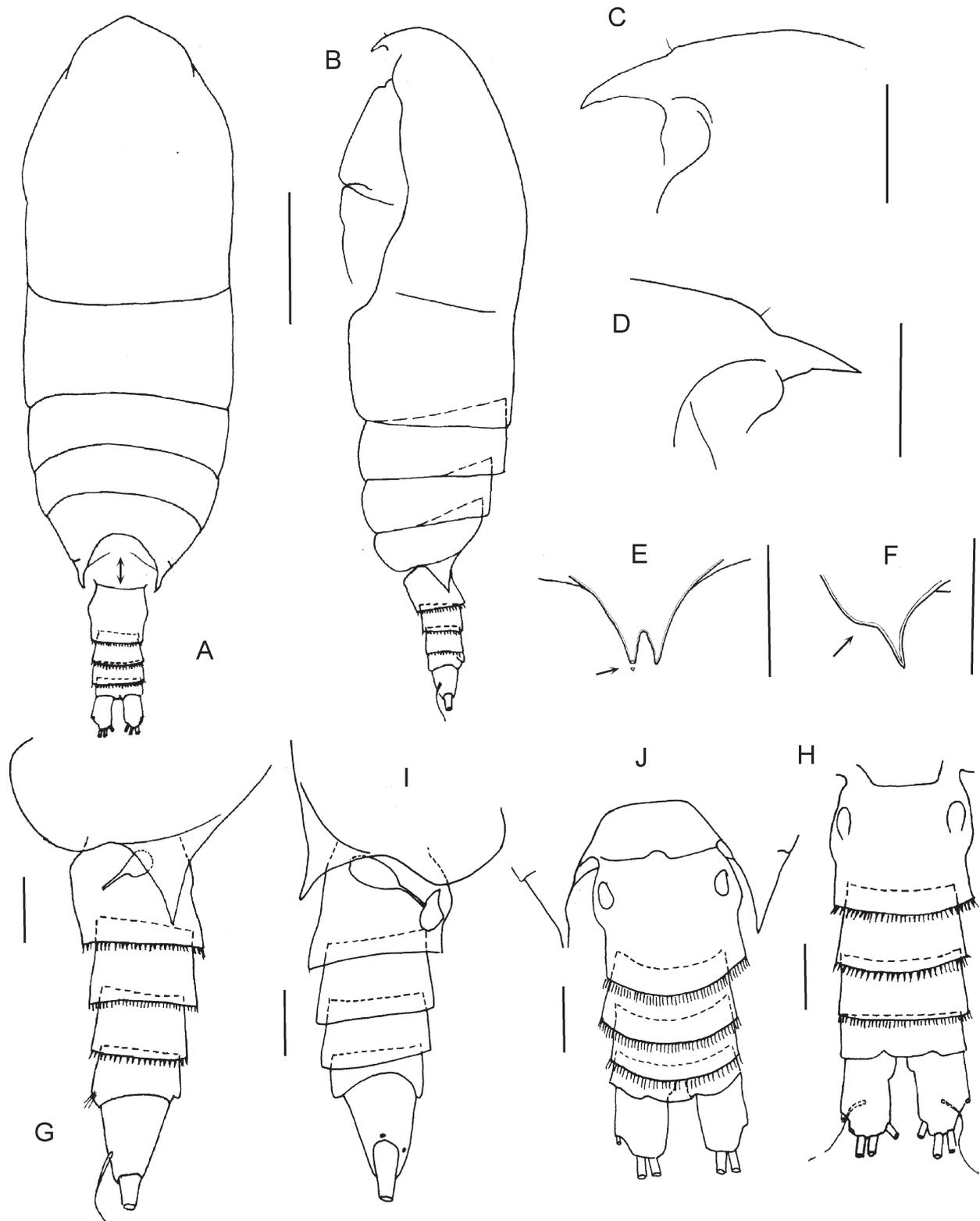


FIGURE 7. *Bradyidius kurilokamchaticus* **sp. nov.** Female. A, habitus, dorsal view; B, habitus, lateral view; C, rostrum, lateral view; D, rostrum, lateral view; E, rostrum, ventral view; F, rostrum, ventral view, abnormal; G, posterior prosome and urosome, lateral view; H, urosome, dorsal view; I, posterior prosome and urosome, lateral view; J, posterior prosome and urosome, dorsal view. Scale bars: A–B 0.5 mm, C–H 0.1 mm. A–C, E, G–H, holotype, D, F, I–J, paratype.

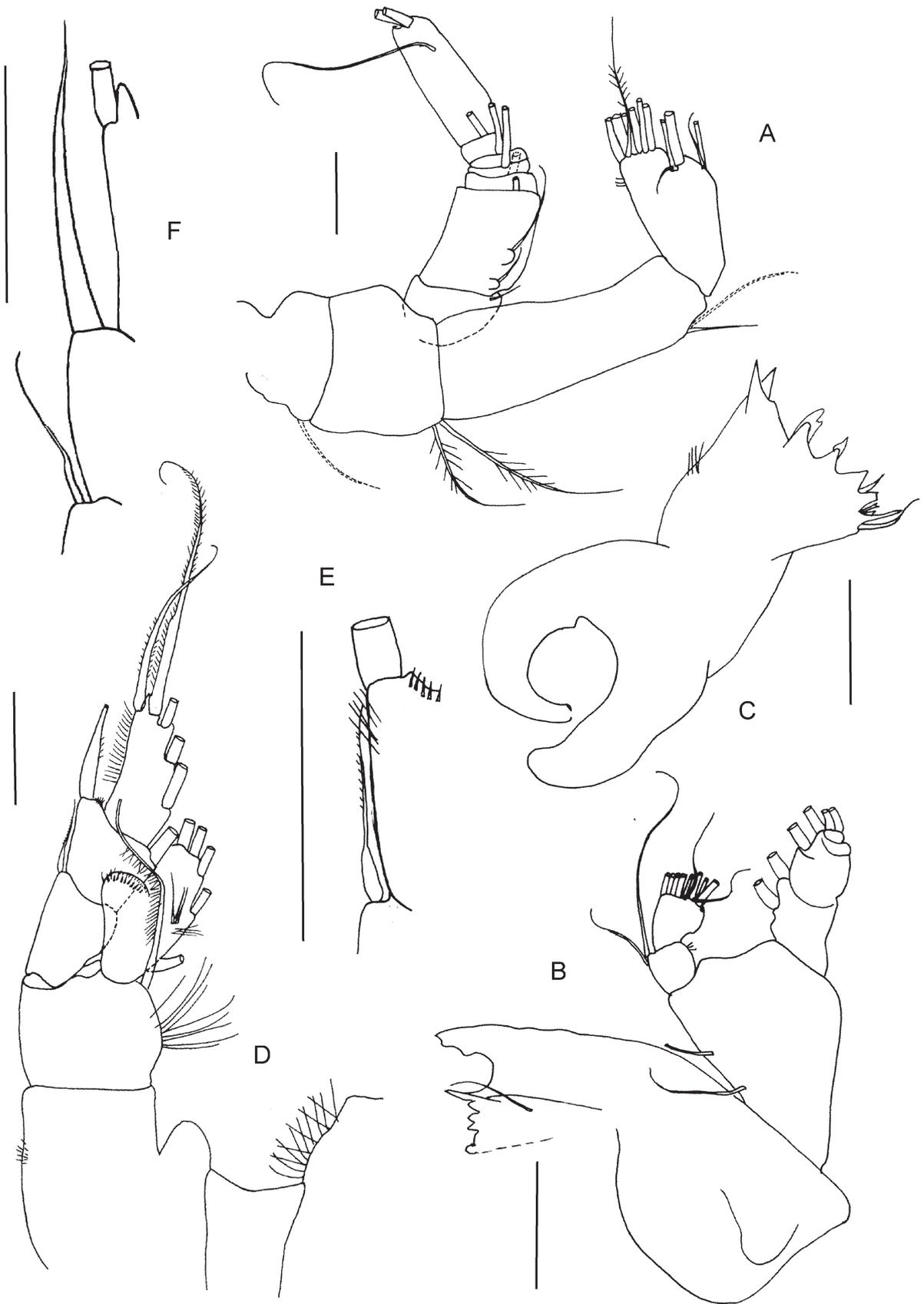


FIGURE 8. *Bradyidius kurilokamchaticus* sp. nov. Female. A, antenna; B, mandible; C, mandible, gnathobase; D, P1; E, P1, exopod segment 1 lateral spine; F, P1, exopod segment 1 and exopod segment 2 lateral spines. Scale bars: 0.1 mm. A–E, holotype; F, paratype.

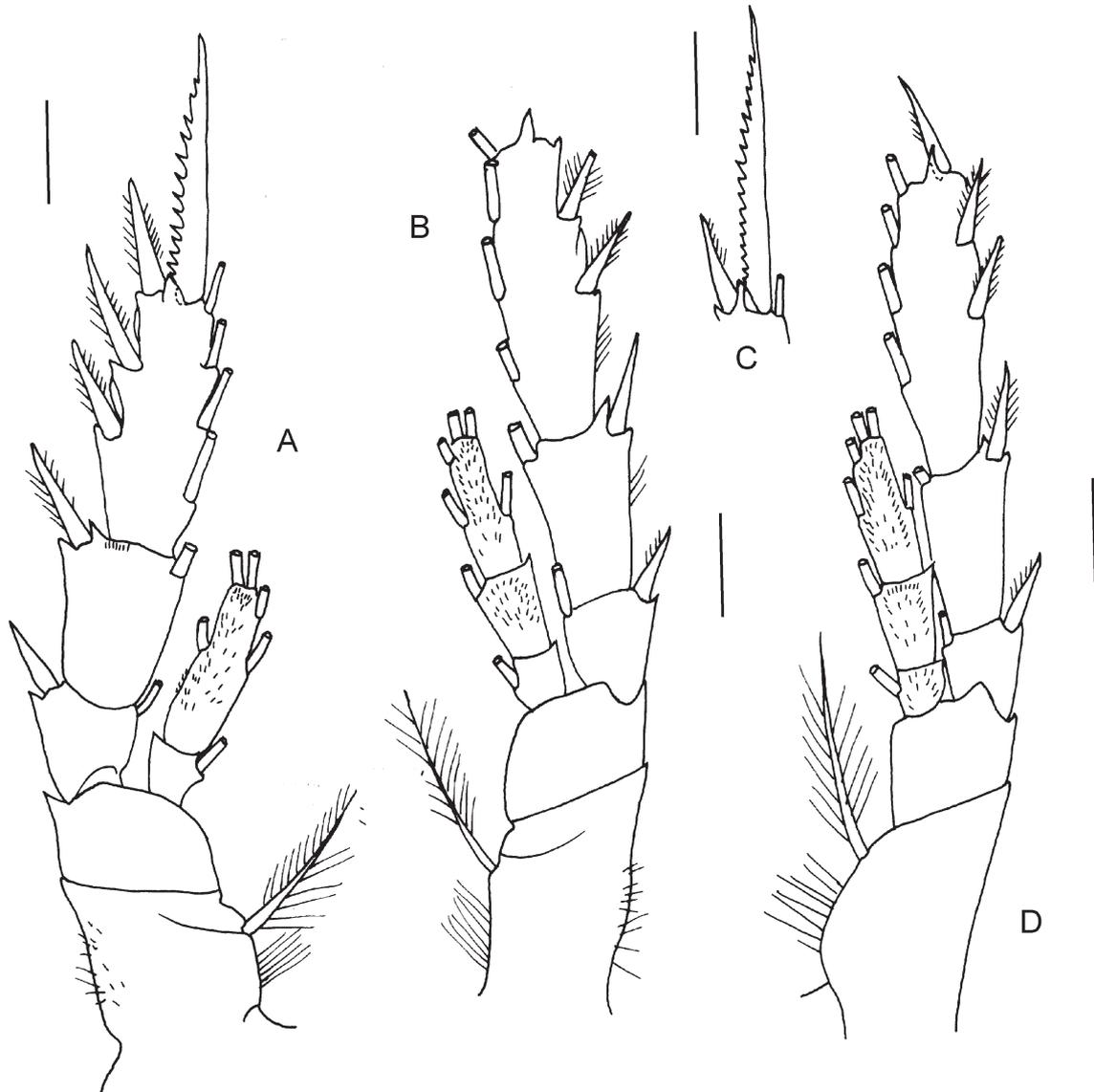


FIGURE 9. *Bradyidius kurilokamchaticus* sp. nov. Female, holotype. A, P2; B, P3; C, P4, terminal spine; D, P4, without terminal spine. Scale bars: 0.1 mm.

Maxilla, after types and additional specimens, praecoxal to basal endites with 3 setae each, all endites decorated with denticles; enditic-like lobe of proximal endopod segment with 3 setal elements, two thicker, spine-like; endopod in holotype with 8 (2+1+2+3) setae (setae partly broken), in paratype and in additional specimen with 9 setae (2+2+2+3).

Maxilliped, after holotype, syncoxa with 1 seta on proximal praecoxal endite, 2 setae on middle praecoxal endite and 3 setae on distal praecoxal endite; coxal lobe with 3 setae and conical tubercle with a deep notch. Basis with 3 setae. Endopod 6-segmented with 2, 4, 4, 3, 3+1, and 4 setae, first segment very small and fused to basis.

Legs. P1 (Fig. 8D–F), coxa with lateral spinules at the left leg in holotype and at the both legs in paratype, in holotype right coxa with projection (Fig. 8D), which might be an abnormality, left coxa in holotype and both coxae in paratype and additional specimen without projection; basis with medial distal seta curved with setules; endopod 1-segmented with lateral lobe, its lateral margin with spinules, anterior segment surface with distal spinules; exopod segment 1 with lateral setiform spine and segments 2 and 3 with 1 lateral spine each; lateral setiform spine of exopod segment 1 not reaching the base of exopod segment 2 lateral spine.

P2–P4 (Fig. 9A–D), P2–P4 coxa with 1 medial seta, at P2–P3 also with lateral spinules; basis without seta; endopod 2-segmented in P2, 3-segmented in P3–P4; posterior surface spinules present on P2 endopod segment 2; P3 endopod segments 2 and 3 and P4 endopod segments 1–3.

P5 absent.

Male unknown.

Type locality. 46° 14.76' N 155° 32.81' E

Etymology. The species name “*kurilokamchaticus*” refers to the type locality, in the Kurile-Kamchatka Trench.

Remarks. The new species *Bradyidius kurilokamchaticus* **sp. nov.** shares with *B. curtus*, *B. pacificus* and *B. arnoldi* a rostrum with nondivergent or parallel points while the rostrum has divergent points in the other congeners. The size of the new species (2.50–2.55 mm) is close to the size of *B. curtus* (2.80–2.90 mm), but *B. kurilokamchaticus* **sp. nov.** is smaller than *B. pacificus* (4.40–4.50 mm) and larger than *B. arnoldi* (1.67 mm). Additionally to the larger size, the new species is distinguished from *B. arnoldi* by the well-developed exopod segment 1 lateral setiform spine (vs lateral spine is rudimentary in *B. arnoldi*, see Fleminger, 1957: figs. 1–13) and length of terminal spine of P2 exopod segment 3, which is as long as segment in *B. kurilokamchaticus* **sp. nov.** (vs 1.5 times longer P2 exopod segment 3 in *B. arnoldi*). *Bradyidius kurilokamchaticus* **sp. nov.** differs from *B. curtus* and *B. pacificus* in the armature of antenna exopod segment 1, that possesses 1 seta (vs seta absent in *B. curtus* and *B. pacificus*), and from *B. curtus* also in the longer points of the prosome posterior corners, reaching the posterior third of the genital double-somite (vs points of posterior corners hardly extending the anterior third of the genital double-somite in *B. curtus*) (Fleminger, 1957; Markhaseva, 1996 and personal data herein).

***Bradyidius* sp. A**

(Fig 10)

Material. One female in poor condition from the Weddell Sea, collected above the sea bed at Sta. 074 on 20 February 2005, 71°18.42' S 13°58.21' W, by the ANDEEP 2 expedition, Polarstern cruise ANT XIX–3, at a depth of 1032 m.

Description (limbs in poor condition, only partly described). Female. Body length 2.25 mm. Prosome 4.40 times as long as urosome. Rostrum two-pointed, divergent (Fig. 10C). Cephalosome and pedigerous somite 1 separate, pedigerous somites 4–5 fused (Fig. 10A–B); posterior corners prolonged into points broken at tips, remaining part reaching posterior border of genital double-somite (Fig. 10A). Urosome of 4 somites. Genital double-somite symmetrical, with significant lateral swellings in its anterior half (dorsal view). Spermathecae narrow-elongate and oval in distal part (Fig. 10B). Caudal rami with 1 lateral seta, 1 ventral seta, and 4 terminal setae.

Antennule reaching posterior border of genital double-somite.

Antenna (Fig. 10D), exopod of 8 segments, setation formula 0,0-1-1, 1, 1, 1, 1, 1, and 3 setae.

Mandible, basis with 2 setae; exopod broken; endopod segment 1 with 2 setae, segment 2 with setae 8 long and 1 short setae.

Maxillule, praecoxal arthrite with 9 terminal spiniform setae and 1 anterior setae, posterior setae broken; coxal endite with 5 setae; coxal epipodite broken; proximal basal endite with 4 setae, distal basal endite with 5 setae; endopod with 16 setae; exopod with 10 setae.

Maxilla, typical for the genus, endopod setation not observed.

Maxilliped typical for the genus.

Legs. P1 (Fig. 10E), coxa with lateral spinules; basis with medial distal seta curved with setules; endopod 1-segmented with lateral lobe, its lateral margin with spinules, anterior segment surface with distal spinules; exopod segments 1–3 with 1 lateral spine each; spine of exopod segment 1 slightly exceeding base of exopod segment 2 lateral spine.

P5 absent.

Male unknown.

Remarks. This is the second registration of the genus *Bradyidius* in the Antarctic, documented, at least by brief taxonomic remarks. The first time the genus was recorded by Wolfenden (1911) from a depths of 1200m and 3000m in the net tows from the Gauss-Station in March 1903 between 64–68°S and 84–88°E. Wolfenden identified two

obtained specimens as *Bradyidius armatus* as he could not find any significant difference between the Antarctic and the North Sea specimens. Due to its poor shape the herein given specimen is designated as *Bradyidius* sp. A., without biological name. It differs from *B. armatus* in: 1) size, that is smaller (2.25 mm) than that of *B. armatus* (2.65–2.70mm) and in the antenna exopod segment 2 armament, that is supplied by 2 setae (vs 3 setae present in *B. armatus*, as revised by Markhaseva, 1993, fig. 6).

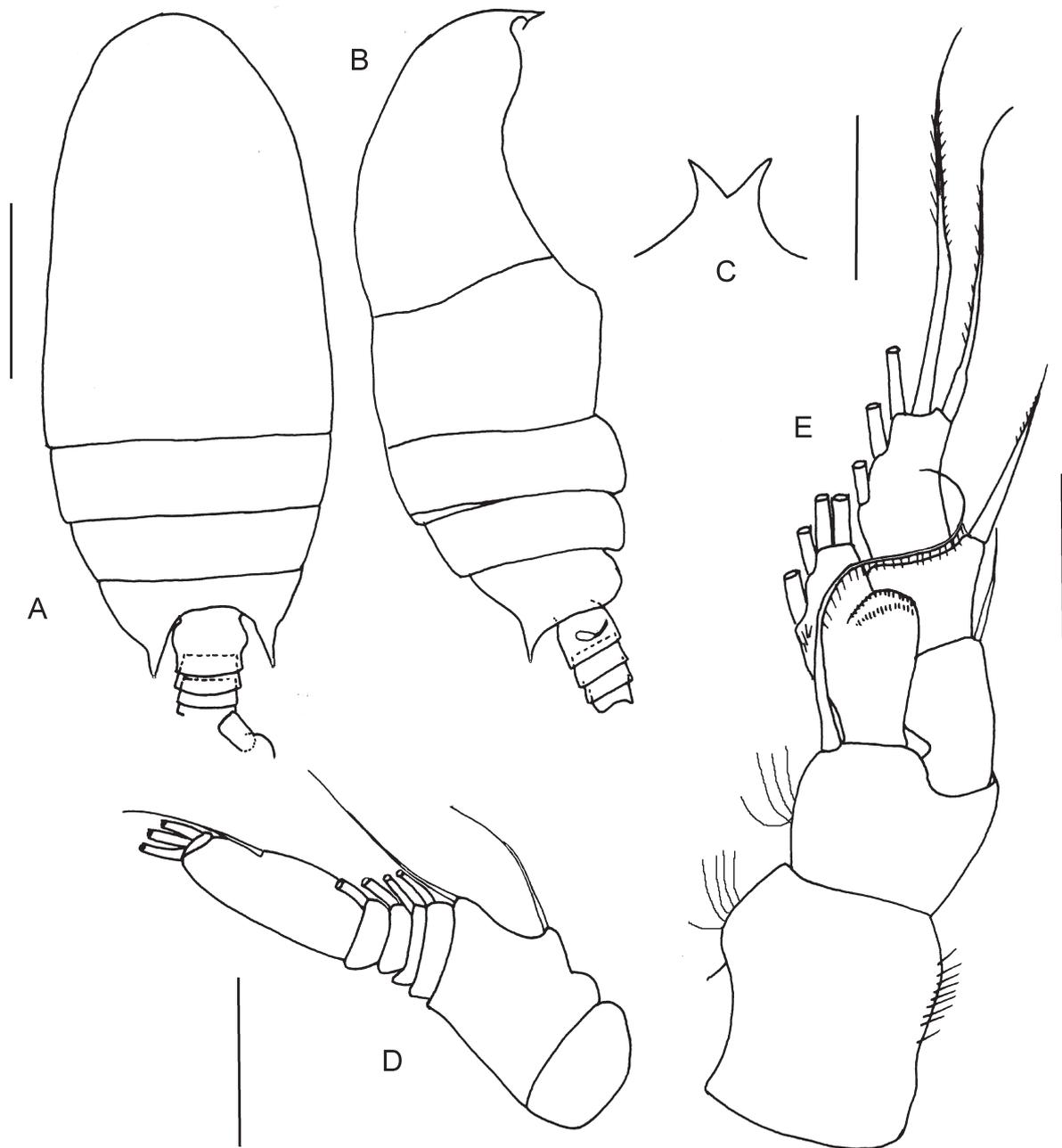


FIGURE 10. *Bradyidius* sp. A. Female, A, habitus, dorsal view; B, habitus, lateral view; C, rostrum, ventral view; D, antenna, exopod; E, P1.

***Bradyidius* sp. B**

(Fig 11)

Material. One female (specimen 1) from the Pacific Ocean, body length not measured (poor condition), collected above the sea bed in the Kurile-Kamchatka Trench, at Sta. 3–9 on 05 August 2012, 47°14.66' N 154°42.88' E, by the KuramBio 1 expedition, Sonne cruise SO 223, at a depth of 4987 m; 1 female in poor condition (specimen 2), from the Pacific Ocean, body length 2.20 mm, collected above the sea bed in the Kurile-Kamchatka Trench, at Sta. 85 on 15 September 2016, 45°01.73' N 151°03.48' E, by the KuramBio 2 expedition, Sonne cruise SO 250, at a depth of 5228 m.

Description. Female. Body length 2.20 mm. Prosome 3.4 times as long as urosome. Rostrum two-pointed, not divergent in specimen 1 (Fig. 11C–D) and with closely spaced points in specimen 2. Cephalosome and pedigerous somite 1 fused, pedigerous somites 4–5 incompletely separate; posterior corners prolonged into short points, covering the proximal third of genital double-somite (Fig. 11A–B, E). Urosome of 4 somites. Genital double-somite symmetrical, in its anterior half with moderately developed lateral swellings (dorsal view). Spermathecae narrow-elongate and rounded in distal part (Fig. 11E). Caudal rami with 1 lateral seta, 1 ventral seta, and 4 terminal setae.

Antennule broken.

Antenna in specimen 2 (Fig. 11F), coxa with 1 seta, basis with 2 setae; exopod of 8 segments, setation formula 0,0-1-1, 1, 1, 1, 1, 1, and 3 setae, endopod segment 1 with 2 setae, segment 2 with 8+7 setae; broken in specimen 1.

Mandible in specimen 2 (Fig. 11G–H), gnathobase with 8 teeth; basis with 2 setae; exopod broken; endopod segment 1 with 2 setae, segment 2 with setae broken; in specimen 1 basis with 1 seta.

Maxillule (Fig. 11I), praecoxal arthrite with 9 terminal spiniform setae, 4 posterior and 1 anterior setae (anterior seta not observed in specimen 1), coxal endite with 5 setae; coxal epipodite with 7 long+2 short setae (broken in specimen 1); proximal basal endite with 4 setae, tubercle visible, distal basal endite with 5 setae; endopod setae broken; exopod with 10 setae.

Maxilla, endites and the enditic lobe of endopod typical for the genus; endopod segment 1 with 1 long+1 short setae; specimen 1 with 1 long+1 short setae at endopod segment 2 while in specimen 2 only 1 seta was observed at each of endopod segments 2 and 3.

Maxilliped typical for the genus.

Legs. P1 (Fig. 11J–K), coxa with or without lateral spinules; basis with medial distal seta curved with setules; endopod 1-segmented with lateral lobe, its lateral margin with spinules, anterior segment surface with distal spinules; exopod segments 1 to 3 with 1 lateral spine each; spine of exopod segment 1 significantly exceeding base of lateral spine at exopod segment 2 (Fig. 11J–K).

P2–P4. P4 exopod segments 2 and 3 broken in other characters as in *B. kurilokamchaticus* sp. nov.

P5 absent.

Male unknown.

Remarks. Due to the poor condition of the single individual the specimen is designated as *Bradyidius* sp. B without biological name. *Bradyidius* sp. B. shows close resemblance to *B. curtus* in the following characters: a rostrum with nondivergent points and prosome posterior corners short, covering only proximal third of the genital double-somite. *Bradyidius* sp. B. can, however, not be attributed to the species *B. curtus* due to the absence of the proximal seta at the antenna exopod segment 2 (which is present in *B. curtus*) and the longer lateral spines at the exopod segments of P1. The exopod segment 1 lateral spine is exceeding the base of the lateral spine at exopod segment 2 (vs not exceeding the base of exopod segment 2 lateral spine in *B. curtus*) and the exopod segment 2 lateral spine is strongly extending over the base of the lateral spine of exopod segment 3 (vs thick short spine not reaching the base of the exopod segment 3 lateral spine in *B. curtus*) (Markhaseva, 1996).

***Bradyidius* sp. C**

(Fig 12)

Material. One female (poor condition) from the Atlantic Ocean, Guinea Basin collected above the sea bed at Sta. 89 on 20 March 2005, 00°42.95' N 05°31.29' W, by the DIVA 2 expedition, Meteor cruise, at a depth of 5141 m.

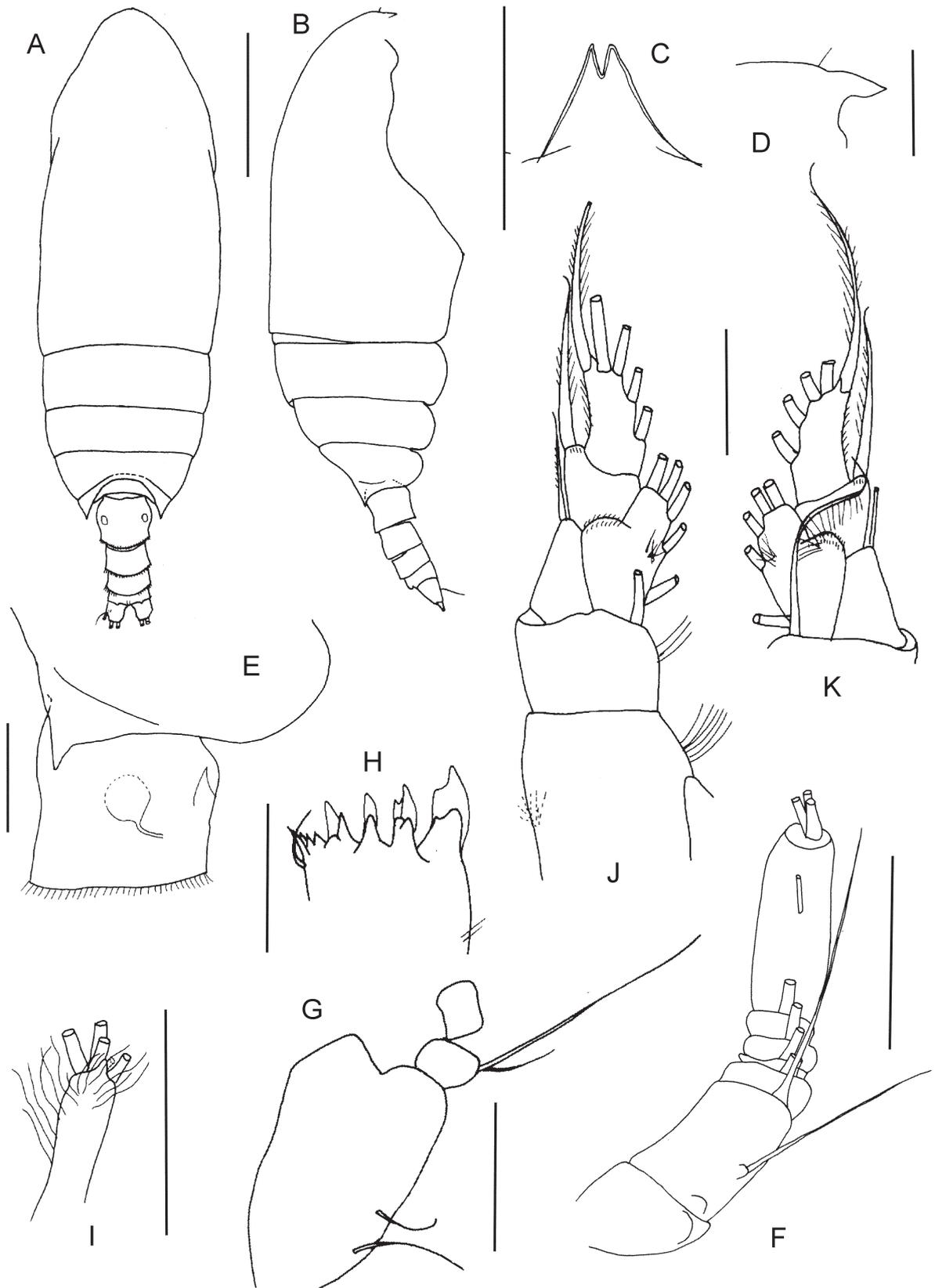


FIGURE 11. *Bradyidius* sp. B. Female, A, habitus, dorsal view; B, habitus, lateral view; C, rostrum, ventral view; D, rostrum, lateral view; E, posterior prosome somite and genital double-somite, lateral view; F, antenna, exopod; G, mandible palp, basis and endopod; H, mandible, gnathobase; I, maxillule, proximal basal endite; J, P1, left; K, P1 right, endo- and exopod.

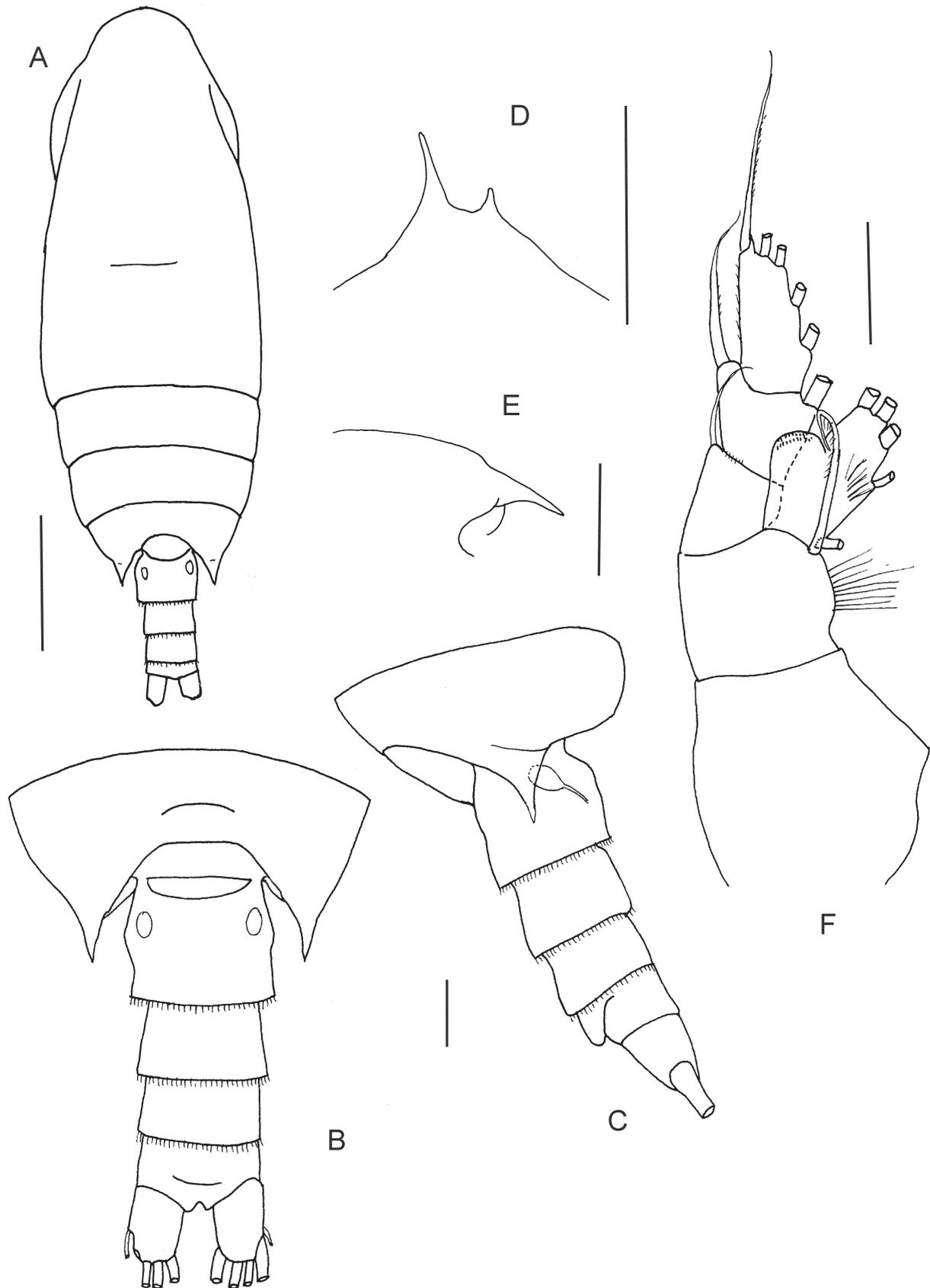


FIGURE 12. *Bradyidius* sp. C. Female, A, habitus, dorsal view; B, posterior prosome and urosome, dorsal view; C, posterior prosome and urosome, lateral view; D, rostrum, ventral view; E, rostrum, lateral view; F, P1, left

Description. Female. Body length 2.50 mm. Prosome 3.60 times as long as urosome. Rostrum two-pointed, asymmetrical with divergent points (Fig. 12D–E). Cephalosome and pedigerous somite 1 and pedigerous somites 4–5 partly separate (Fig. 12A–C); posterior corners prolonged into points exceeding middle length of genital double-somite (Fig. 12A–C). Urosome of 4 somites. Genital double-somite symmetrical, with lateral swellings in its anterior half (dorsal view). Spermathecae narrow-elongate and oval in distal part (Fig. 12C). Caudal rami with 1 lateral seta, 4 terminal setae and ventral seta broken, and (Fig. 12B).

Antennule reaching pedigerous somite 4.

Antenna, exopod of 8 segments, setation formula 1,1-1-1, 1, 1, 1, 1, 1, and 3 setae.

Mandible, basis with 2 setae; exopod 5-segmented with 1, 1, 1, 1, and 2 setae; endopod segment 1 with 2 setae, segment 2 with 9 long setae and 1 short setae.

Maxillule, praecoxal arthritis with 9 terminal spiniform setae, 1 anterior, and 4 posterior setae; coxal endite with 5 setae; coxal epipodite with 7 long and 2 short setae; proximal basal endite with 4 setae, distal basal endite with 5 setae; endopod setae could not be counted; exopod with 10 setae.

Maxilla, endites and enditic lobe of endopod typical for the genus, endopod setation not observed.

Maxilliped typical for the genus.

Legs. P1 (Fig. 12F), coxa lateral setules not observed; basis with medial distal seta curved with setules; endopod 1-segmented with lateral lobe, its lateral margin with spinules, anterior segment surface with distal spinules; exopod segments 1–3 with 1 lateral spine each; spine of exopod segment 1 slightly exceeding the base of exopod segment 2 lateral spine.

P2–P4 as in *B. kurilokamchaticus* sp. nov., except for P4 coxa without lateral spinules. P5 absent.

Male unknown.

Remarks. Due to its poor condition of this specimen no biological name is assigned and it is herein designated as *Bradyidius* sp. C. This individual possesses asymmetrical rostral points. An asymmetry of rostral points is not typical for the genus *Bradyidius* and is herein considered as an abnormality of this individual. *Bradyidius* sp. C shares the form of the posterior corners of prosome, which are exceeding the middle length of the genital double-somite, but not reaching its posterior border, as well as the divergent rostral points, with *B. saanichi*, *B. hirsutus* and *B. similis*, but differs in a longer lateral spine of P1 exopod segment 1 (not exceeding the base of the lateral spine of P1 exopod segment 2 in *B. saanichi*, *B. hirsutus* and *B. similis*). Additionally, *Bradyidius* sp. C differs from *B. saanichi* and *B. similis* in the setation of the antenna exopod proximal segments as (1,1-1-1), while the setation in the latter two species is 0,0-1-1. It furthermore differs from *B. hirsutus* in the presence of 2 setae at the mandible basis, while the latter possesses 1 seta (Park, 1966; Bradford, 1976; Shih *et al.*, 1981; Markhaseva, 1996 and personal data herein).

Taxonomic notes on the genera *Bradyidius* and *Aetideopsis*

Classical morphological analysis shows a close relationship between the genera *Bradyidius* and *Aetideopsis* Sars, 1903. Taxonomic differentiation of their females is not easy and is mostly based on the differences in the morphology of the lateral spines at P1 exopod segments 1 and 2 and the segmentation of the P2 endopod. Males of these genera are even more difficult to distinguish (Markhaseva, 1996: 9). Bradford-Grieve and Boxshall (2019) listed 14 characters in their morphological cladistic analysis of the family structure of the Clausocalanoidea, that differentiate these genera. Only few species of the genera *Bradyidius* and *Aetideopsis* were included in the cladistic analysis as examples of these genera (females of *Bradyidius capax*, *Aetideopsis tumorosa* Bradford, 1969, *A. rostrata* Sars, 1903 and *A. minor* (Wolfenden, 1911)). As a result, *Bradyidius* and *Aetideopsis* appeared in different clades indicating that they are not closely related (Bradford-Grieve and Boxshall, 2019, fig. 6, Appendix 1).

For genera that are difficult to distinguish, an indication of new distinguishing characters is very valuable. Therefore, all characters that showed different character states in the species analyzed by Bradford-Grieve and Boxshall (2019) were revised for this study for all species of *Bradyidius* and *Aetideopsis*. Their study was based on the literature as well as an original study of the Zoological Institute RAS collections (Table 2 herein). Three characters that were newly recognized as distinguishing characters by Bradford-Grieve and Boxshall (2019, Table 2, Appendix 1, characters 11, 13 and 15) concerning the setation of the antennule ancestral segments XII, XV and XVII, are here confirmed as diagnostic characters for all representatives of both genera. I.e., in all revised species of *Aetideopsis*

TABLE 2. Morphological characters and their states as observed in *Aetideopsis* and *Bradyidius* females in the cladistic analysis of Bradford-Grieve and Boxshall (2019, Table 2, Appendix 1)¹.

Taxonomic names (females only)	A1 ancestral segment XXIII distal seta extends to: short of end of A1, or well beyond end of A1 (9) ²	A2 Exp 1 seta: present, or absent (23)	A2 Exp 2 seta: present, or absent (24)	Md basis seta 3: present, or absent (29)	Mdp Exp1 seta 3: present, or absent (33)	Mx1 coxal endite seta 5: present, or absent (35)	Mx1 arthroal membrane between basis and Exp1: present, or absent (41)	Mx1 arthroal membrane between Exp 2 and Exp 3: present, or absent (42)	Mx2 Exp1 seta 7: untransformed/ present, or absent (63)	Mx2 Exp2 seta 8: untransformed/ present, or absent (64)	P1 basis outer border seta: present, or absent (71)
<i>Aetideopsis</i> ³	short of end of A1	absent	absent	absent	present	present	absent	absent	absent	absent	present
<i>A. albatrossae</i>	short of end of A1	absent	absent	absent	present	present	present	present	?	?	present
<i>A. antarctica</i>	short of end of A1	?	?	?	?	?	?	?	?	?	absent
<i>A. armata</i>	short of end of A1	absent	absent	absent	present	present	present	present	present	present	present
<i>A. browsei</i>	?	absent	absent	absent	absent	present	present	absent	present	present	present
<i>A. carinata</i>	short of end of A1	absent	absent	absent	absent	present	present, incomplete	present, incomplete	present	present	absent
<i>A. minor</i>	short of end of A1	absent	absent	absent	present	present	present	present	present	present	present
<i>A. multiserata</i>	short of end of A1	absent	absent	absent	present	present	present	traces of separation	present	present	present
<i>A. retusa</i>	nearly reaching the end of A1	absent	absent	absent	present	present	present	present	present	present	present
<i>A. rhinoceros</i>	?	absent	absent	absent	absent	present	present	absent	present	present	present
<i>A. rostrata</i>	short of end of A1	absent	absent	absent	present	present	present	present, incomplete	present	present	present
<i>A. tumorosa</i>	reaching the end of A1	absent	absent	absent	present	present	present	present, incomplete	present	present	absent

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TABLE 2. (Continued)

Taxonomic names (females only)	A1 ancestral segment XXIII distal seta extends to: short of end of A1, or well beyond end of A1 (9) ²	A2 Exp 1 seta: present, or absent (23)	A2 Exp 2 seta: present, or absent (24)	Md basis seta 3: present, or absent (29)	Mdp Enp1 seta 3: present, or absent (33)	Mx1 coxal endite seta 5: present, or absent (35)	Mx1 arthroal membrane between basis and Enp1: present, or absent (41)	Mx1 arthroal membrane between Enp 2 and Enp 3: present, or absent (42)	Mx2 Enp1 seta 7: untransformed/ present, or absent (63)	Mx2 Enp2 seta 8: untransformed/ present, or absent (64)	P1 basis outer border seta: present, or absent (71)
<i>Bradyidius</i> ⁴	<u>well beyond end of A1</u>	<u>present</u>	<u>present</u>	<u>present</u>	<u>absent</u>	<u>absent</u>	<u>present</u>	<u>present</u>	<u>present</u>	<u>present</u>	<u>absent</u>
<i>B. armatus</i>	well beyond end of A1	absent	present	absent	absent	?	present	?	?	?	absent
<i>B. capax</i>	well beyond end of A1	present	present	absent	absent	absent	present	present	present	present	absent
<i>B. curtus</i>	<u>well beyond end of A1</u>	absent	present	absent	absent	present	present	traces of separation	present	present	absent
<i>B. hirsutus</i>	well beyond end of A1	present	present	absent	present	present	present	absent	?	?	absent
<i>B. luluae</i>	<u>beyond the end A1</u>	present	present	absent	absent	present	present	absent	absent	absent	present
<i>B. pacificus</i>	<u>short of end A1</u>	absent	absent	absent	absent	present	present	present	present	present	absent
<i>B. plinói</i>	well beyond end of A1	absent	absent	absent	absent	present	present	absent	absent	absent	absent
<i>B. rakuma</i>	?	absent	absent	absent	absent	present	present	present	present	?	absent
<i>B. saanichi</i>	well beyond end of A1	absent	absent	absent	absent	present	present	present, incomplete	?	?	absent
<i>B. similis</i>	well beyond end of A1	absent	absent	absent	absent	present	present	present	present	present	present
<i>B. spinifer</i>	?	present	present	absent	present	present	present	?	?	?	present
<i>B. styliformis</i>	short of end A1	present	present	absent	absent	present	present	?	absent	absent	absent

.....continued on the next page

TABLE 2. (Continued)

Taxonomic names (females only)	A1 ancestral segment XXVIII distal seta extends to: short of end of A1, or well beyond end of A1 (9) ²	A2 Exp 1 seta: present, or absent (23)	A2 Exp 2 seta: present, or absent (24)	Md basis seta 3: present, or absent (29)	Mdp Enp1 seta 3: present, or absent (33)	Mx1 coxal endite seta 5: present, or absent (35)	Mx1 arthrodial membrane between basis and Enp1: present, or absent (41)	Mx1 arthrodial membrane between Enp 2 and Enp 3: present, or absent (42)	Mx2 Enp1 seta 7: untransformed/ present, or absent (63)	Mx2 Enp2 seta 8: untransformed/ present, or absent (64)	P1 basis outer border seta: present, or absent (71)
<i>B. subarmatus</i>	well beyond end of A1	present	present	absent	present	present	present	present	present	present	absent
<i>B. kurilokamchaticus</i> sp. nov.	?	present	present	absent	absent	present	present	present	present	present	absent
<i>B. abyssalis</i> sp. nov.	well beyond end of A1	present	present	present	present	present	present	present, incomplete	present	present	absent
<i>B. parabyssalis</i> sp. nov.	?	present	present	present	present	present	present	present, incomplete	present	present	absent

¹) Data compiled from Table 2 and Appendix 1 of Bradford-Grieve and Boxshall (2019) that present morphological characters/states used for cladistic analysis and data matrix of character state scores. Characters concerning setation of the antennule ancestral segments XII, XV and XVII are not included.

²) Numbers in the title of columns (in brackets) correspond to the character state score numbers in Bradford-Grieve and Boxshall (2019, Table 2, Appendix 1).

³⁻⁴) In bold and underlined are characters and their states for *Aetideopsis* and *Bradyidius* extracted from Appendix 1 in Bradford-Grieve and Boxshall (2019).

⁵) In bold are the results of the newly personal observations of these species from the collections of the Zoological Institute RAS. The females of *A. cristata*, *B. arnoldi* and *B. tropicus* with incomplete descriptions are not included.

Sources for this table: Sars, 1902; Fleminger, 1957; Bradford, 1969; Grice, 1972; Park, 1966; 1975, 1978; Campaner, 1978; Shih *et al.* 1981; Othman & Greenwood, 1987; Markhaseva, 1993, 1996; Bradford-Grieve, 2003; Sedova *et al.* 2009; McKinnon *et al.*, 2011; Bradford-Grieve and Boxshall, 2019 and personal observations.

1 seta is present at each of the antennule ancestral segments XII, XV and XVII while 2 setae are present in these segments in all revised species of *Bradyidius*. These characters can therefore supplement the differential diagnoses of the genera *Bradyidius* and *Aetideopsis*.

Other characters (11), demonstrating different states in the species *B. capax*, *A. tumorosa*, *A. rostrata* and *A. minor* in the cladistic analysis of Bradford-Grieve and Boxshall (2019, Table 2, Appendix 1, characters 9, 23, 24, 29, 33, 35, 41, 42, 63, 64 and 71) appeared to be not diagnostic for *Bradyidius* and *Aetideopsis*, because these characters appear in both genera, when all representatives of these genera are included into a review (Table 2, herein). They can therefore not supplement a differential diagnoses of *Bradyidius* and *Aetideopsis*.

Following amended differential diagnoses of the genera *Bradyidius* and *Aetideopsis* are proposed, supplemented by the selected diagnostic characters of the armature of the antennule ancestral segments XII, XV and XVII, as recognized by Bradford-Grieve and Boxshall (2019).

Differential diagnosis of the genus *Aetideopsis* (females).

The lateral spine of P1 exopod segment 2 is not thicker, than the lateral spine of P1 exopod segment 1; the endopod of P2 is one-segmented, or not clearly 2-segmented; each of the antennule ancestral segments XII, XV and XVII possesses 1 seta.

Differential diagnosis of the genus *Bradyidius* (females).

The lateral spine of P1 exopod segment 2 is thicker than the lateral spine of P1 exopod segment 1; the endopod of P2 is clearly 2-segmented; each of the antennule ancestral segments XII, XV and XVII possesses 2 setae.

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References

- Bradford, J.M. (1969) New species of *Aetideopsis* Sars and *Bradyidius* Giesbrecht (Copepoda: Calanoida) from the southern hemisphere. New Zealand. *Journal of Marine and Freshwater Research*, 3, 73–97.
<https://doi.org/10.1080/00288330.1969.9515279>
- Bradford, J.M. (1976) A new species of *Bradyidius* (Copepoda: Calanoida) from Mgazana estuary, Pondoland, South Africa, and a review of the closely related genus *Pseudotharybis*. *Annals of the South African Museum*, 72, 1–10.
- Bradford-Grieve, J.M. (2003) A new species of benthopelagic calanoid copepod of the genus *Bradyidius* Giesbrecht, 1897 (Calanoida, Artideidae) from New Zealand. New Zealand. *Journal of Marine and Freshwater Research*, 37, 95–103.
<https://doi.org/10.1080/00288330.2003.9517149>
- Bradford-Grieve, J.M. & Boxshall, G.A. (2019) Partial re-assessment of the family structure of the Clausocalanoidea (Copepoda: Calanoida) using morphological data. *Zoological Journal of the Linnean Society*, 185, 958–983.
<https://doi.org/10.1093/zoolinnean/zly086>
- Brenke, N. (2005) An epibenthic sledge for operations on marine soft bottom and bedrock. *Marine Technology Society Journal*, 39, 10–19.
<https://doi.org/10.4031/002533205787444015>
- Campaner, A.F. (1978) On some new planktobenthic Aetideidae and Phaennidae (Copepoda, Calanoida) from the Brazilian continental shelf. I. Aetideidae. S. Paulo, *Ciência e Cultura*, 30, 863–876.
- Ferrari, F.D. & Ivanenko, V. (2001) Interpreting segment homologies of the maxilliped of cyclopoid copepods by comparing stage-specific changes during development. *Organisms, Diversity and Evolution*, 1, 113–131.
<https://doi.org/10.1078/1439-6092-00009>
- Ferrari, F.D. & Ivanenko, V. (2008) The identity of protopodal segments and the ramus of maxilla 2 of copepods (Copepoda). *Crustaceana*, 81, 823–835.
<https://doi.org/10.1163/156854008784771702>
- Ferrari, F.D. & Markhaseva, E.L. (2000a) *Brachycalanus flemingeri* and *B. brodskyi*, two new copepods (Crustacea: Calanoida:

- Phaennidae) from benthopelagic waters of the tropical Pacific. *Proceedings of the Biological Society of Washington*, 113, 1064–1078.
- Ferrari, F.D. & Markhaseva, E.L. (2000b) *Grievella shanki*, a new genus and species of scolecitrichid calanoid copepod (Crustacea) from a hydrothermal vent along the South East Pacific Rise. *Proceedings of the Biological Society of Washington*, 113, 1079–1088.
- Fleminger, A. (1957) New calanoid copepods of the families Aetideidae, Euchaetidae and Stephidae from the Gulf of Mexico. *Fishery Bulletin of the Fish Wildlife Service*, 117, 355–363.
- Giesbrecht, W. (1893) Systematik und Faunistik der pelagischen Copepoden des Golfes von Neapel und der angrenzenden Meeres. Abschnitte. *Fauna und Flora des Golfes von Neapel*, 19, 1–831.
<https://doi.org/10.5962/bhl.title.59541>
- Grice, G.D. (1972) The existence of a bottom-living calanoid copepod fauna in deep water with descriptions of five new species. *Crustaceana*, 23, 219–242.
<https://doi.org/10.1163/156854072X00138>
- Huys, R. & Boxshall, G.A. (1991) *Copepod Evolution*. The Ray Society, London, 468 pp.
<https://doi.org/10.1163/193724092x00193>
- Johannessen, P.J. (1976) A new species and a new record of calanoid copepods from western Norway. *Sarsia*, 60, 19–24.
<https://doi.org/10.1080/00364827.1976.10411293>
- Markhaseva, E.L. (1993) Two new species of *Bradyidius* with notes on *B. armatus* Giesbrecht (Crustacea, Copepoda: Aetideidae). *Zoosystematica Rossica*, 2, 47–53.
- Markhaseva, E.L. (1996) Calanoid copepods of the family Aetideidae of the world ocean. *Proceedings of the Zoological Institute RAS, St. Petersburg*, 268, 1–331.
- Markhaseva, E.L. & Ferrari, F.D. (2006) New benthopelagic bradfordian calanoids (Crustacea: Copepoda) from the Pacific Ocean with comments on generic relationships. *Invertebrate Zoology*, 2, 111–168.
<https://doi.org/10.15298/invertzool.02.2.01>
- Markhaseva, E.L. & Renz, J. 2015. A new genus, *Peniculoides* (COPEPODA, CALANOIDA), from deep waters of the North Atlantic with notes on the definition of Clausocalanidae. *Crustaceana*, 88, 1031–1047.
<https://doi.org/10.1163/15685403-00003467>
- Markhaseva, E.L. & Schnack-Schiel, B. (2003) New and rare calanoid copepods from the Great Meteor Seamount, North Eastern Atlantic. *Ophelia*, 57 (2), 107–123.
<https://doi.org/10.1080/00785236.2003.10409508>
- Markhaseva, E.L. & Schulz, K. (2006) New benthopelagic aetideids (Crustacea: Copepoda): Calanoida) from deep Antarctic waters. *Invertebrate Zoology*, 3, 137–155.
<https://doi.org/10.15298/invertzool.03.2.02>
- Markhaseva, E.L. & Schulz, K. (2008) Two new species of *Prolutamator* gen. nov. and a new species of *Pseudotharybis* (Copepoda: Calanoida: Aetidaeidae) from deep waters of the South Atlantic and Antarctic. *Mitteilung aus dem Hamburgischen Zoologischen Museum und Institut*, 105, 31–51.
- Markhaseva, E.L., Laakmann, S. & Renz, J. (2014) An interim synopsis of the Bradfordian families with a description of *Thoxancalanus spinatus* (Copepoda: Calanoida), a new diaixid genus and species from the deep Atlantic Ocean. *Marine Biodiversity*, 44, 63–88.
<https://doi.org/10.1007/s12526-013-0185-0>
- Markhaseva, E.L., Bradford-Grieve, J. & Renz, J. (2017a) New records of the rare benthopelagic genera *Comantenna* Wilson, 1924 and *Crassantenna* Cole, Green, Howcroft et Rawlins, 1972 (Copepoda: Calanoida: Aetideidae) from the North Pacific abyss. *Arthropoda Selecta*, 26, 25–34.
<https://doi.org/10.15298/arthsel.26.1.04>
- Markhaseva, E.L., Mohrbeck, I. & Renz, J. (2017b) Description of *Pseudeuchaeta vulgaris* n. sp. (Copepoda: Calanoida), a new aetideid species from the deep Pacific Ocean with notes on the biogeography of benthopelagic aetideid calanoids. *Marine Biodiversity*, 47, 289–297.
<https://doi.org/10.1007/s12526-016-0527-9>
- Matthews, J.B.L. (1964) On the biology of some bottom-living copepods (Aetideidae and Phaennidae) from western Norway. *Sarsia*, 16, 1–46.
<https://doi.org/10.1080/00364827.1964.10409532>
- McKinnon, A.D., Corley, J. & Duggan, S. (2011) Two new species of *Aetideopsis* (Copepoda, Aetideidae) from the Eastern Indian Ocean. *Crustaceana*, 84, 831–848.
<https://doi.org/10.1163/001121611X566767>
- Othsuka, S., Boxshall, G.A. & Shimomura, M. (2005) Three new species of deep-sea hyperbenthic aetideid copepods (Crustacea) collected from Nansei Islands, southwestern Japan. In: Hasegawa, K., Shinohara, G. & Takeda, M. (Eds.), Deep-Sea Fauna and Pollutants in Nansei Islands. *National Science Museum Monographs*, 29, pp. 225–247.
- Othman, B.H.R. & Greenwood, J.G. (1987) A new species of *Bradyidius* (Copepoda, Calanoida) from the Gulf of Carpentaria, Australia. *Journal of Plankton Research*, 9, 1133–1141.
<https://doi.org/10.1093/plankt/9.6.1133>
- Park, T.S. (1966) A new species of *Bradyidius* (Copepoda: Calanoida) from the Pacific coast of North America. *Journal of the*

Fishery Research Board of Canada, 23, 805–811.

<https://doi.org/10.1139/f66-074>

- Park, T.S. (1975) Calanoid copepods of the genera *Aetideopsis*, *Pseudaetideus*, and *Chiridius* from the Gulf of Mexico. *Bulletin of Marine Science*, 25, 272–290.
- Park, T.S. (1978) Calanoid copepods (Aetideidae and Euchaetidae) from Antarctic and Subantarctic waters. *In*: Biology of the Antarctic seas. Vol. 7. *Antarctic Research Series*, 27, pp. 91–290.
<https://doi.org/10.1029/AR027p0091>
- Razouls, C., Desreumaux, N., Kouwenberg, J. & de Bovée, F. (2005–2020) Biodiversity of Marine Planktonic Copepods (morphology, geographical distribution and biological data). Sorbonne University, CNRS. Available from: <http://copepodes.obs-banyuls.fr/en> (accessed 30 June 2021)
- Renz, J. & Markhaseva, E.L. (2015) First insights into genus level diversity and biogeography of deep sea benthopelagic calanoid copepods in the South Atlantic and Southern Ocean. *Deep-Sea Research Part I*, 105, 96–110.
<https://doi.org/10.1016/j.dsr.2015.08.007>
- Sars, G.O. (1902) Copepoda Calanoida, Parts V & VI, Scolecithricidae, Stephidae, Tharybidae, Pseudocyclopiidae. *An Account of the Crustacea of Norway, with short descriptions and figures of all the species*, Bergen Museum, 4, 49–72, pls. 33–48.
- Sedova, N.A., Grigoryev, A.S. & Grigoryev, S.S. (2009) Morphological variation in *Bradyidius pacificus* (Brodsky, 1950) (Copepoda: Aetideidae) in the eastern part of the Sea of Okhotsk. *Zoosystematica Rossica*, 18, 17–24.
<https://doi.org/10.31610/zsr/2009.18.1.17>
- Shih, C.T., Rainville, L. & Maclellan, D.C. (1981) Copepodids of *Bradyidius similis* (Sars, 1902) (Crustacea: Copepoda) in the Saguenay Fjord and the St. Lawrence Estuary. *Canadian Journal of Zoology*, 59 (6), 1079–1093.
<https://doi.org/10.1139/z81-150>
- Schulz, K. (2002) A new species of the hyperbenthic copepod genus *Comantenna* Wilson, 1924 (Calanoida: Aetideidae) from the eastern Weddell Sea. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, 99, 101–107.
- Schulz, K. & Markhaseva, E.L. (2000) *Parabradyidius angelikae*, a new genus and species of benthopelagic copepod (Calanoida: Aetideidae) from the deep Weddell Sea (Antarctica). *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, 97, 77–89.
- Vervoort, W. (1952) Copepoda. Sub-order: Calanoida. Family: Aetideidae. Genera: *Bradyidius*, *Bradyetes*, *Bryaxis*. *Fiches d'Identification du Zooplankton*, Sheet 44, 1–4.
- Wolfenden, R.N. (1911) Die marinen Copepoden der Deutschen Südpolar Expedition 1901–1902. II. *Die pelagischen Copepoden der Westwinddrift und des südlichen Eismeers mit Beschreibung mehrerer neuer Arten aus dem Atlantischen Ozean. Dt. Südpolar-Exped.*, 12 (Zoology 4), 181–380.
- Zvereva, Zh.A. (1977) A new species of *Aetideopsis* Sars (Copepoda: Calanoida) from Aniva Bay (Okhotsk Sea). *In*: Marine plankton (systematics and faunistics). *Issledovaniya Fauny Morei*, 20 (28), 6–8. [in Russian]