



New deep-water species of Augaptilidae (Multicrustacea, Copepoda, Calanoida) from the Arctic Ocean

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Abstract

Two new species of the calanoid copepod family Augaptilidae are described from specimens collected from bathypelagic depths of the Arctic Ocean. The female of *Euaugaptilus verae* **sp. nov.** can be distinguished from other congeneric species by 1) the Md tooth arrangement, 2) the structure of Mx1, and 3) the lack of external spines on Re2 and 3 of the female P5. The female of *Alrhabdus antjeboetiusae* **sp. nov.** can be distinguished from the only species of this genus, *A. johrdeae* Grice, 1973, by 1) the shape of the rostrum, 2) absence of paired spinal protrusions at the posterior corners of the last pedigerous somite, 3) position of spermatheca on the genital double-somite, 4) the Md tooth arrangement, and 5) P5 endopod 1-2 lacking modified medial setae. Both species were collected in the deepest regions of the Eurasian and Canadian Basins of the Arctic Ocean in the water layers between 1000 m and the seafloor.

Key words: Copepods, deep Arctic basins, bathypelagic, *Euaugaptilus*, *Alrhabdus*

Introduction

The diversity of pelagic copepods has been studied in the deep Arctic Ocean since the beginning of the oceanographic surveys in this remote and inaccessible region (Sars 1900; Bogorov 1946; Brodsky & Nikitin 1955; Virketis 1957, 1959; Johnson 1963). During the last 100 years vast zooplankton collections of several Arctic ice drifting stations and research icebreakers have been processed by expert taxonomists and marine ecologists for this purpose (Sars 1900; Brodsky 1967; Heptner 1969; Damkaer 1975; Sirenko *et al.* 1996; Markhaseva 1996, 1998, 2002; Markhaseva & Kosobokova 1998, 2001; Andronov & Kosobokova 2011). As a result, the copepod species inventories have been produced for all the four major basins of the Arctic Ocean and its marginal seas (Grainger 1965; Dunbar & Harding 1968; Hughes 1968; Mumm 1993; Sirenko 2001; Kosobokova *et al.* 1998; Kosobokova & Hirche 2000; Auel & Hagen 2002; Hopcroft *et al.* 2005; Kosobokova & Hopcroft 2010; Kosobokova 2012). The most detailed and verified species list for the deep central Arctic Ocean was compiled as a part of the Census of Marine Life project a decade ago by Kosobokova *et al.* (2011) based on examination of extensive source material and a critical analysis of published data. The authors provided a list of 91 copepod species from 25 families and concluded that the species composition of epi- and mesopelagic copepods in the Arctic Ocean have been well characterized to date. At the same time, they assumed that there was still much to be resolved and discovered in the bathypelagic layers of this ocean.

Consistent with this assumption, extensive sampling of the bathypelagic depths during later expeditions of the R/V “Polarstern” (Germany) to the central Arctic (Schauer 2008, 2012, 2016; Boetius & Purser 2017), brought new faunistic findings. In this paper, we describe two new deep-water species of calanoid copepods from Augaptilidae family based on specimens collected in the deepest regions of the Arctic Ocean in 2007-2016.

Material and Methods

Samples containing the new copepod species were collected during the R/V “*Polarstern*” cruises ARK XXII/2 (2007), ARK XXVI/3 (2011), PS94 (2015), and PS101 (2016) in the Arctic Ocean deep basins with a Multinet Maxi (Hydrobios, Kiel; mouth opening 0.49 m² and 0.150 μm mesh size) (Fig. 1, Table 1). One vertical cast was typically performed with this net with the following sampling layers: bottom (3000 m)-2000-1000-750(500)-300-200-100-50-25-0 m. In order to protect the Multinet from damage, the lower limit of the sampled layer was always set 10-50 meters above the seafloor. All samples were preserved in 4% borax-buffered formaldehyde. Sorted copepods were observed whole in glycerin, and dissected under a stereomicroscope.

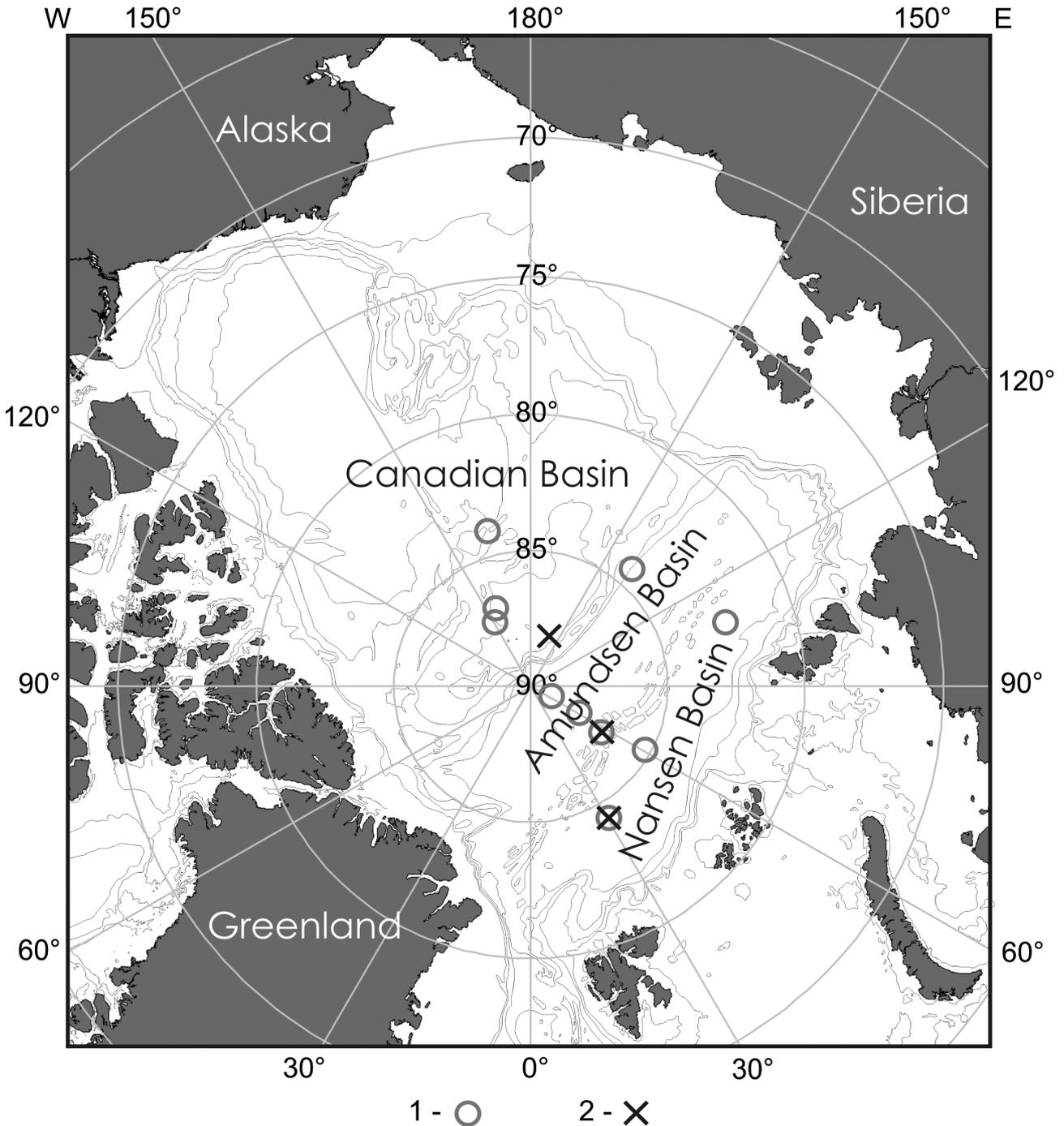


FIGURE 1. Map showing the sampling locations in the Arctic Ocean where the new copepod species were found: 1—*Euaugaptilus verae* sp. nov., 2, *Alrhabdus antjeboetiusae* sp. nov.

TABLE 1. List of specimens of *Euaugettilus verae* sp. nov. and *Alrhabdus antjeboetius* sp. nov. recorded in the deep Arctic Ocean.

Expedition of RV "Polarstern"	StationNo.	Date	Bottom depth, m	Samplinglayer, m	Total body length, mm	Locality	Place of deposition
1. <i>Euaugettilus verae</i> sp. nov.							
PS101	101/60	15.09.2016	3884	2000–3000	3.1	85°15.7'N, 60°04.197'E	Holotype No. 91143, ZIN RAS
ARK XXVI/3	215	21.08.2011	4386	3000–4325	3.2	89°11.34'N, 61°7.06'E	Paratype No. 91144, ZIN RAS
–"	239	06.09.2011	1960	1000–1900	2.8	84°4.63'N, 164°13.43'W	Paratype No. 91145, ZIN RAS
–"	250	11.09.2011	3675	2000–3000	2.9	84°22.33'N, 139°46.93'E	Paratype No. 91146, ZIN RAS
–"	227	29.08.2011	3890	3000–3815	2.8	86°51.73'N, 155°6.34'W	IORAS
PS94	94/50	27.08.2015	4056	3000–3900	3.15	84°23.00'N, 29°46.50'E	IORAS
–"	94/70	03.09.2015	3180	2000–3000	3.1	86°57.25'N, 55°34.19'E	IORAS
ARK XXVI/3	212	19.08.2011	4416	3000–3500	2.7	88°0.97'N, 59°36.07'E	IORAS
–"	263	15.09.2011	3553	3000–3525	2.8	82°35.97'N, 108°23.23'E	IORAS
ARK XXII/2	333	04.07.2007	3264	2000–2875	3.0	87°18.62'N, 150°8.26'W	IORAS
2. <i>Alrhabdus antjeboetius</i> sp. nov.							
PS101	101/165	29.09.2016	3884	2800–3950	2.66	86°55.91'N, 56°0.03'E	Holotype No. 91166, ZIN RAS
ARK XXII/2	324	01.09.2007	3964	2000–3934	2.57	88°4.59'N, 161°1.92'E	Paratype No. 91167, ZIN RAS
PS94	94/50	27.08.2015	4056	3000–3900	2.6	84°23.00'N, 29°46.50'E	IO RAS

All figures were prepared using a *camera lucida*. Drawings were made from the photographs taken with a Kodak EasyShare C643 digital camera mounted on a Leica MZ16 dissecting microscope and with a Lewenhuk C510 5M digital camera mounted on Olympus CX41 dissecting microscope. The details of the drawings were compared with details visible under the light microscope and corrected when necessary.

All measurements were taken from the formalin-preserved specimens immersed in glycerin. Total body length was measured from forehead margin to the posterior border of the caudal rami.

The terminology used in the descriptions follows Huys & Boxshall (1991), but the maxilliped syncoxa is considered to consist of 3 precoxal endites and 1 coxal endite, according to Ferrari & Markhaseva (2000). The following abbreviations are used in the descriptions and Figs.: Pr—prosome; Pr 1–5—pedigerous somites 1–5; Ur—urosome; CR—caudal rami; A1—antennule; A2—antenna; Md—mandible; Mx1—maxillule; Mx2—maxilla; Mxp—maxilliped. P1–P5—swimming legs 1–5; Re—exopod; Re1–8—exopod segments 1–8; Ri—endopod; Ri1–3—endopod segments 1–3; TL—total body length.

The type material of the new taxa are deposited in the Zoological Institute, Russian Academy of Sciences, St. Petersburg (ZIN RAS), additional material is deposited in the P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow (IO RAS) (Table 1).

Taxonomy

Subclass Copepoda Milne-Edwards, 1840

Order Calanoida Sars, 1903

Family Augaptilidae Sars, 1905

1. Genus *Euaugaptilus* Sars, 1920

Euaugaptilus verae sp. nov.

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(Fig. 2A–I, Fig. 3A–J)

Material examined

Holotype. Adult female, dissected, in glycerin-gelatin preparation, 3.1 mm TL, 2.4 mm Pr. Body destroyed during dissection. Collected in the Arctic Ocean, “Polarstern” expedition PS101 Sta. PS101/60, 85°15.7'N, 60°04.197'E, 15 September 2016, bottom depth 3884 m, depth of collection 2000–3000 m. ZIN RAS accession No. 91143 (Table 1).

Paratypes. Three adult females, one is 3.2 mm TL. Collected in the Arctic Ocean, RV “Polarstern” expedition ARK XXVI/3 Sta. 215, 89°11.34'N, 61°7.06'E, 21 August 2011, bottom depth 4386 m, depth of collection 3000–4325 m. ZIN RAS accession No. 91144 (Table 1). Second adult female, dissected, in glycerin-gelatin preparation, 2.8 mm TL. Body destroyed during dissection. Collected in the Arctic Ocean, RV “Polarstern” cruise ARK XXVI/3 Sta. 239, 84°4.63'N, 164°13.43'W, 6 September 2011, bottom depth 1960 m, depth of collection 1000–1900 m. ZIN RAS accession No. 91145 (Table 1). Third adult female, 2.9 mm TL. Collected in the Arctic Ocean, RV “Polarstern” cruise ARK XXVI/3 Sta. 250, 84°22.33'N, 139°46.93'E, 11 September 2011, bottom depth 3675 m, depth of collection 2000–3000 m. ZIN RAS accession No. 91146 (Table 1).

Additional material. Six females collected in the Arctic Ocean during the RV “Polarstern” expeditions (Table 1): 1 female, 3.0 mm TL, expedition ARK XXII/2 Sta. 333, 87°18.62'N 150°8.26'W, 4 July 2007; 1 female, 2.7 mm TL, expedition ARK XXVI/3 Sta. 212, 88°0.97'N 59°36.07'E, 19 August 2011; 1 female, 2.8 mm TL, Sta. 227, 86°51.73'N 155°6.34'W, 29 August 2011; 1 female, 2.8 mm TL, Sta. 263, 82°35.97'N 108°23.23'E, 15 September 2011; 1 female, 3.15 mm TL, expedition PS94 Sta. 94/50, 84°23.00'N 29°46.50'E, 27 August 2015; 1 female, 3.1 mm TL, expedition PS94 Sta. 94/70, 86°57.25'N 55°34.19'E, 3 September 2015. Material deposited in the IO RAS, Moscow (Table 1).

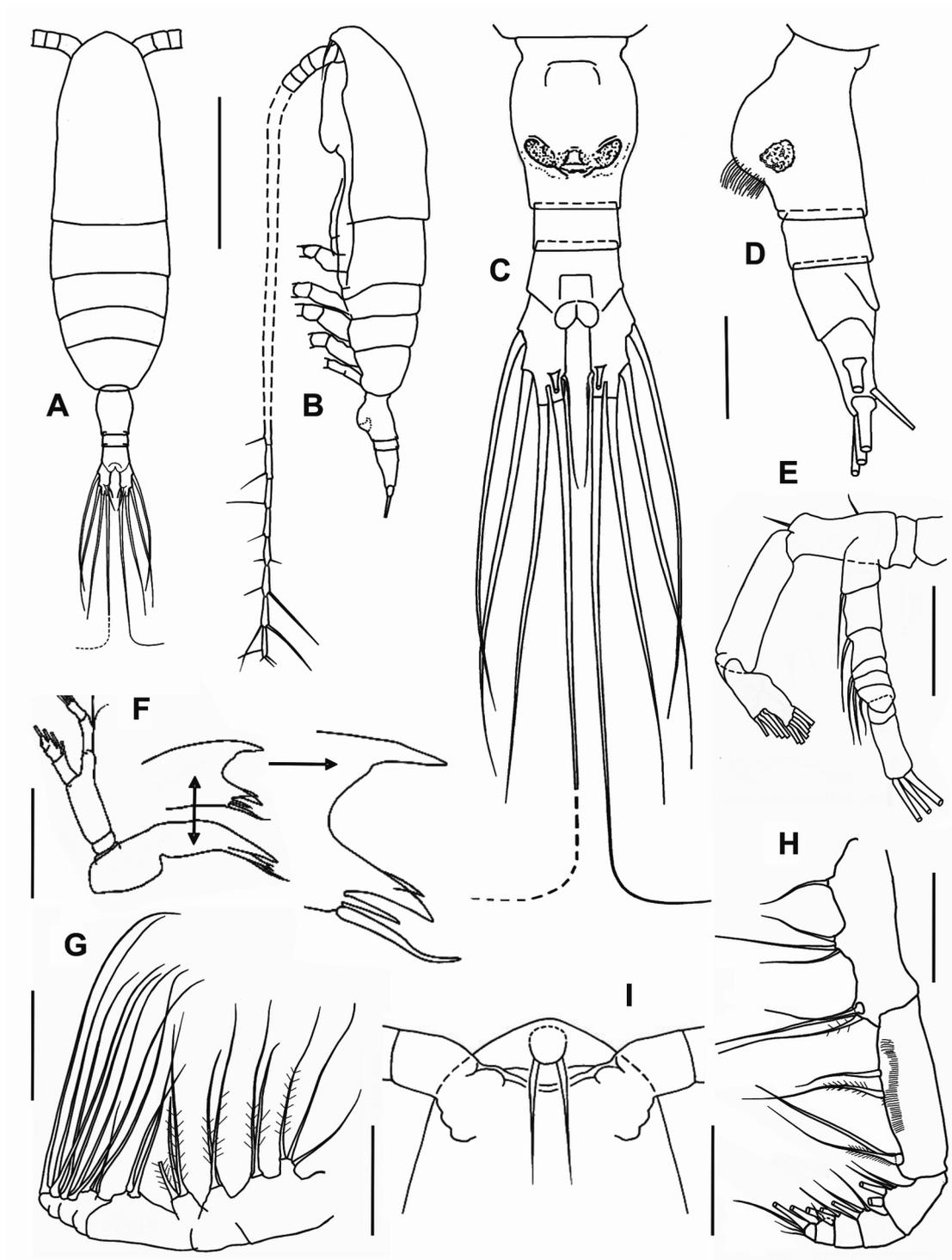


Figure 2. *Euaugaptilus verae* sp. nov., female, holotype from the Arctic Ocean. A, habitus, dorsal; B, same, lateral; C, Ur, ventral; D, same, lateral; E, A2; F, Md; G, Mx2; H, Mxp; I, head and rostrum, anteroventral. Scale bars: A–B, 1 mm, C–I, 0.2 mm.

Differential diagnosis. *Euaugaptilus verae* sp. nov. females can readily be distinguished from currently known species of the genus by the combined presence of the following main characters: (1) the morphology of the toothed edge of the tip of Md blade, (2) Mx1 with 1 seta on third inner lobe and 3 setae on merged basis and Ri, and (3) lack of external spines on Re2 and 3 of the female P5.

Description. Adult female, TL length 2.8–3.2 mm. Body slender (Fig. 2A–B). Prosome 0.8 of TL, 2.1 times as long as wide in dorsal view. Forehead rounded dorsally or laterally (Fig. 2A–B). Rostrum of two long, well-developed filaments (Fig. 2B, I). Cephalosome separate from Pr1, Pr4 and 5 fused, posterior corners of Pr5 rounded,

without spines. Urosome 3-segmented, and 0.3 length of Pr, Ur3 completely separate from CR. Genital double-somite (Ur1) symmetrical, 1.2 times as long as its maximum width and 0.52 length of Ur in dorsal view (Fig. 2C–D). Ventrally Ur1 rounded with numerous fine spinules around a conspicuous genital boss occupying middle part of the somite (Fig. 2D). Caudal rami slightly asymmetrical in dorsal view. The Ur1-3 and CR are in the proportional lengths as 47: 12: 21: 20=100.

Antennule (Fig. 2B) 25-segmented, symmetrical and long, extend beyond distal end of CR by the last 5 segments when completely stretched backwards.

Antenna (Fig. 2E) Ri1 fused to basis, bearing 2 small lateral setae. Endopod 3-segmented, Ri1 and 2 almost cylindrical, long, the distal segment comprised of 3 and 4 fused, 0.6 the length of Ri2, with two separate bundles of setae: 4 on inner lobe and 6 on outer lobe. Exopod 8-segmented, as long as the entire Ri. Distal segment the longest, with 3 strong terminal setae.

Mandible (Fig. 2F) with strong curved mandibular blade bearing 4 teeth and basal spine, medial tooth the largest and widely separated from 3 lateral teeth and spine. Toothed edge nearly perpendicular to long axis of blade. Mandibular palp, consisting of basis, Ri and Re equal in length and nearly as long as mandibular blade, Ri1 with 2 distal setae, Ri2 with 4 terminal setae, Re with 4 setae.

Maxillule (Fig. 3J) inner lobe 1 (basal arthrite) elongate with 7 spines, inner lobe 2 (coxal endite) absent, outer lobe with 5 setae, inner lobe 3 (merged basis and Ri) with 1 and 3 setae, Re with 4 terminal and 3 marginal setae.

Maxilla (Fig. 2G) elongate. Precoxal endites with 3 and 2 setae, coxal endites with 2 and 3 setae, basis with 2 pairs of setae, basal endite absent. Endopod with 7 long setae. None of maxillary setae armed with hooked spinules ("buttons", according to Sewell 1932).

Maxilliped (Fig. 2H) coxa with 1, 3, and 3 setae on its 3 lobes. Basis nearly as long as coxa, with 2 pairs of setae. Endopod 1 with 2 setae, Ri2-5 with 1 long setae each. None of setae on maxilliped armed with hooked spinules.

Legs P1-P5 with 3-segmented Ri and Re. Basis of P1 (Fig. 3A) with plumose medial seta, coxa with lateral seta, Ri with 1, 2, and 5 setae, respectively, Re with fine spinule tufts at base of large lateral spines (Fig. 3B) and 1, 1, and 5 setae.

P2-3 (Fig. 3C–D) coxa with plumose medial setae, basis lacks lateral seta. Endopod with 1, 2, and 7 setae, respectively. Exopod lateral spines very reduced, Re1-3 with 1, 1, and 6 setae, respectively.

P4 (Fig. 3E–G) basis with large lateral seta. Endopod segments 1-3 with 1, 2, and 7 setae, respectively (Fig. 3F). In some specimens (paratype No. 91145) left Ri2 of abnormal shape with superfluous setae (3 instead of 2) and Ri3 with 9 setae (instead of 7) (Fig. 3E, G). Exopods as in P2-3 (Fig. 3E).

P5 (Fig. 3H) coxa lacks medial seta, basis with medially directed very long lateral seta. Exopod segment 1 lacks medial setae, Re2 and 3 lack lateral spines, Re2 with short and spinelike medial seta, Re3 with 3 medial setae and terminal spine about 1.6 of the segment's length. Endopod segments 1-3 with 1, 1, and 6 setae, respectively. In some specimens (paratype No. 91145) Ri3 of left P5 with only 5 setae (Fig. 3I).

Note. The presence of superfluous setae on Ri2 and 3 of the left P4 in some individuals (paratype No. 91145 and two other paratype specimens), and the presence of superfluous seta on Ri2 of the left P5 (2 instead of 1) along with the simultaneous reduction of the number of setae on Ri3 (5 instead of 6) suggests that endopod segments of P4 and P5 in *E. verae* underwent modifications independently of each other.

Male unknown.

Type locality. Arctic Ocean, 85°15.7'N, 60°04.197'E.

Etymology. The species name, a singular feminine genitive, is proposed in memory of Assoc. Prof. Vera Aleksandrovna Brotskaya (1903–1962) (Department of Invertebrate Zoology of the Moscow State University) for her outstanding tutorial merits. She was the permanent scientific secretary of the Department since the 1940s, and she led the summer students' field training course on invertebrate zoology at the White Sea Biological Station of the MSU from the 1950s till the end of her life.

Remarks. The genus *Euaugaptilus* is among the most species-rich genera of oceanic calanoid copepods, next to *Paraeuchaeta*, currently encompassing from 73 (Razouls *et al.* 2005-2023) to 71 accepted and 77 described species (Walter & Boxshall 2023). The female *E. verae* **sp. nov.** shares generic features with other representatives of *Euaugaptilus*. The link <https://copepodes.obs-banyuls.fr/fichefamlist.php?fam=6#g86> (Razouls *et al.* 2005- 2023) provides characteristics of *Euaugaptilus* species supplied with illustrations from initial descriptions and greatly facilitates identification and comparison of species within this genus.

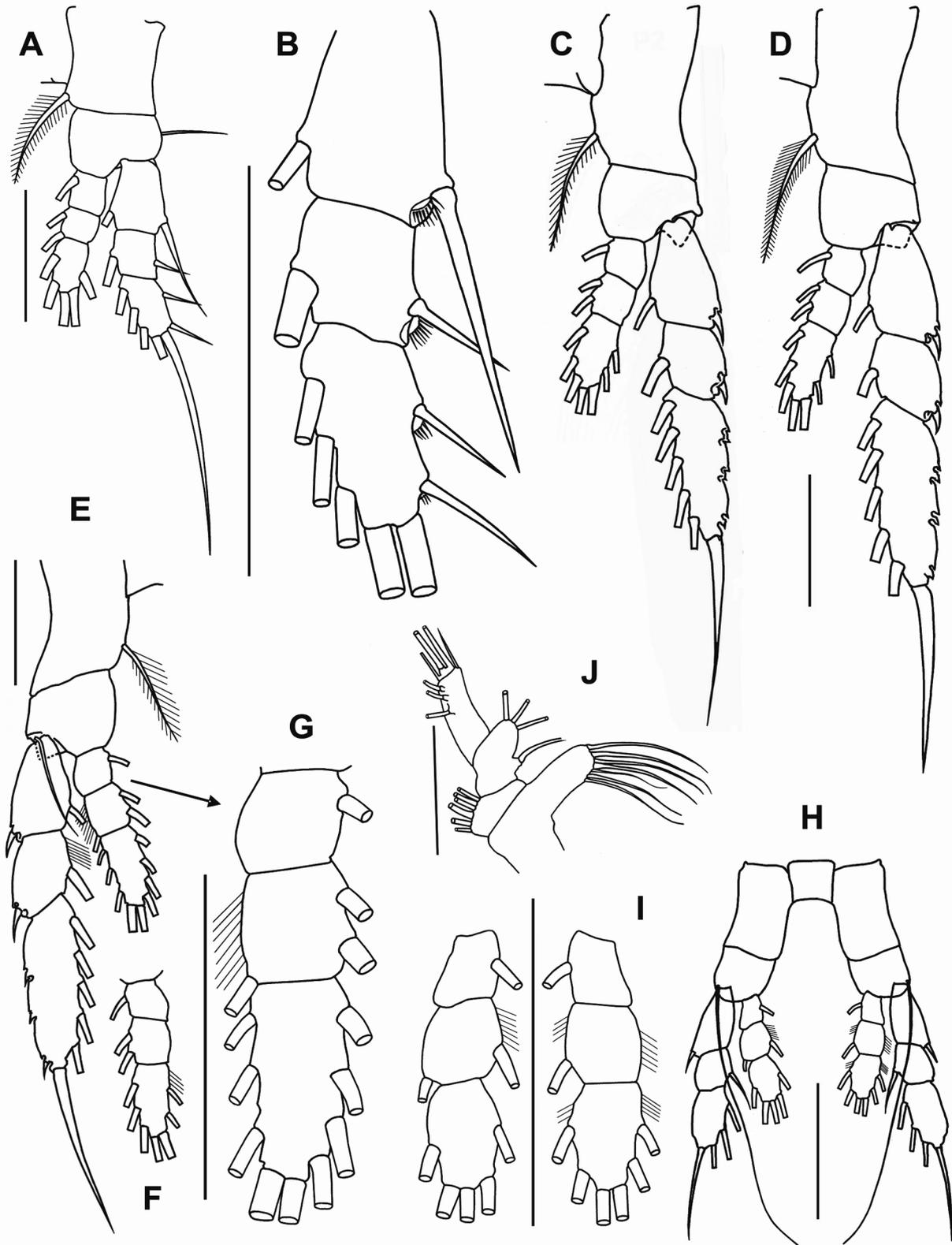


FIGURE 3. *Euaugaptilus verae* sp. nov., female, holotype. A, P1; B, left P1, Re; C, P2; D, P3; E, P4, F, right P4, Ri; G, left P4, Ri; H, P5; I, left and right P5 Ri; J, Mx1; A–D, J, anterior; E–G, H–I, posterior. Scale bars: 0.2 mm.

The comparison of the key diagnostic features of *E. verae* **sp. nov.** females with other *Euaugaptilus* species is presented in Table 2. By the structure of Md and Mx1, females *E. verae* **sp. nov.** most closely resemble *E. sublongiseta* Park, 1970 and *Euaugaptilus ? sublongiseta* (Tanaka & Omori 1974). It is necessary to note, however, that drawings of *E. ? sublongiseta* in Tanaka & Omori (1974) show pronounced differences with the original description of *E. sublongiseta* by Park (1970) most noticeable in the length/ width ratio of the female genital double-somite (ventrally), which is 1.38 in Tanaka & Omori (1974), and 1.78 in Park's (1970) original description. The patterns of the female genital field of *E. sublongiseta* and *E. ? sublongiseta* (Park 1970; Tanaka & Omori 1974) also differ substantially. Based on these differences, we believe that *E. sublongiseta* Park, 1970 and *E. ? sublongiseta* (Tanaka & Omori 1974) represent two different species.

By the appearance and pattern of the genital field and the structural details of appendages, *Euaugaptilus verae* **sp. nov.** closely resembles *E. ? sublongiseta* (Tanaka & Omori, 1974, their pp. 255-258, Fig. 29). However, it additionally differs from the latter species (and *E. sublongiseta* Park, 1970) by the absence of external spines on the Re2 and 3 of P5. Among other *Euaugaptilus* species, the structure of the toothed edge of the Md blade of *E. verae* **sp. nov.** females is similar to *E. longiseta* Grice & Hülsemann, 1965, *E. marginatus* Tanaka, 1964, *E. humilis* Farran, 1926, *E. vesicus* Park, 1970, and *E. unisetosus* Park, 1970 (Table 2). At the same time, the structure of Mnd palp of *E. verae* **sp. nov.** differs from all the listed species. The structure of Mx1 of *E. verae* is very similar to *E. longiseta*, and close to *E. angustus* (Sars, 1905), *E. atlanticus* Roe, 1975, and *E. marginatus*, but differs from the latter three species by setation of the third inner lobe (merged basis and Ri). The lack of lateral spines on Re3 of the female P5 characteristic of *E. verae* **sp. nov.** is also observed in *E. diminutus* Park, 1970 and *E. fagettiae* Björnberg, 1975 (Table 2).

Distribution. The species of the genus *Euaugaptilus* are among the most sparsely distributed copepods in the oceans (Matsuura *et al.* 2010). Rarely males of the genus are found. They are essentially inhabitants of the meso- and bathypelagic zones wherein many congeneric species occur sympatrically (e.g. Grice & Hülsemann 1965; Roe 1975; Deevey & Brooks 1977; Matsuura *et al.* 2010). Until now, only one species of the genus, *E. hyperboreus*, has been known from the deep Arctic Ocean (Harding 1966; Brodsky 1967; Dunbar & Harding 1968; Kosobokova *et al.* 2011; Kosobokova 2012). It is much larger (female TL 7.4 mm, Brodsky 1967) compared to *E. verae* **sp. nov.** (female TL 2.8–3.2 mm, Table 1). *Euaugaptilus hyperboreus* was recorded in meso- and bathypelagial of the Arctic Ocean, between 200 and 3000 m, but predominantly occupied the depth range between 500 and 2000 m (Kosobokova, unpublished). In contrast, specimens of *E. verae* **sp. nov.** were collected exclusively from the bathypelagic of the deep Arctic basins (Fig. 1) and the deepest sampled water layers (1000–4325 m) close to the seafloor (Table 1).

2. Genus *Alrhabdus* Grice, 1973

Alrhabdus antjeboetiusae **sp. nov.**

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(Fig. 4A–J, Fig. 5A–H)

Material examined

Holotype. Adult female, dissected, in glycerin-gelatin preparation, 2.66 mm TL, Pr 1.90 mm. Collected in the Arctic Ocean, from the RV “*Polarstern*” expedition PS101 Sta. PS101/165, 86°55.91'N, 56°0.03'E, 29 September 2016, bottom depth 3884 m, depth of collection 2850–3950 m. ZIN accession No. 91166 (Table 1).

Paratype. One adult female, partly dissected, in glycerin-gelatin preparation, 2.57 mm TL. Collected in the Arctic Ocean, from the RV “*Polarstern*” expedition ARK XXII/2 Sta. 324, 88°4.59'N, 161°1.92'E, 1 September 2007, bottom depth 3964 m, depth of collection 3934–2000 m. ZIN accession No. 91167 (Table 1).

Additional material. One female, 2.60 mm TL, collected in the Arctic Ocean, from the RV “*Polarstern*” expedition PS94, Sta. 94/50, 84°23.00'N 29°46.50'E, 27.08.2015, bottom depth 4056 m; actual depth of collection 3000–3900 m (Table 1).

Differential diagnosis. *Alrhabdus antjeboetiusae* **sp. nov.** differs from the only known species of this genus, the type species *A. johrdeae*, by its size (*A. johrdeae* TL is 1.47 mm, while *A. antjeboetiusae* **sp. nov.** TL is 2.57–2.66 mm), rostrum with a central lobe, by the absence of spines on the posterior corners of the Pr and morphology of the

TABLE 2. Similarity (+) and dissimilarity (-) between the key diagnostic features of *E. verae* sp. nov. females and other Euaugaptilus species. Data for comparison from <https://copepodes.obs-banyuls.fr/fichefamlist.php?fam=6#g86>

Species	Total length, mm	Region	Structure of toothed edge of Md blade	Structure of Mnd palp	Structure of Mx1 (merged basis and Ri)	Lack of lateral spines on Re2&3 of P5
<i>E. verae</i> sp. nov.	2.8–3.2	Arctic Ocean	+	+	+	+
<i>E. sublongiseta</i> Park, 1970	1.86–2.30	Gulf of Mexico	+	+	+	-
<i>E. ? sublongiseta</i> Tanaka & Omori 1974	1.86–2.30	Japan (Izu region)	+	+	+	-
<i>E. longiseta</i> Grice & Hülsemann, 1965	1.82–2.8	Tropics	+	-	+	-
<i>E. marginatus</i> Tanaka, 1964	1.66–2.26	central Pacific	+	-	+	+
<i>E. humilis</i> Farran, 1926	1.54	Biscay Bay	+	-	+	-
<i>E. vescus</i> Park, 1970	1.56	Gulf of Mexico	+	-	+	+
<i>E. unisetosus</i> Park, 1970	1.52	Gulf of Mexico	+	-	+	Not shown
<i>E. angustus</i> (Sars, 1905)	4.66–7.90	Tropics	-	-	+	-
<i>E. atlanticus</i> Roe, 1975	2.8–2.9	NE Atlantic	-	-	+	-
<i>E. diminutus</i> Park, 1970	1.32–1.44	Caribbean Sea	-	-	-	+
<i>E. fagettiae</i> Björnberg, 1975	1.43	Chile	-	-	-	+

genital double-somite with spermathecae located in its distal part in *A. antjeboetiusae* sp. nov., while in *A. johrdeae* it is located in the proximal part of the somite. Another noticeable difference between the species is the structure of lateral setae on P5 Ri 1-2. While in *A. johrdeae* they are modified (lobate) and bear sensory filament terminally (Grice, 1973), they are unmodified in *A. antjeboetiusae* sp. nov.

Description. Adult female, TL 2.57-2.66 mm. Body slender (Fig. 4A–B). Prosome 0.7 of TL, 2.5 times as long as its maximum width in dorsal view. Cephalosome separate from Pr1, and Pr4 and 5 fused. Posterior corners of Pr obtuse-triangular, slightly pointed in dorsal view though rounded in lateral view. Forehead broadly rounded laterally (Fig. 4A–B). Rostrum plate large, as long as wide, with two robust widely spaced protrusions (Fig. 4C–D). Urosome 4-segmented and 0.28 length of Pr, anal Ur4 completely separate from CR. Genital double-somite (Ur1) 1.15 times as long as its maximum width in dorsal view and 1.1 times as long as its maximum width in lateral view with round, conspicuous genital boss occupying middle part of the somite (Fig. 4F–G). Caudal rami asymmetrical, right ramus (0.19 mm) slightly longer than left (0.18 mm) with elongate dorsal seta (Fig. 4I). The Ur1-3 and CR are in the proportional

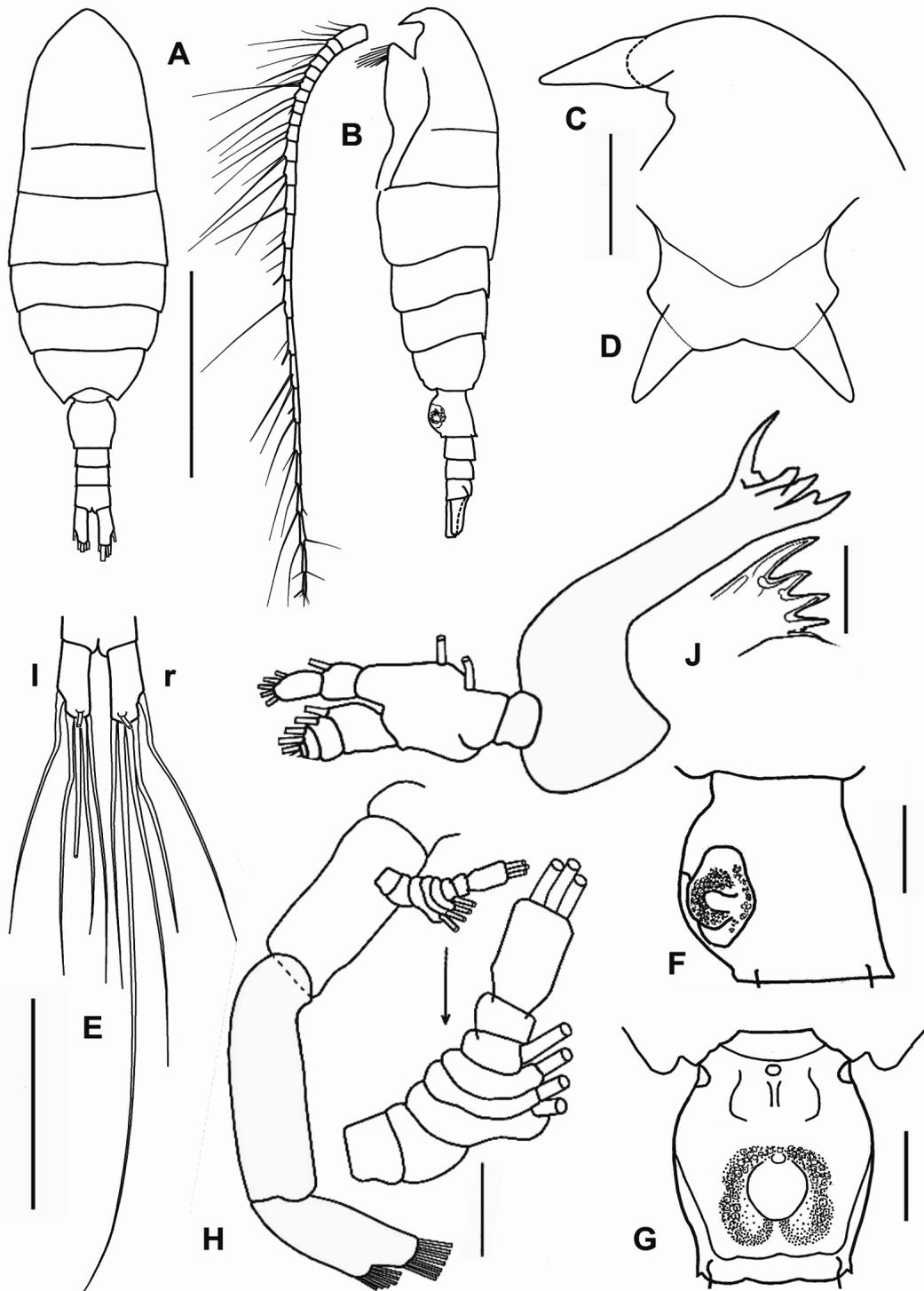


FIGURE 4. *Alrhabdus antjeboetiusae* sp. nov., female, holotype from the Arctic Ocean. A, habitus, dorsal; B, habitus and A1, lateral; C, rostrum, lateral; D, same, anteroventral; E, CR, dorsal; l, left ramus, r, right ramus; F, genital double-somite, lateral; G, same, ventral; H, A2; J, Md. Scale bars: A–B, 1 mm, C–D, F–J, 0.1 mm, E—0.5 mm.

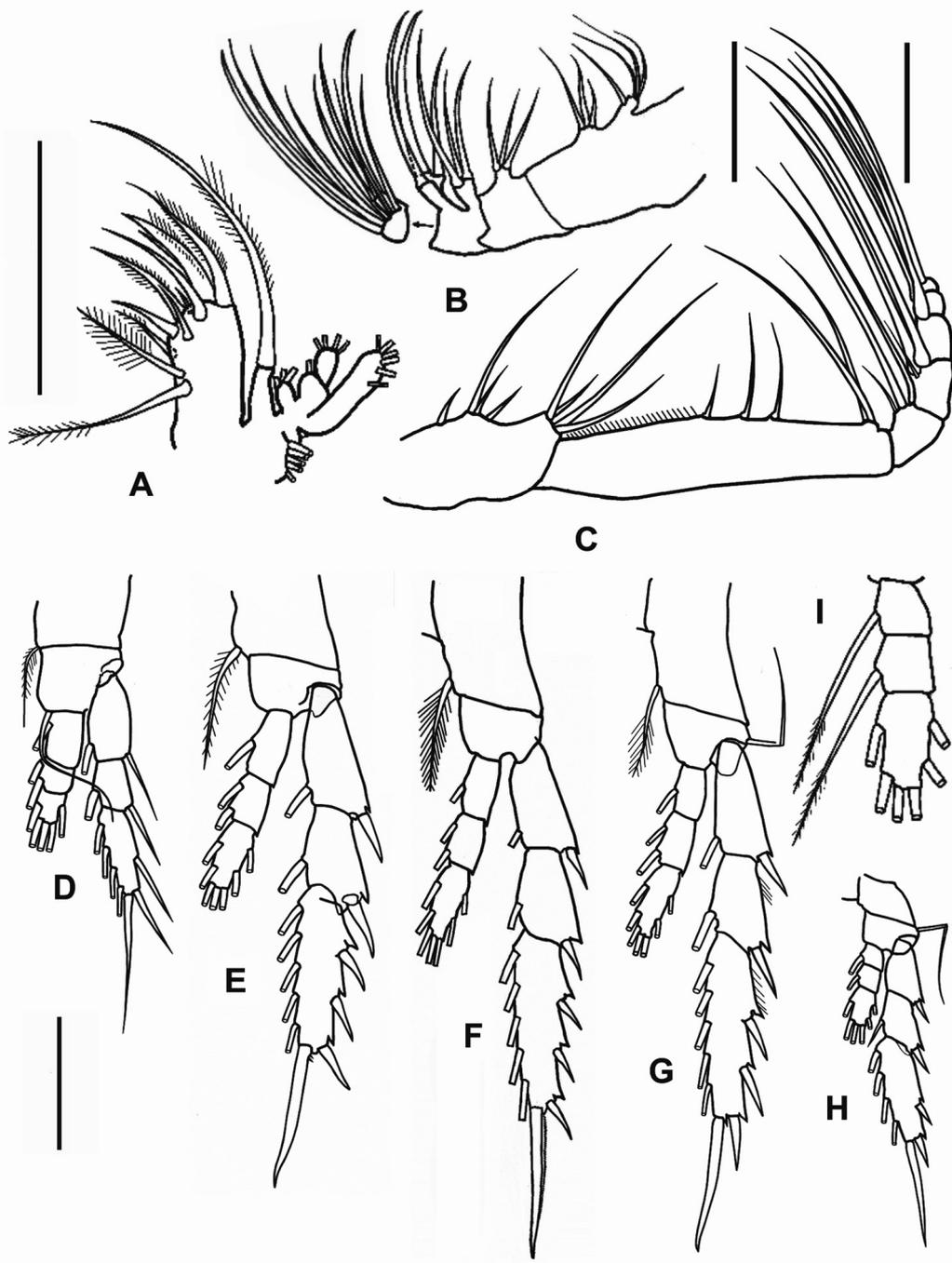


FIGURE 5. *Alrhabdus antjeboetiusae* sp. nov., female, holotype. A—Mx1; B—Mx2; C, Mxp; D, P1; E, P2; F, P3; G, P4; H, P5; I, right P5, Ri. Scale bars: 0.2 mm.

lengths as 31: 11: 12: 18: 28 (right ramus)=100. Antennule (Fig. 4B) symmetrical, 25-segmented, slightly longer than body, extends beyond CR by one distal segment, its proximal half bears numerous very long and thin setae (Fig. 4B).

Antenna (Fig. 4H) Ri2 0.6 length of Ri1, with 4 terminal setae on medial lobe and 6 setae on lateral lobe. Exopod small, 0.5 the length of Ri1, of rather unusual appearance consisting of 8 segments varying in size and shape. Exopod segments 3 to 6 with 1 large seta each, terminal Re8 with 3 setae.

Mandible (Fig. 4J) with strong mandibular blade bearing 4 lateral teeth and medial basal spine. Basis, Ri, and Re of mandibular palp nearly half the length of mandibular blade. Endopod slightly shorter than exopod. Basis with 2 long setae, Ri1-2 with 1 and 5 setae, and Re of 4 segments of different size with 6 setae.

Maxillule (Fig. 5A) medial lobe 1 (basal arthrite) with 9 strong spines, inner lobe 2 (coxal endite) with 1 very prominent spine, inner lobe 3 with 3 and 4 setae on merged basis and Ri; Re with 6 terminal setae, outer lobe with 5 setae.

Maxilla (Fig. 5B) two fused precoxal endites with 4 and 3 setae of different lengths. Distal segment of coxa fused to basis, coxal and basis endites each bear 3 setae. Endopod segments fused together, bearing 9 setae of different length. None of maxillary setae armed with hooked spinules ("buttons", Sewell 1932).

Maxilliped (Fig. 5C) precoxa and coxa fused, with 1, 3, and 4 setae. Basis elongate with 3 medial setae, with proximal hirsute from base to first seta. Endopod fused to basis. Setae on Mxp lack armed hooked spinules.

Legs P1-P5 (Fig. 5D-I) with 3-segmented Ri and Re, P1-P4 coxa with plumose medial setae. Basis of P1 (Fig. 5D) lacks lateral seta. Exopod segments with elongate lateral spines of same size. Endopod segments with 1, 2, and 5 setae, respectively.

P2-3 (Fig. 5E-F) basis lacks lateral seta. Exopod terminal spines about 0.9 length of Re3. Endopod segments with 1, 2, and 7 setae, respectively.

P4 (Fig. 5G) basis with lateral seta. Exopod similar to that of P3, terminal spine on Re3 about 0.7 of segment's length.

P5 (Fig. 5H) coxa lacking medial setae, basis with long lateral seta. Exopod segment 1 lacking medial seta, Re2 with medial seta, short and spinelike, Re3 with 4 medial setae. All three Re segments with lateral spines. Terminal spine on Re3 about 1.3 of the segment's length. Endopod segments 1-3 with 1, 1, and 6 setae, respectively, setae on Ri1-2 of usual shape, not flattened (lobate) or modified, and lack sensory filament terminally (Fig. 5I).

Male. Unknown.

Type locality. Arctic Ocean, 86°55.91'N, 56°0.03'E.

Etymology. The name of the new species, a term in singular feminine, genitive case, is dedicated to Dr. Antje Boetius, an eminent deep-sea explorer and the Leading scientist of the Arctic "Polarstern" expedition PS-101 (2016) where the holotype of this new species was collected.

Remarks. *Alrhabdus antjeboetiusae* sp. nov. is the second species described in this genus.

Distribution. Both species of the genus *Alrhabdus* known to date are recognized as bathypelagic. The type species, *A. johrdeae*, was described from the near-bottom water layer at depth >1700 m off the coast of the New Providence Island (Bahamas, 25°10' N and 77°25' W, Grice (1973)). Later, it was registered in tropical Atlantic south of the equator (Renz & Markhaseva 2015, their Fig. 3) at ultra-abyssal depths from 4605 to 5646 m (Markhaseva, unpublished) and considered obligate or predominantly benthopelagic (Renz & Markhaseva 2015). The new species *A. antjeboetiusae* sp. nov. is also collected at bathypelagic (2000–3950 m) of the Arctic Ocean, although the real distance of the lower sampling interval from the seafloor remained unknown (Table 1).

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