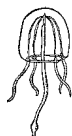


A NEW GENUS AND TWO NEW SPECIES OF MISOPHRIOID COPEPODS (CRUSTACEA) FROM THE NORTH ATLANTIC HYPERBENTHOS

DAMIA JAUME & GEOFFREY A. BOXSHALL

SARSIA



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Fosshageniella glabra gen. et sp. nov. is described from the hyperbenthic community at two widely separated localities in the North Atlantic. The new genus exhibits the most primitive condition known in the Misophrioida for the structure of the fifth leg of both sexes, which retains the intercoxal sclerite, separate coxa and basis, a distinct endopod, and a segmentation pattern and armature of both rami almost identical to those postulated for the misophrioid ancestor. *Arcticomisophria hispida* sp. nov. is described from the Vøring Plateau in the North Atlantic. Its most outstanding features relate to the structure and armature of the mouthparts, which are considered to be the most plesiomorphic among misophrioid copepods. The allocation of this taxon to the genus *Arcticomisophria* is only tentative and should be reevaluated when additional material, in particular males of the type species, becomes available.

Damia Jaume, IMEDEA (CSIC), Ctra. Valldemossa, km 7'5, 07071 Palma de Mallorca, Spain.
– Geoffrey A. Boxshall Department of Zoology, The Natural History Museum, Cromwell Road, London SW7 5BD, United Kingdom.

KEYWORDS: Copepoda; taxonomy; *Fosshageniella* gen. nov.; Misophrioida; hyperbenthos.

INTRODUCTION

The copepod order Misophrioida currently comprises 23 described species distributed in 13 genera. Even though the group includes both neritic and bathypelagic taxa (BOECK 1864; SARS 1909a; HULSEMANN & GRICE 1964; OHTSUKA & al. 1992), it has undergone a pulse of diversification in the deep-sea hyperbenthos (BOXSHALL 1983; ALVAREZ 1985; MARTÍNEZ ARBIZU & SEIFRIED 1996) and, especially, in anchihaline caves (BOXSHALL & ILIFFE 1986, 1987, 1990; HUYS 1988; OHTSUKA & al. 1992; JAUME & BOXSHALL 1996a, b).

Misophrioids are noteworthy for displaying the most primitive states known in the podoplean copepods for some characters. They probably represent a branch that diverged early from the podoplean lineage within the Copepoda (HUYS & BOXSHALL 1991; JAUME & BOXSHALL 1996a). The order is also remarkable for its biogeography: some of its cave-dwelling representatives show extreme disjunct distributions and are currently interpreted as faunal relicts of ancient seas (JAUME & BOXSHALL 1996a, b).

Known marine hyperbenthic misophrioids belong to the genera *Misophriopsis* BOXSHALL (three species, one in the deep-sea, the other two on the shelf; BOXSHALL 1983; OHTSUKA & al. 1992), *Misophriella* BOXSHALL (deep-sea, monotypic; BOXSHALL 1983) and *Archimisophria* BOXSHALL (two deep-sea species; BOXSHALL 1983; ALVAREZ 1985). Recently, the monotypic *Arcticomisophria* has been described from deep waters of the Arctic Ocean (MARTÍNEZ

ARBIZU & SEIFRIED 1996). In this paper we present the description of a new genus, represented by a new species collected from two widely separated North Atlantic stations, and the description of a second species of *Arcticomisophria*, also from the North Atlantic.

The new genus established here was previously referred to as *Misophriopsis* sp. by HUYS & BOXSHALL (1991). These authors presented a set of illustrations of a *Misophriopsis*-like misophrioid, which differed from *M. dichotoma* BOXSHALL, 1983, the single representative of the genus known at that time, in several aspects of the fifth legs. These differences could be interpreted as justifying distinct generic status, as was pointed out by OHTSUKA & al. (1992) when they presented an emended diagnosis of *Misophriopsis* accompanying their description of a new species of the genus, and their reallocation of *Misophria sinensis* BOXSHALL, 1990 to *Misophriopsis*.

According to HUYS & BOXSHALL (1991: Appendix I), the *Misophriopsis* sp. material they examined came from three different localities: a deep-sea plateau in the North Atlantic, the bottom of a Norwegian fjord, and a station somewhere off Greenland. Our reexamination of these materials as part of a wider revision of misophrioid genera confirmed that they are distinct from *Misophriopsis* and should be placed in two separate genera.

The terminology follows HUYS & BOXSHALL (1991). Materials are deposited in the collections of The Natural History Museum, London (BMNH) and the Zoologisk Museum, Oslo (ZM Oslo).

TAXONOMIC PART

Family Misophriidae BRADY, 1878

Fosshageniella gen. nov.

Diagnosis. First pedigerous somite free, completely concealed beneath posterior extension of dorsal cephalic shield of cephalosome. Female antennule 19-segmented, with ancestral segment VII separate from fused segments II–VI. Male antennule 14-segmented, with sheath retained on ancestral segment XV partly enclosing segment XVI. Two setae on first endopodal segment of antenna. Mandibular exopod 3-segmented. Maxillary exopod bearing 10 setae; endopod with armature formula 4,3,6; coxal epipodite with 7 setae. Leg 1 with 2 inner setae on second endopodal segment. Fifth legs with distinct intercoxal sclerite in both sexes; coxa and basis separate, former unarmed, latter bearing outer seta; exopod 2-segmented in female, first segment armed with outer seta, second segment with 1 seta on each side of apical spine plus 1 seta on outer margin. Male exopod 3-segmented; first segment bearing 1 seta on outer margin, second segment with 1 seta on inner margin, third segment with 1 seta on each side of apical spine, plus 1 seta on inner and outer margins; endopod 1-segmented in both sexes, provided with 2 distal setae. Armature of caudal rami consisting of 7 setae.

Etymology. The genus is dedicated to the eminent Norwegian copepodologist, our colleague Audun Fosshagen, in recognition of his many contributions to copepod systematics.

Type species. *Fosshageniella glabra* sp. nov.

Fosshageniella glabra sp. nov.
(Figs 1-6)

Misophriopsis sp.: HUYS & BOXSHALL (1991: figs 2.3.3C-E; 2.3.12A, B; 2.3.12E).

Material examined. Northwest territories, Canada: Second Norwegian Arctic Expedition, 'Fram', 1898-1902 (Sars collection)(ZM Oslo 21161). Collected on 12 July 1901. Sars (1909b) does not give precise locality data for this material, stating 'As all these localities lie within the same restricted area, I do not consider it necessary to enumerate all the places where each species was actually found'. According to GRIEG (1909) on 12 July 1901 the 'Fram' was sampling at about 35 m depth in a bay near Landsend, Jones Sound, Ellesmere Island (76°50.9' N 89°32' W). Holotype: Adult female 0.74 mm, preserved in 70 % ethanol. Allotype: Adult male 0.61 mm, partially dissected and preserved as follows: prosome with all mouthparts and swimming leg pairs 1 and 2 attached, and urosome with fifth legs attached, both pieces in 70 % ethanol; legs 3 and 4 mounted in lactophenol, on a single permanent slide. Paratypes: Five adult females and

one copepodid, preserved in 70 % ethanol and two permanent slides, latter containing appendages of one of the females.

Norway: Frierfjorden/Langesundfjorden, depth 99 m, deep mud. Two adult females and 1 adult male (BMNH Reg. nos 1996.1231-1233). Collected by R. Huys, Spring 1985.

Adult Paratype female. Body (Fig. 1A, B) 0.72 to 0.74 mm long, compact. Prosome ovoid in dorsal view, 5-segmented, almost 3 times longer than urosome. Rostrum (Fig. 1B) short and pointed. First pedigerous somite free, completely concealed by carapace-like posterior extension of dorsal cephalic shield. Second to 4th pedigerous somites with lateral margins slightly produced posteriorly. Prosomal somites ornamented with epicuticular ridges (not represented in figures) similar to those illustrated on urosomal somites (Fig. 1C, D). Urosome (Fig. 1C) 5-segmented, often with each somite strongly telescoped inside preceding somite. Genital somite and first abdominal somite fused forming double-somite, but retaining incomplete dorsal suture; 3 pairs of sensillae positioned dorsally on somite as illustrated. Arrangement of internal genital apparatus and number and location of copulatory pores not resolved in the material examined, although single copulatory duct emanating from single, ventral copulatory pore was the structure described by HUYS & BOXSHALL (1991: 88; figs 2.3.12A, B) for the Norwegian fjord population. Paired gonopores located ventrolaterally, each covered by operculum derived from sixth legs (Fig. 1D); each operculum armed with tiny pointed process, short spine and long seta. Posterior margins of genital double-somite and third and fourth urosomal somites provided with continuous hyaline frill; sensillae apparently absent from dorsal surface of latter somites. Anal somite and caudal rami densely ornamented with denticles, former with pair of sensillae dorsally. Anus located dorsal, anal operculum weakly developed. Caudal rami about as long as anal somite and as long as wide; armature of 7 setae; dorsal row of large denticles present along posterior margin of ramus.

Antennules (Fig. 1E) 19-segmented, not reaching posterior margin of cephalosome. Segments 1 to 8 richly ornamented with spinules and setules ventrally, and with several parallel, transverse rows of short denticles dorsally. Segmental fusion pattern and armature as follows: Segment 1 (corresponding to ancestral segment I), 1 seta; segment 2 (corresponding to fused ancestral segments II to VI), 10 setae; segments 3 and 4 (ancestral segments VII and VIII), 2 setae each; segment 5 (fused ancestral segments IX to XII), 8 setae; segments 6 to 8 (XIII to XV), 2 setae each; segment 9 (XVI), 2 + aesthetasc; segment 10 (XVII), 2 setae; segment 11 (XVIII), 2 + aesthetasc; segments 12 and 13 (XIX and XX), 2 setae each; segment 14 (XXI), 2 + aesthetasc; segments 15 and 16 (XXII and XXIII), 1 seta each; segment 17 (XXIV), 2 setae; segment 18 (XXV), 2 + aesthetasc; segment 19 (fused XXVI to

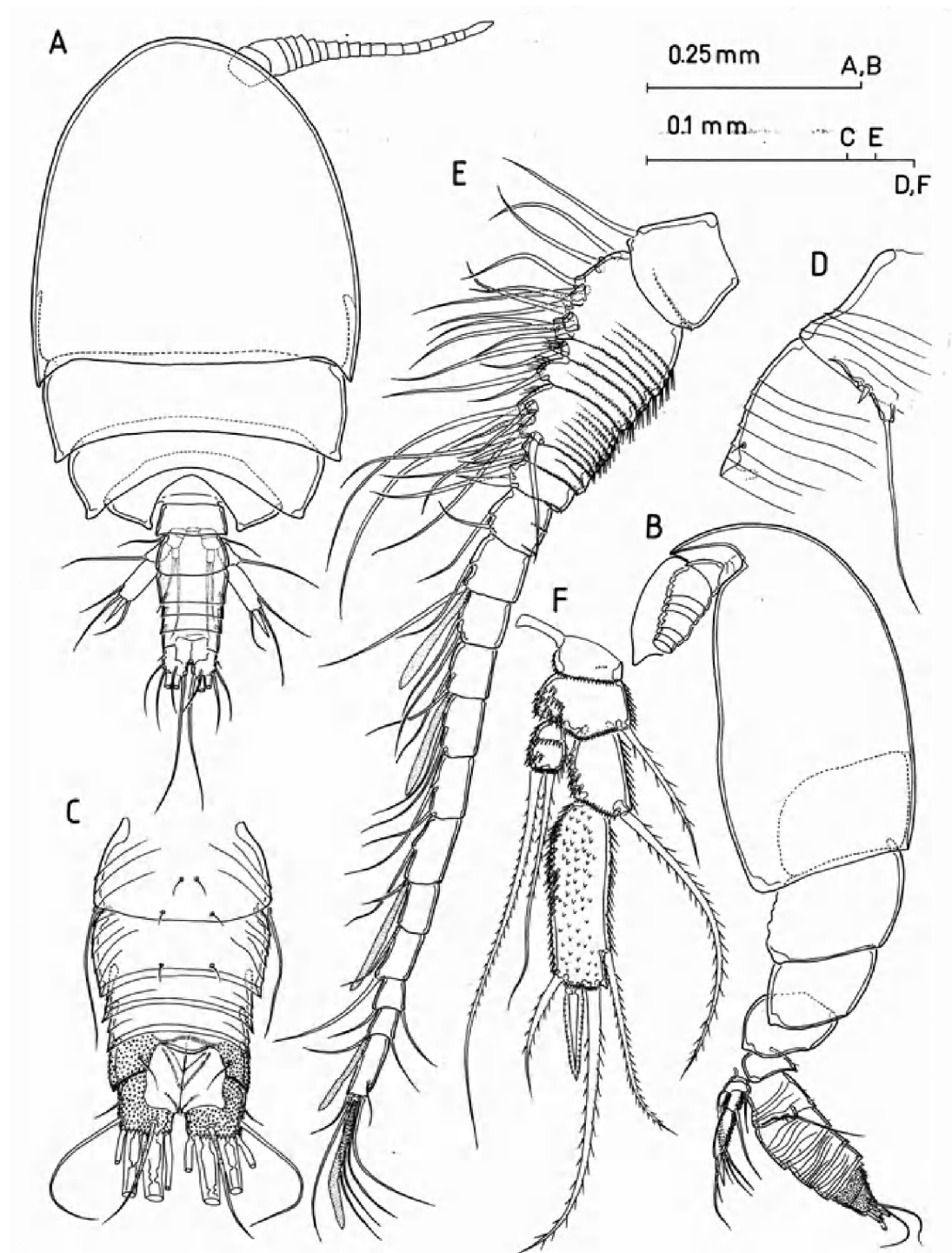


Fig. 1. *Fosshageniella glabra* gen. et sp. nov., adult female. A, Body, dorsal aspect; B, Body, lateral; C, Genital and abdominal somites, dorsal; D, Detail of genital operculum, lateral; E, Antennule, dorsal; F, Fifth leg, anterior.

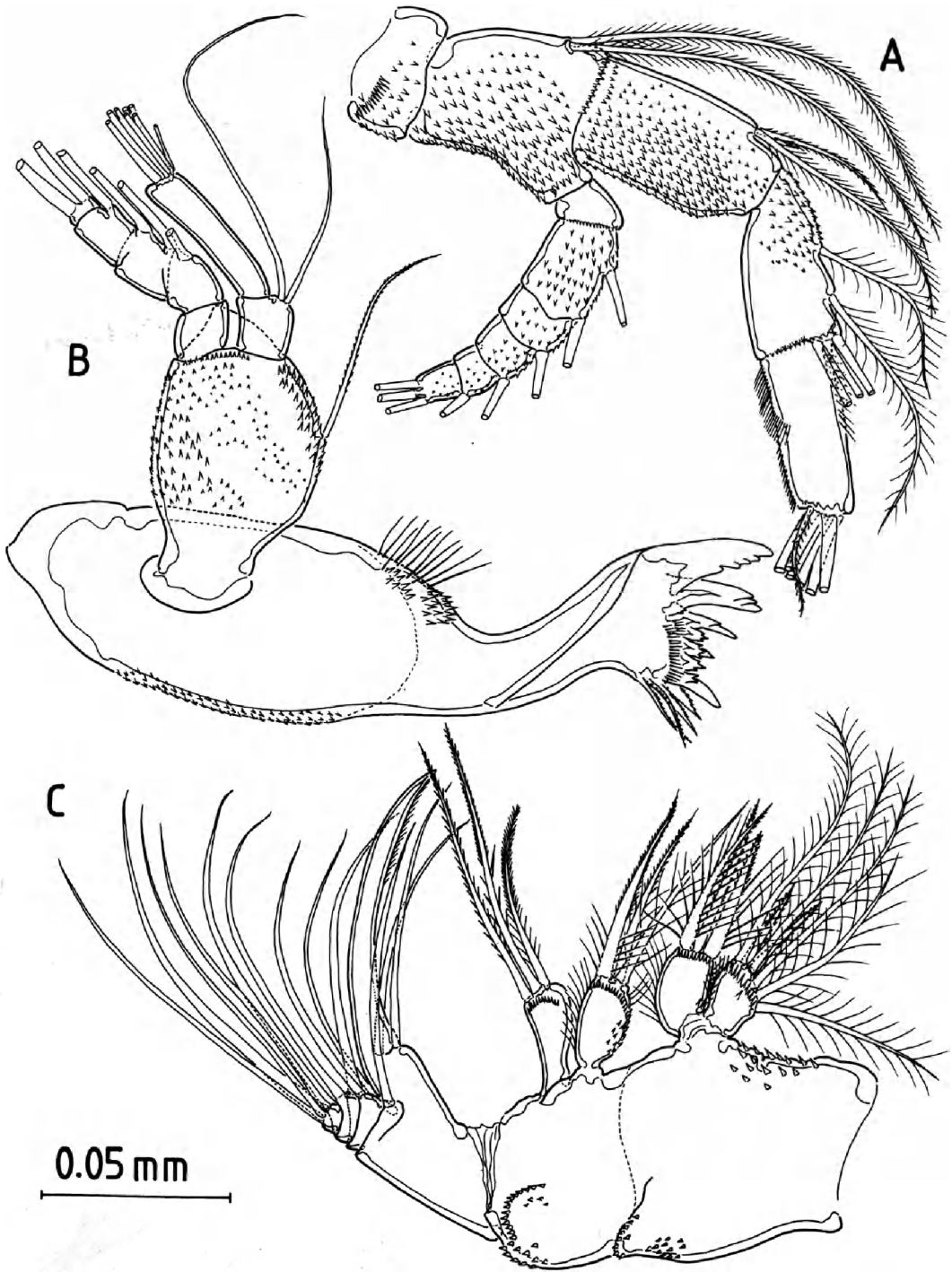


Fig. 2. *Fossenhageniella glabra* gen. et sp. nov., adult female. A, Antenna; B, Mandible; C, Maxilla.

XXVIII), 7 + aesthetasc. Segment 16 (XXIII) with anterior margin produced distally into lobe bearing stout seta. Segments 17 and 18 (XXIV and XXV) with 1 of setae located at posterior distal angle. Aesthetasc on apical segment fused at base to adjacent seta.

Antenna (Fig. 2A) biramous. Coxa unarmed. Basis bearing 2 long, inner setae subdistally. Endopod 3-segmented, segments about same length as basis; segment 1 bearing 2 unequal inner setae subdistally; segment 2 with 2 medial and 3 distal setae; segment 3 with 7 setae distally, and row of spinules and 2 rows of setules along margins, as figured. Exopod longer than first endopodal segment, 6-segmented, setal formula 0,2,1,1,1,3; presumed homologies with ancestral segments as follows: segment 1 (I-II), segment 2 (III-IV), segments 3 to 5 (V to VIII), segment 6 (IX-X); segment 2 about twice as long as other segments. Antennal segments ornamented with denticles, as figured.

Mandible (Fig. 2B) with stout coxal gnathobase, ornamented with several rows and patches of spinules and denticles, as figured; gnathobase well developed, with 7 deeply incised, unequal teeth, plus 2 serrate spine-like teeth and 2 setae dorsally. Mandibular palp well developed, biramous; basis about as long as rami, densely ornamented with denticles and bearing single seta about two-thirds of distance along inner margin. Endopod 2-segmented, setal formula 2, 8; segment 2 elongate. Exopod apparently 5-segmented, but close analysis revealing partial fusions, resulting in actual 3-segmented condition; suture lines between segments oblique and not in exactly corresponding position on anterior and posterior surfaces; setal formula 0,4,2.

Maxillule (Fig. 3A) with well defined praecoxa; praecoxal arthrite provided with 7 strong spines and 8 setae, 2 of which arising from anterior surface and 3 from posterior. Coxal endite bearing 6 thick setae distally; coxal epipodite bearing 7 setae. Basal endites armed with 4 setae each, distal largely incorporated into segment; basal exite absent. Endopod comprising single compound segment, representing 3 fused ancestral segments; armature divided into 3 groups representing original segmental elements, with formula 4,3,6. Exopod 1-segmented, bearing 10 setae. Maxillular segments richly ornamented with spinules, denticles and setules, as figured.

Maxilla (Fig. 2C) 5-segmented, praecoxa and coxa partially fused forming syncoxa; endites with setal formula 7,3,3,3; syncoxa and endites ornamented with spinules and setules, as figured. First endopodal segment only partially incorporated to basis to form allobasis; basal endite powerfully developed, drawn out into stout, curved medial claw bearing 1 basal seta at each side; two setae derived from proximal endopodal segment incorporated into allobasis. Free endopod 3-segmented, with setal formula 2,2,4; segments 1 and 2 horseshoe-shaped, with posterior side displaced distally.

Maxilliped (Fig. 3B) slender, 7-segmented. Syncoxa with 3 indistinct (coxal) endites, setal formula 1,3,2. Basis about as long as syncoxa, armed with 3 marginal setae. Syncoxa and basis ornamented with denticles and setules, as figured. Endopod 5-segmented, with setal formula 2,2,2,2,5; homology of segments probably corresponding to ancestral segments II to VI, with ancestral segment I incorporated into basis.

Swimming legs (Figs 4 and 5; Fig. 5 based on a male) biramous, both rami 3-segmented. Leg 1 somewhat reduced in size; leg 3 largest; intercoxal sclerite of leg 4 reduced. Legs richly ornamented with spinules, setules and denticles, especially on posterior surfaces (not represented in figures). Armature formula as follows:

			Exopodal segment			Endopodal segment		
	Coxa	Basis	1	2	3	1	2	3
Leg 1	0-1	I-I	I-1; I-1;	III,I,4		0-1*, 0-2;	1,2,3	
Leg 2	0-1	1-0	I-1; I-1;	III,I,5		0-1; 0-2;	1,2,3	
Leg 3	0-1	1-0	I-1; I-1;	III,I,4		0-1; 0-2;	1,2,3	
Leg 4	0-1	1-0	I-1; I-1;	III,I,5		0-1; 0-2;	1,2,2	

*Element lost in figured specimen.

Exopodal segment 3 of leg 4 with proximal seta on inner margin lost in one member of leg pair in some individuals, giving formula III,I,4 for that leg.

Fifth legs (Fig. 1F) symmetrical, slender, biramous, comprising coxa, basis, 2-segmented exopod and 1-segmented endopod; narrow intercoxal sclerite joining both legs. Coxa unarmed, basis bearing outer seta. First exopodal segment armed with seta on outer margin; second segment armed with 2 unequal setae and 1 denticulate spine distally, and 1 seta subdistally on outer margin; outer margin produced distally into minute pointed process. Endopod armed with 2 unequal setae distally. All segments richly ornamented with spinules and denticles, especially on posterior surfaces (not represented in figure).

Adult male. Body (Fig. 6A) up to 0.61 mm long, resembling female. Urosome (Fig. 6B) 6-segmented. Genital somite typically containing 2 pear-shaped spermatophores; paired gonopores located ventrally at posterior margin of somite; genital opercula (Fig. 6C) formed by subrectangular flaps densely covered by short denticles, each armed with 3 long, spinulose setae, innermost shortest.

Antennules (Fig. 6D) 14-segmented, symmetrical, digeniculate with geniculations between segments homologous with ancestral segments XV and XVI, and between XX and XXI. Segment XV cup-shaped, forming sheath around proximal half of segment XVI. Proximal segments ornamented with denticles and setules (omitted from figure for greater clarity) as in female. Segmental armature

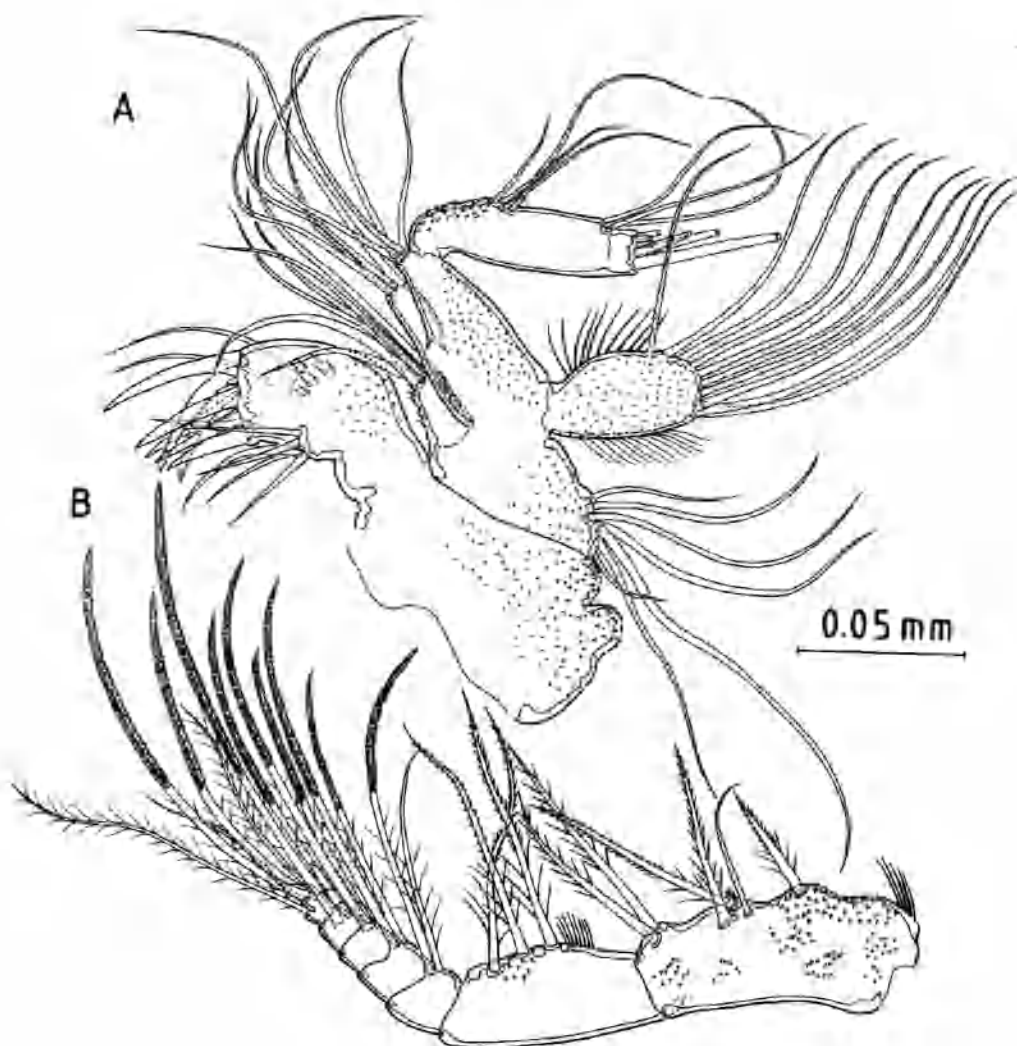


Fig. 3. *Fossahageniella glabra* gen. et sp. nov., adult female. A. Maxillule, ornamentation on thick spines of praecoxal arthrite omitted to improve clarity; B. Maxilliped.

and fusion pattern as follows: Segment 1 (corresponding to ancestral segment I), 1 seta + aesthetasc; segment 2 (fused ancestral segments II to VI), 9 setae (possibly 10, see below) + 2 aesthetascs; segment 3 (VII), 2 + ae; segment 4 (VIII), 2 setae; segment 5 (IX to XII), 8 + 2 ae; segment 6 (XIII), 2 setae; segment 7 (XIV), 2 + ae; segment 8 (XV), 2 setae; segment 9 (XVI), 2 + ae; segment 10 (XVII), 2 setae; segment 11 (XVIII), 2 + ae; segment 12 (XIX-XX), 3 setae (possibly 4, see below); segment 13 (XXI-XXIII), 3 setae (possibly 4, see below) + ae; segment 14 (XXIV-XXVIII), 11 + 2 ae, apical aesthetasc fused at base to adjacent seta. Identification of ancestral

segment XXIV based on location of proximal seta on posterior margin of antennule.

Other mouthparts and swimming legs 1 to 4 as in female.

Fifth legs (Fig. 6E) differing from female only in 3-segmented condition of exopod; first exopodal segment armed with 1 seta on outer margin; second segment with distal seta on inner margin; third segment with 2 setae and 1 spine distally, and single seta midway along inner and outer margins of segment. Posterior surface of segments richly ornamented with long spinules (not figured); anterior surface bearing sparse rows of short denticles.

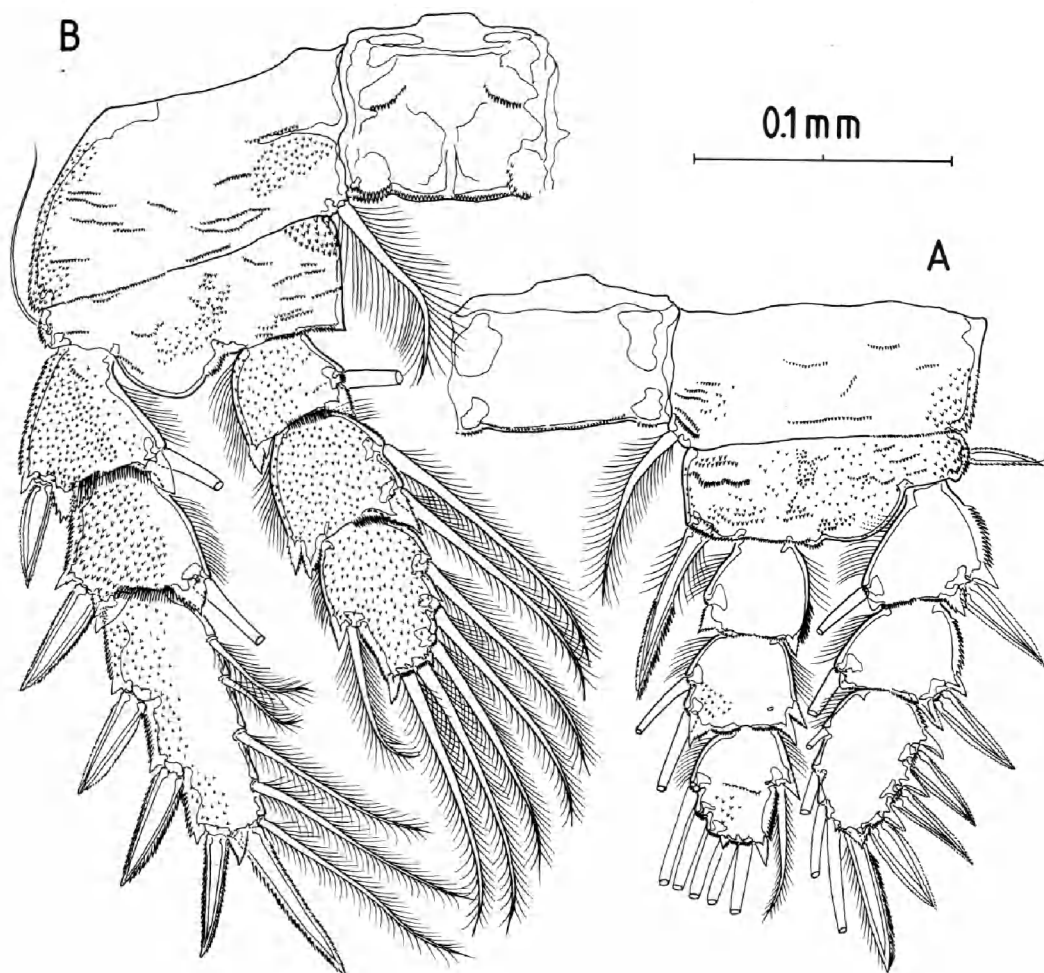


Fig. 4. *Fosshageniella glabra* gen. et sp. nov., adult female. A, Leg 1, anterior; B, Leg 2, anterior.

Variability. Comparison between the material from Ellesmere Island collected during the Second Norwegian Arctic Expedition and that from Norwegian fjords has not revealed any significant differences. Minute differences in the distribution of spinules and denticles on the surfaces of the segments of the female fifth leg revealed by comparison of Fig. 1F ('Fram' Expedition) with figs 2, 3, 12E from HUYS & BOXSHALL (1991) (Norwegian fjords) could not be confirmed. Reexamination of the latter material revealed ornamentation identical to that shown in Fig. 1F.

Differences apparent from comparison of the number of armature elements on the segments of the male antennule in the two populations (cf. Fig. 6D ('Fram' Expedition) with HUYS & BOXSHALL (1991: figs 2, 3, 3C-E (Norwegian fjords))) are more problematic. Segment 2 (fused ancestral segments II to VI) bears 9 setae plus 2 aesthetascs in the

'Fram' material, whereas this segment displays 10 setae plus 2 aesthetascs in the Norwegian fjord population. Segment 5 bears 8 setae plus 2 aesthetascs in the 'Fram' population, but only 7 plus an aesthetasc in the Norwegian fjord population. Other differences relate to minute elements figured on segments 12 (fused ancestral segments XIX-XX) and 13 (XXI-XXIII) of the Norwegian fjord population by HUYS & BOXSHALL (1991), but which were not detected by us in the 'Fram' population (see above). Unfortunately, the available material from the Norwegian fjords includes only one male, with incomplete antennules. We consider that these differences are more likely due to the poor state of preservation of the dissected individuals (which could have lost elements) rather than to real differences between the populations, since the number of armature elements on the male antennular segments of

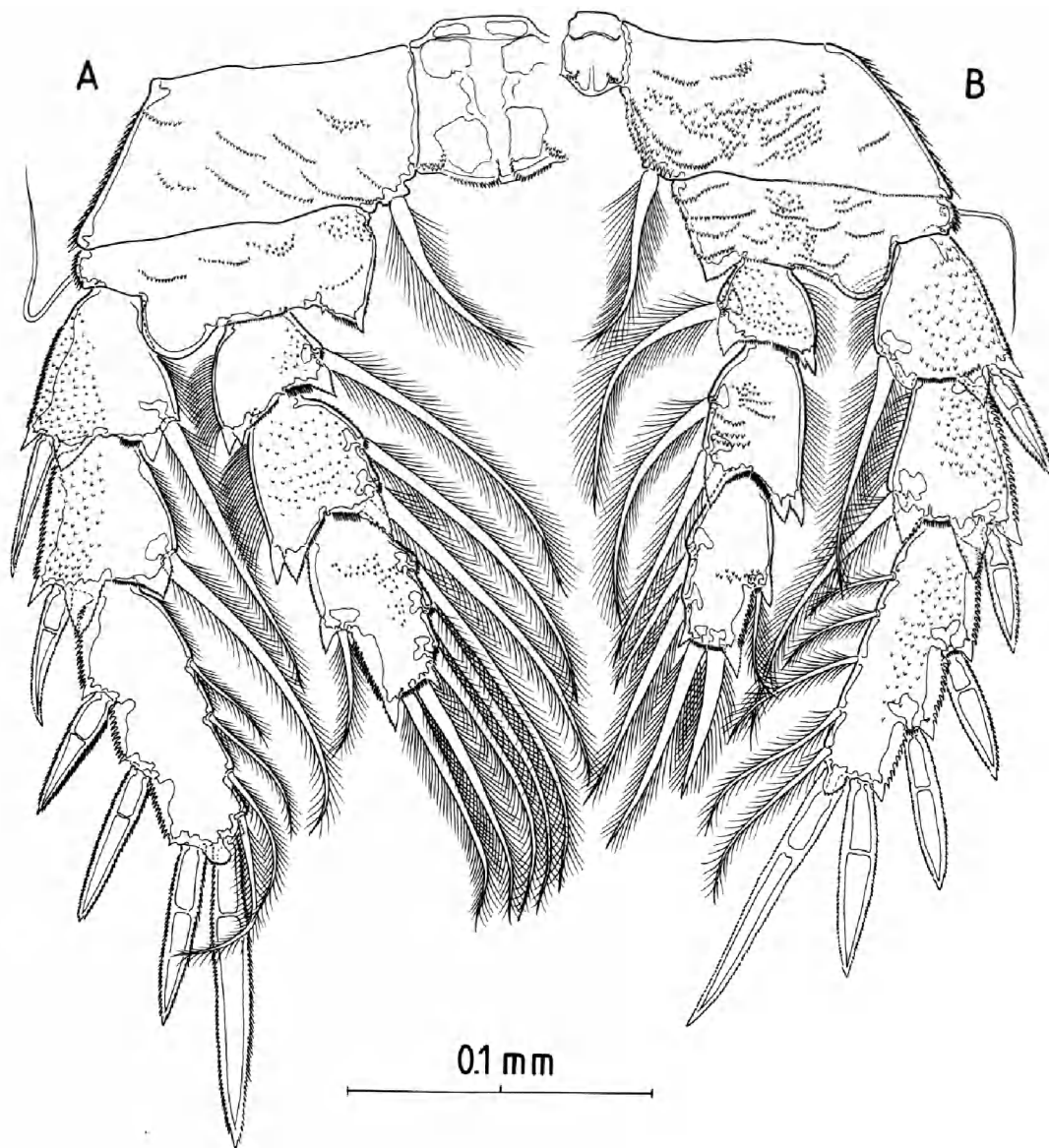


Fig. 5. *Fosshageniella glabra* gen. et sp. nov., adult male. A, Leg 3, anterior; B, Leg 4, anterior.

misophrioid copepods rarely displays any intrageneric variability.

E t y m o l o g y . The species name, from the Latin '*glaber*' (= hairless), refers to the smooth dorsal surface of the urosomal somites.

R e m a r k s . The new genus from the North Atlantic described above resembles *Misophriopsis* BOXSHALL, 1983 (sensu OHTSUKA & al. 1992) in body shape, the free first

pedigerous somite (completely concealed by a carapace-like posterior extension of the cephalosome), the general structure of the mouthparts and other appendages, as well as in the rich integumental ornamentation displayed by both body somites and appendages (BOXSHALL 1983; 1990; HUYS & BOXSHALL 1991; OHTSUKA & al. 1992). Closer study reveals remarkable differences between them.

The female antennule of the new taxon is 19-segmented, with ancestral segment VII not incorporated into compound segment 2 (II-VI). In *Misophriopsis*, segment VII

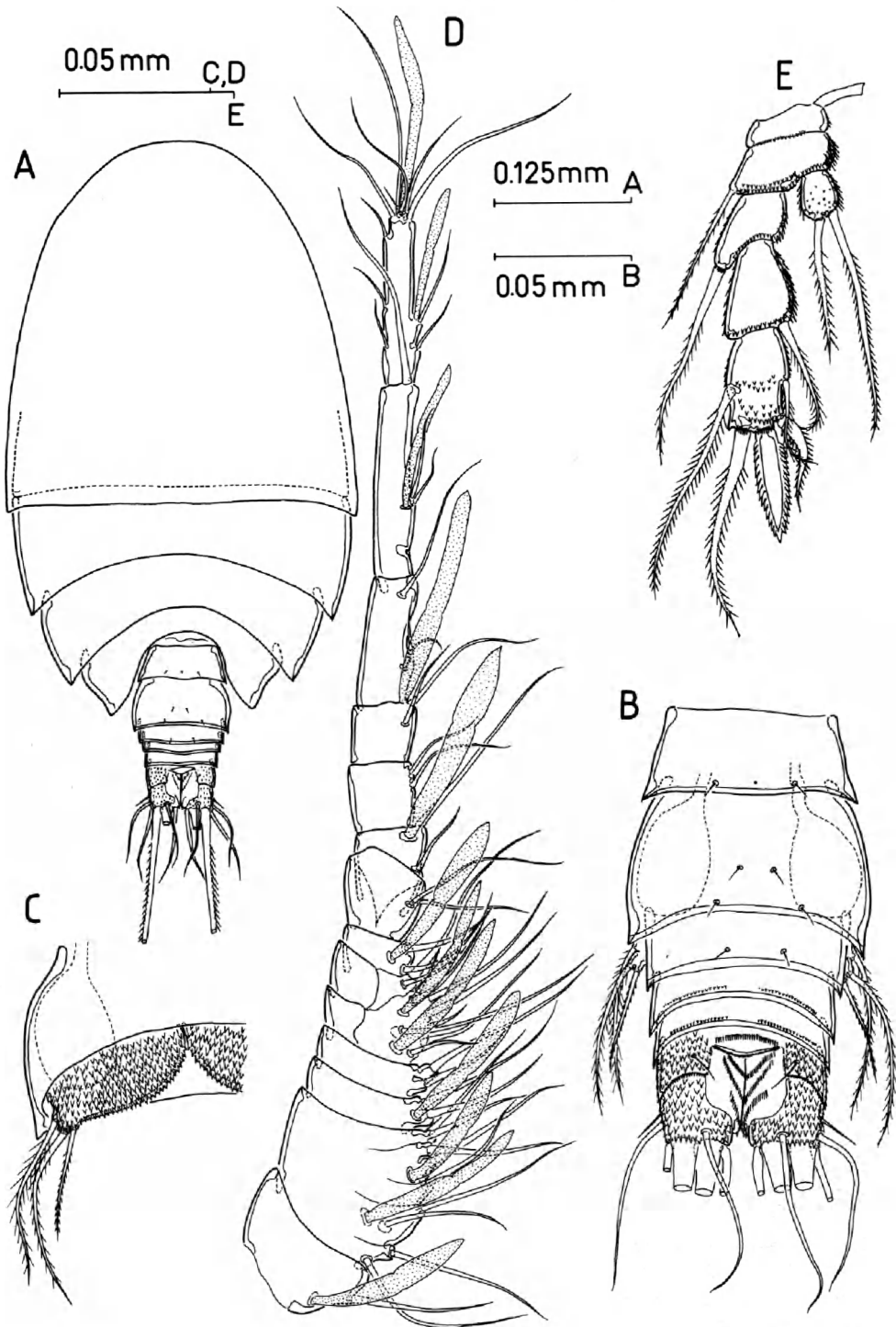


Fig. 6. *Fosshageniella glabra* gen. et sp. nov., adult male. A, Body, dorsal. B, Urosome, dorsal; C, Detail of genital operculum, ventral; D, Antennule; E, Fifth leg, anterior.

is incorporated into segment 2 (which represents fused segments II-VII), resulting in a 18-segmented antennule. There are also differences in the number of segments of the male antennule, which is 12-segmented in *Misophriopsis* but 14-segmented in the new taxon. Ancestral segment XIII is not incorporated here into the compound segment representing fused ancestral segments IX-XII. The sheath between the ancestral segments XV and XVI is retained in *Fosshageniella*, whereas in *Misophriopsis* the sheath is lost and the segments involved are partially fused.

The female fifth leg of *Fosshageniella* retains an intercoxal sclerite and bears a long seta on the outer margin of both exopodal segments, the endopod is provided with 2 distal setae, and the coxa and basis are separate. In the fifth leg of *Misophriopsis* the coxa and basis are fused, the intercoxal sclerite and the outer armature elements on the exopod are lost, and the endopod bears a single seta.

The male fifth legs also differ significantly. In *Fosshageniella* the intercoxal sclerite and separate coxa and basis are retained, an outer seta is present on both first and third exopodal segments; and the endopod bears 2 setae. In *Misophriopsis* the coxa and basis are fused, the intercoxal sclerite and the outer setae on exopod are lost, and the endopod bears a single seta.

Other differences between these two genera relate to the mandibular palp. In *Fosshageniella*, the exopod is actually 3-segmented with setal formula 0,4,2, although it is apparently 5-segmented due to the almost complete suture lines retained between some of the partially fused segments. The exopod has an apparent 0,2,1,1,2 setal formula. This exopodal segmentation and armature (present also in *Misophria* and *Arcticomisophria*) is noteworthy since a 5-segmented condition and setal formula of the exopod 1,1,1,1,2 (as displayed by *Speleophria* BOXSHALL & LILFFE, 1986) was considered to be the ancestral state for the Misophrioida by HUYS & BOXSHALL (1991). The armature exhibited by the second segment of *Fosshageniella* may be indicative of its derivation from 2 fused ancestral segments, from which we could infer a 6-segmented condition for the exopod as the ancestral state for misophrioids, as noted for *Arcticomisophria* by MARTÍNEZ ARBIZU & SEIFRIED (1996). The mandibular palp of *Speleophria* and *Misophria* (cf. JAUME & BOXSHALL 1996 and HUYS & BOXSHALL 1991) should be regarded as 6-, or originally 6-segmented, by reinterpretation of the proximal part as an unarmed exopodal segment rather than as a basal pedestal. The exopod of the mandible of *Misophriopsis* (cf. OHTSUKA & al. 1992) is 5-segmented with setal formula 1,1,1,1,2.

The armature of the maxillule and maxilla also differs in the two genera. The maxillule of *Fosshageniella* has a setal formula of 4,3,6 for the endopod, and has 10 setae on the exopod; the armature in *Misophriopsis* is 3,3,6,

and 8, respectively. The maxilla of *Fosshageniella* bears 7 elements on the proximal praecoxal endite and 5 on the allobasis, whereas in *Misophriopsis* these numbers are 6 and 7, respectively.

Fosshageniella also is closely related to the recently described *Arcticomisophria*. Comparisons of the morphology of the female between these two genera reveal remarkable similarities in the segmentation and armature of the antennule, antenna, mandible, maxilla and maxilliped. The fifth legs are also similar in retaining separate coxa and basis, a 2-segmented exopod and a 1-segmented endopod bearing 2 apical setae. The fifth legs of the males of these two genera are also similar in structure and presumed setation.

These genera can be differentiated as follows. In *Fosshageniella*, the second segment of the endopod of leg 1 bears 2 setae rather than only 1 in *Arcticomisophria*. The number of armature elements on the distal segment of the exopod of leg 5 also differs: four in *Fosshageniella* and only 3 in *Arcticomisophria*. In addition the distal element on the exopod is a stout spine ornamented with denticulate hyaline frill in *Fosshageniella*, whereas in *Arcticomisophria* it is setiform and lacks hyaline frill. Also significant is the retention of the intercoxal sclerite between the fifth legs in *Fosshageniella* since this is apparently lost in *Arcticomisophria*.

There are other differences between these genera in the armature of the antennae and maxillules. In *Fosshageniella* the first endopodal segment of the antenna retains 2 setae, whereas in *Arcticomisophria* only 1 is present. The second exopodal segment of the antenna of *Fosshageniella* is about twice the length of the other exopodal segments (a condition also displayed in *Misophriopsis*), whereas this segment is just longer than the others in *Arcticomisophria*. The maxillulary exopod of *Fosshageniella* is armed with 10 marginal setae, the setal formula of the endopod is 4,3,6, and the coxal epipodite retains 7 setae. As noted by MARTÍNEZ ARBIZU & SEIFRIED (1996), *Arcticomisophria* displays the maximum setation counts for the maxillule known among misophrioids, with 11 exopodal setae, an endopod formula 4,4,6, and a coxal epipodite with 8 setae. The maximum number of elements on the praecoxal arthrite is, however, greater in *Fosshageniella* (15) than in *Arcticomisophria* (14).

The maxillae differ in the degree of incorporation of the proximal endopodal segment to basis to form the allobasis: the incorporation is only partial in *Fosshageniella* but complete in *Arcticomisophria*.

The structure of the genital system in *Fosshageniella* (as described above) should be confirmed when more material becomes available, but the single copulatory pore and single copulatory duct observed in *Fosshageniella* contrast with the 2 separate pores and ducts described in *Arcticomisophria* (MARTÍNEZ ARBIZU & SEIFRIED 1996).

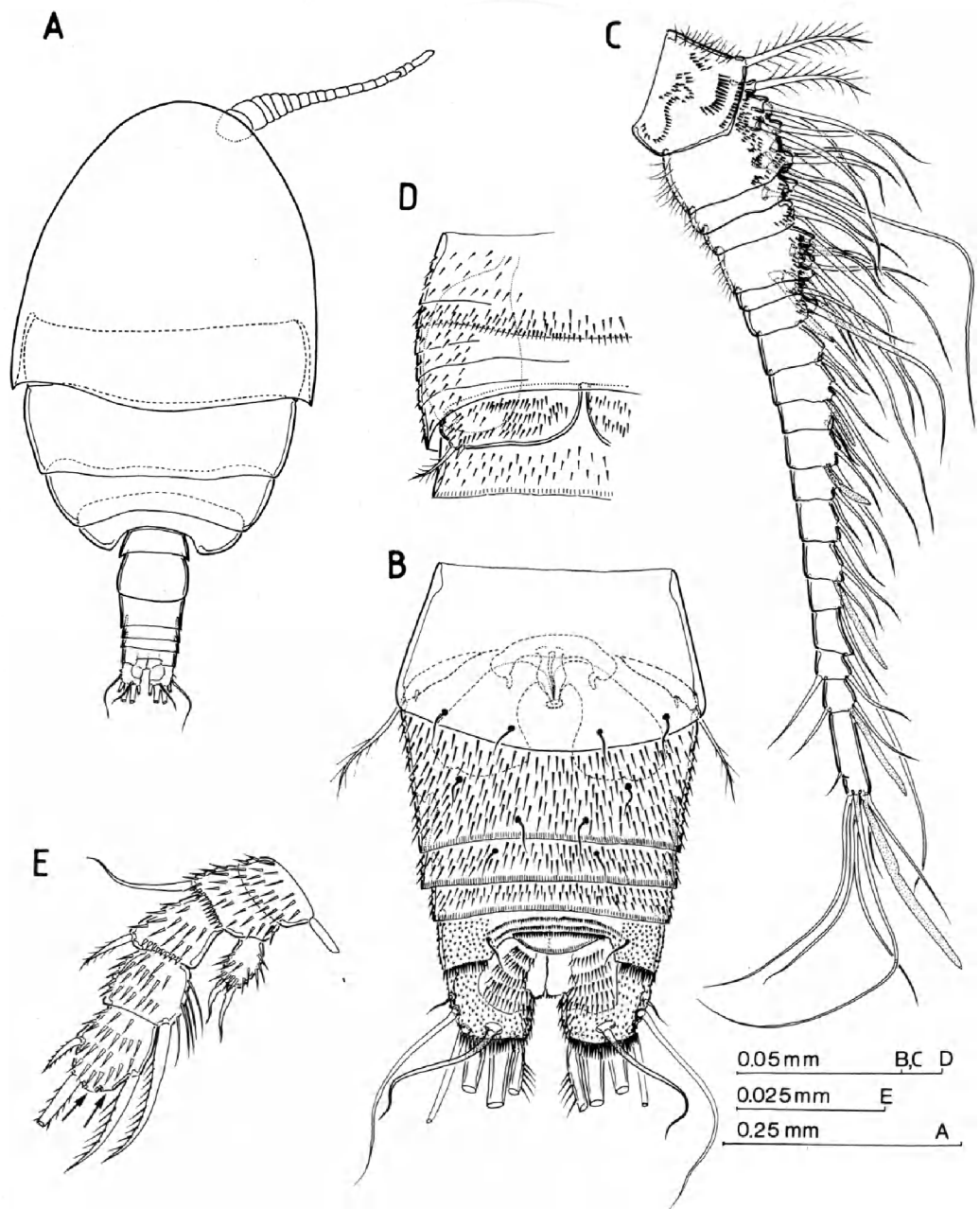


Fig. 7. *Arcticomisophria hispida* sp. nov.; A-C: Adult female; D-E: Adult male. A, Body, dorsal; B, Urosome, dorsal (spinulation on anterior part of genital double-somite omitted); C, Antennule, ventral; D, Genital operculum, ventral; E, Fifth leg, posterior view (arrows indicating insertion points of lost armature elements; length of endopodal setae probably abnormal).

Genus *Arcticomisophria* MARTÍNEZ ARBIZU & SEIFRIED
1996

Arcticomisophria hispida sp. nov.
(Figs 7-10)

Material examined. Norway: Voring Plateau, 66°58.8' N, 4°10.2' E; 1380m depth. Holotype: Adult female 0.59 mm (BMNH Reg. no. 1995.1530). Allotype: Adult male 0.39 mm (BMNH Reg. no. 1995.1531). Paratype copepodid

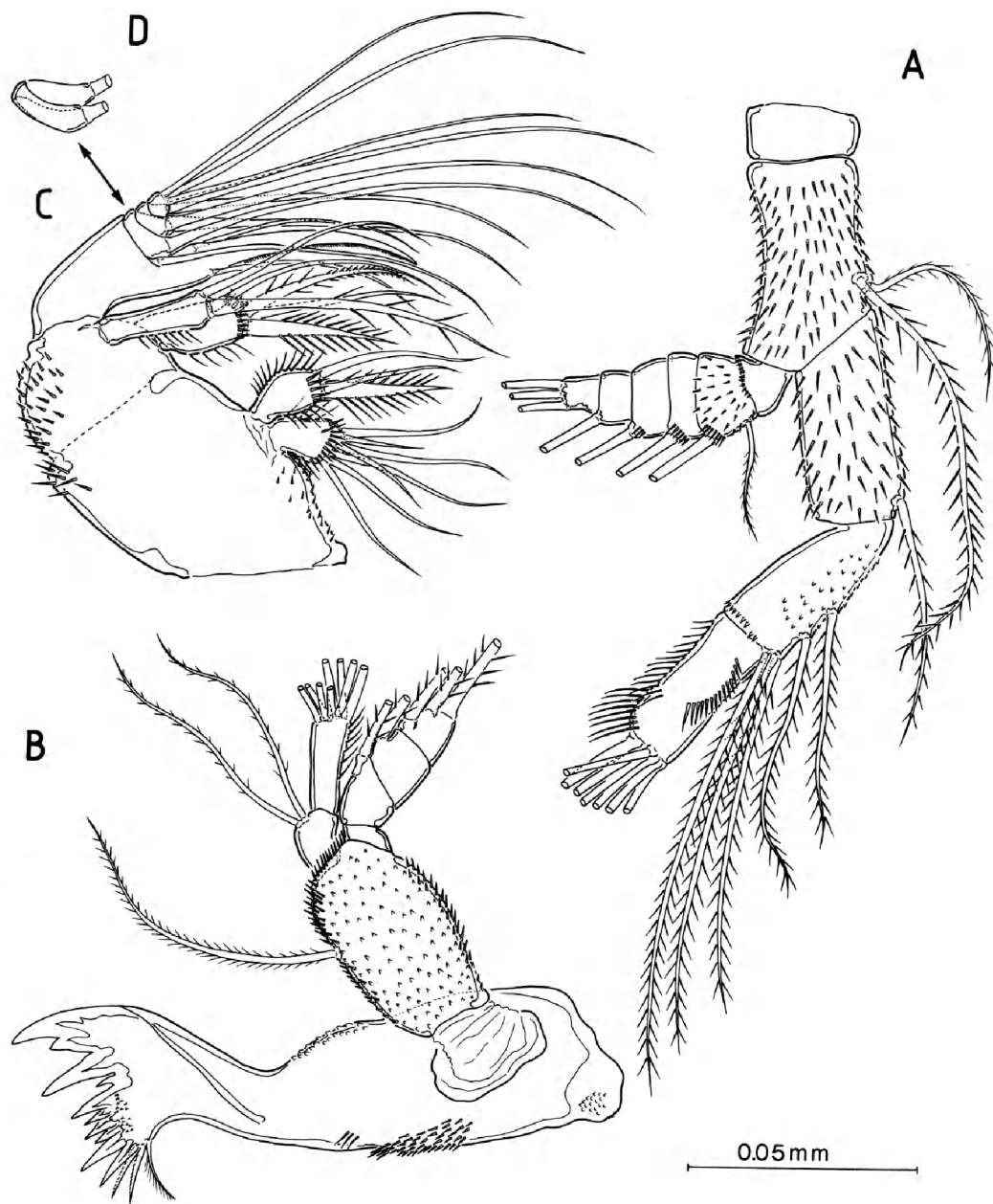


Fig. 8. *Arcticomisophria hispida* sp. nov., adult female. A, Antenna; B, Mandible; C, Maxilla, D, Detail of proximal endopodal segment of maxilla.

(BMNH Reg. no.1995.1532). All preserved in 70 % ethanol. Additional material, one adult male, 2 adult females and 1 copepodid, all damaged, used to study variation but not preserved. Collected by A. Fosshagen, 5 June 1981.

Adult female. Body (Fig. 7A) of holotype 0.59 mm long, robust, ovoid, completely covered by ornamentation of tiny setules and spinules. Prosome 5-segmented, more than 2.5 times longer than urosome. Rostrum short and rounded. First pedigerous somite free, completely concealed by carapace-like posterior extension

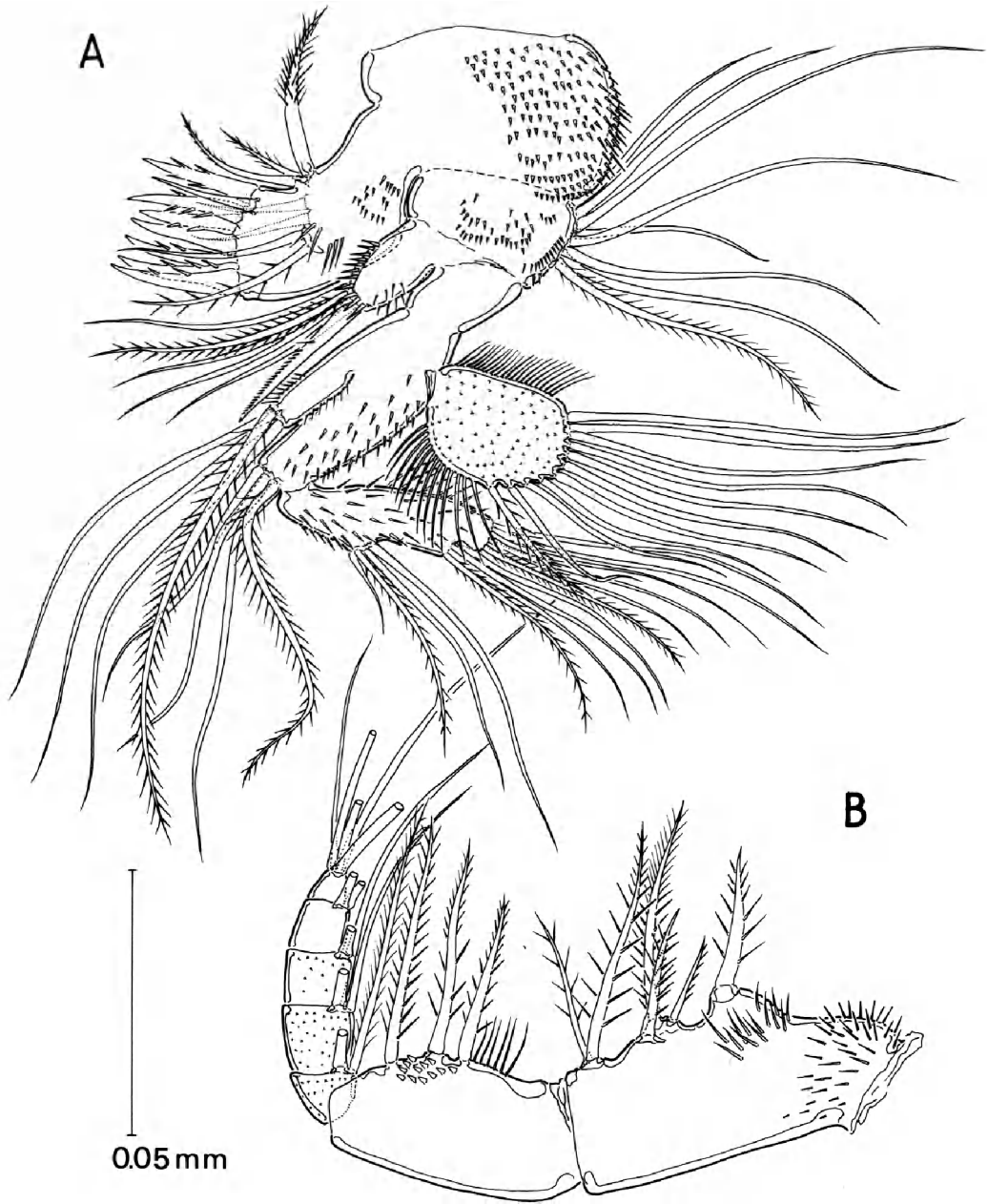


Fig. 9. *Arcticomisophria hispida* sp. nov., adult female. A, Maxillule; B, Maxilliped.

of cephalosome. Urosome 5-segmented, often with each somite strongly telescoped inside preceding somite; somites densely ornamented with spinules (Fig. 7B). Genital somite and first abdominal somite partially fused forming double-somite, with single copulatory pore opening ventrally about midway along double-somite;

paired gonopores located ventrolaterally anterior to copulatory pore, each covered by opercular plate armed with tiny pointed process, short spine and long plumose seta. Double-somite with 4 pairs of long sensillae located as figured. Internal genital system complex, with two separate, parallel copulatory ducts appearing to origi-

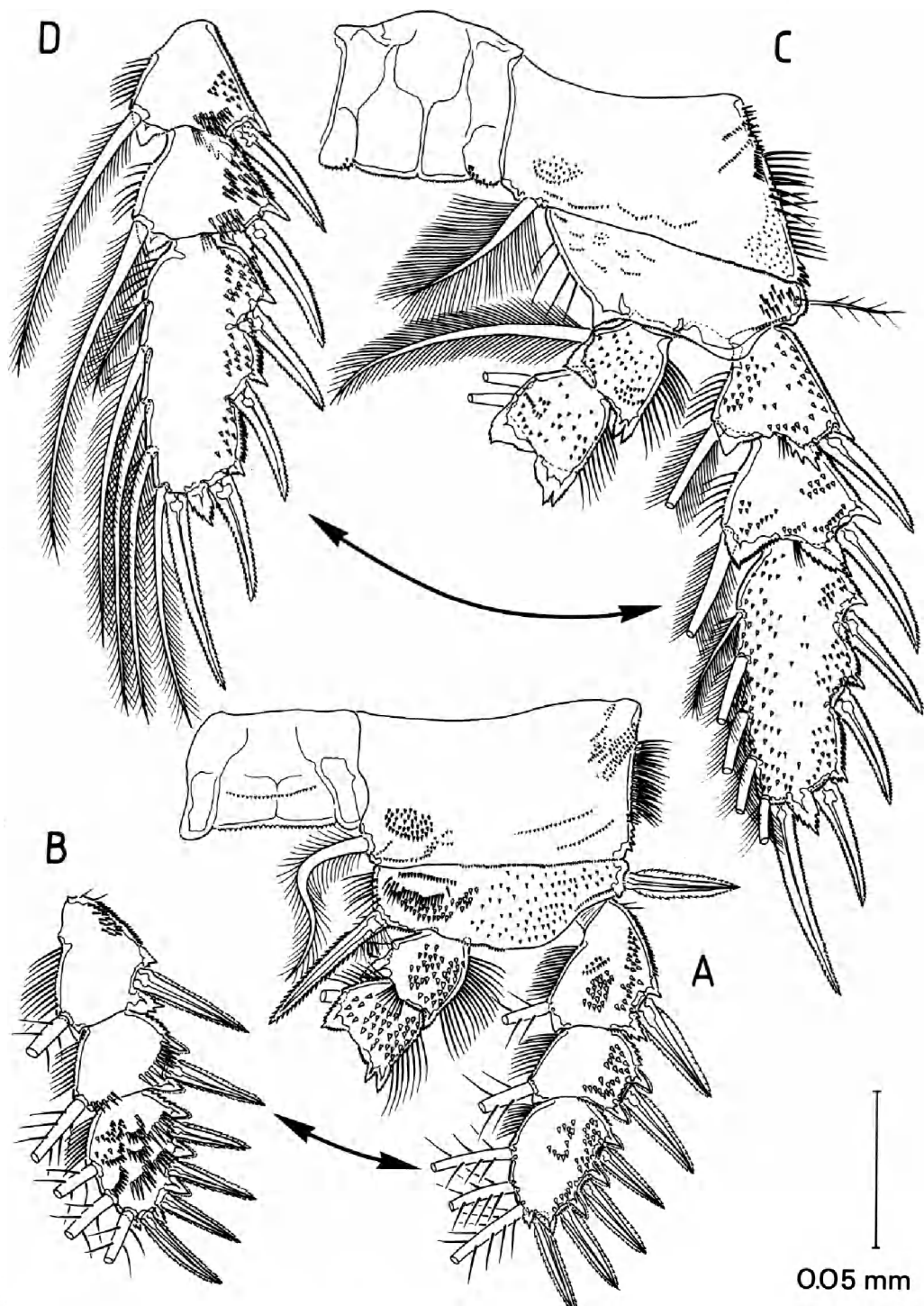


Fig. 10. *Arcticomisophria hispida* sp. nov., adult female. A, Leg 1, anterior view (distal segment of endopod missing); B, Exopod of leg 1, posterior; C, Leg 2, anterior (distal segment of endopod missing); D, Exopod of leg 2, posterior.

nate at copulatory pore. Posterior margins of genital double-somite and of second and third abdominal somites provided with continuous, striated hyaline frill. Two dorsal sensillae present on second abdominal somite; sensillae absent from third. Anal somite about as long as preceding somite, but covered more densely by shorter spinules; anus opening dorsally, overlain partly by weakly developed anal operculum ornamented with striated hyaline frill; 3 well defined transverse rows of spinules present between anterior margin of somite and operculum; pair of sensillae implanted dorsally; row of long spinules present laterally on posterior margin. Caudal rami about as long as anal somite and as long as wide, with armature of 7 setae; dorsal row of long spinules present along posterior margin of each ramus; other ornamentation as figured.

Antennules and antennae (Figs 7C and 8A) identical in segmentation and armature to *Fosshageniella glabra*, except in *A. hispida* first endopodal segment of antenna bearing single seta instead of 2 in *F. glabra*, and second exopodal segment of antenna of *A. hispida* wider than long and only just longer than other exopodal segments, rather than elongate and double length of other exopodal segments as in *F. glabra*.

Mandible (Fig. 8B) similar to *F. glabra* except for fusion pattern and setal formula (0,1,1,3) exhibited by apparently 4-segmented exopod, and for presence of single dorsal seta on gnathobase rather than 2 as in *F. glabra*.

Maxillule (Fig. 9A) with well defined praecoxa produced medially into arthrite provided with 7 strong spines and 8 setae, 2 of which arising from anterior surface and 3 from posterior. Coxal endite bearing 1 thick pectinate spine and 5 setae distally; coxal epipodite vestigial, incorporated into segment, represented by 8 setae. Basal endites armed with 4 setae each, distal largely incorporated into segment; basal exite absent. Endopod unsegmented, representing 3 fused ancestral segments; armature divided into 3 groups representing original segmental elements, with formula 4,4,6. Exopod 1-segmented, bearing 11 setae. Maxillary segments richly ornamented with spinules, denticles and setules, as figured.

Maxilla and maxilliped (Figs 8C,D; 9B) identical in segmentation and setation to *F. glabra*, except for total, instead of partial, incorporation of proximal endopodal segment of maxilla into basis to form allobasis; allobasis retaining only single seta derived from incorporated endopodal segment.

Swimming legs (Fig. 10) biramous, with 3-segmented rami (although segmentation of exopod of leg 4 not confirmed); leg 1 somewhat reduced in size; intercoxal sclerite of leg 4 narrower than on other legs. Legs richly ornamented with spinules, setules and denticles, as figured. Spine and seta formula (where known) as follows:

	Coxa	Basis	Exopodal segment			Endopodal segment		
			1	2	3	1	2	3
Leg 1	0-1	I-I	I-1; I-1;	III,I,3		0-1; 0-1;	1,2,3	
Leg 2	0-1	1-0	I-1; I-1;	III,I,5		0-1; 0-2;	?	
Leg 3	0-1	1-0	I-1; I-1;	?		0-1; 0-2;	?	
Leg 4	0-1	1-0	I-1; ? ; ?			0-1; 0-2;	?	

Status of fifth legs unconfirmed except for presence of coxae and intercoxal sclerite.

Adult male. Body (not figured) 0.39 mm long, resembling that of female. Urosome 6-segmented, with genital somite symmetrical, typically containing 2 pear-shaped spermatophores; paired gonopores opening ventrolaterally; genital opercula (Fig. 7D) formed by subrectangular flaps densely covered by long spinules, each armed with plumose seta and short spine.

Antennules (not figured) 14-segmented, symmetrical, digeniculate. Fusions representing ancestral segments II to VI, IX to XII, XIX-XX, XXI to XXIII, and XXIV to XXVIII. Segment 8 (corresponding to ancestral segment XV) cup-shaped, forming sheath around proximal half of segment 9 (XVI). Geniculations located between segments 8 and 9, and between 12 (XX) and 13 (XXI). Armature formula unresolved due to poor state of preservation of material available.

Segmentation and setation of other mouthparts and swimming legs 1 to 4 as in female.

Fifth legs (Fig. 7E) partly damaged: biramous, with separate coxa and basis, retaining narrow intercoxal sclerite. Exopod 3-segmented; first segment armed with 1 outer seta; second segment with distal seta on inner margin; third segment with 3 armature elements distally and single seta midway along inner and outer margins. Endopod 1-segmented, bearing 2 setae distally. Posterior surface of segments richly ornamented with long spinules; anterior surface bearing sparse rows of short denticles.

Etymology. The species name is from the Latin '*hispidus*', and refers to the rich armature of long spinules covering the urosomal somites dorsally.

Remarks. The generic placement of *A. hispida* sp. nov. is based on the common possession, with *A. bathylaptevensis* MARTÍNEZ ARBIZU & SEIFRIED 1996, of the following character states: segmentation and armature of the antennule and antenna (including characters such as the relative lengths of the exopodal segments); armature of the maxillule (although the praecoxal arthrite of *A. bathylaptevensis* apparently bears 1 less element); the presence of a single seta on the second endopodal segment of leg 1; and the retention of separate coxa and basis on the female fifth leg.

There are numerous differences between *A. hispida* and *A. bathylaptevensis*. One of the most conspicuous being the ornamentation of the urosomal surfaces, which are densely spinulate in *A. hispida* but smooth in *A. bathylaptevensis*. In several other features, such as the retention of the intercoxal sclerite in the fifth legs, or the apparent presence of a single copulatory pore (although retaining 2 copulatory ducts) *A. hispida* exhibits a different condition from that found in *A. bathylaptevensis*. The mandibular exopod in *A. hispida* displays only 5 setae and a different segmentation pattern from that of *A. bathylaptevensis*. Finally, although the maxillae of both species display complete fusion of the proximal endopodal segment to the basis, they differ in the number of setae on the allobasis derived from the incorporated segment: a single seta in *A. hispida* compared with 2 setae in *A. bathylaptevensis*.

The poor state of preservation of the available *A. hispida* material has prevented a comprehensive evaluation of these apparent differences, and prevented the determination of the state of important characters, such as the armature of the exopod of the fifth legs. Until new material of this taxon becomes available we consider that the material from the Vøring plateau should be tentatively allocated to *Arcticomisophria*.

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