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Plesioscolecithrix (Copepoda, Calanoida, Scolecitrichidae): a new genus, and a new species from the high Antarctic Weddell Sea (Southern Ocean)

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SARSIA

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Both sexes of *Plesioscolecithrix juhlae* gen. et sp. nov. are described from the Weddell Sea shelf, Antarctic, in near-bottom water layers from 167 to 254 m. The new genus has segmentation and setation of the swimming legs P1–P4 typical of the Clausocalanoidea. With the group of clausocalanoidean families Diaixidae Sars, 1902, Parkiidae Ferrari & Markhaseva, 1996, Phaennidae Sars, 1902, Tharybidae Sars, 1902 and Scolecitrichidae Giesbrecht, 1892 it shares the possession of sensory setae both on the maxilla exopod and on the syncoxa of the maxilliped. The genus is hypothesized to be one of the most primitive among the family Scolecitrichidae and deviations from the usual scolecitrichid morphology are discussed. Its family placement is tentative because of many significant morphological deviations from the scolecitrichid type. The main generic characters distinguishing the new genus from other scolecitrichids are as follows: the number (four) and morphology of thin brush-like sensory setae with very small brushes at the exopod of the maxilla; the simple structure of the male fifth legs (with almost symmetrical coxo- and basipods in both legs); well-developed oral parts in males; the absence of the female fifth legs.

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Keywords: Calanoida; Plesioscolecithrix; Weddell Sea; benthopelagic; sensory setae.

INTRODUCTION

Scolecitrichids have been collected from pelagic to benthopelagic waters of the World Ocean. The new genus and species *Plesioscolecithrix juhlae* is described from the Antarctic shelf of the Weddell Sea. It was collected in the vicinity of the sea-bed and should be considered as being benthopelagic. Generally, the benthopelagic fauna is poorly known and needs further study. Many new taxa were found recently during near-bottom sampling in the different regions of the World Ocean (see Bradford-Grieve 2004). However, first data on the benthopelagic fauna of the Antarctic have been obtained relatively recently (Bradford & Wells 1983; Hulsemann 1985; Schulz 1996, 1998, 2002; Ohtsuka & al. 1998; Schulz & Markhaseva 2000) and confirm previous speculations on the high endemicity of this fauna. *Plesioscolecithrix juhlae* sp. nov. adds to our knowledge of the biodiversity of rare benthopelagic Antarctic calanoids that have been registered so far in the near-bottom waters of the Antarctic.

The boundaries of the Scolecitrichidae are not well defined. The most recent publications state that: "the boundaries of the Scolecitrichidae, however, remain an unresolved problem" (Ohtsuka & al. 2003; Boxshall & Halsey 2004). The latter authors include 26 genera in the family. We follow Vyshkvartzeva (2001), who considers that Scolecitrichidae contains 23 genera.

The present species is assigned to a new genus in the Scolecitrichidae, which currently includes: *Amallothrix* Sars, 1925; *Archescolecithrix* Vyshkvartzeva, 1989; *Falsilandrumius* Vyshkvartzeva, 2001; *Grievella* Ferrari & Markhaseva, 2000; *Heteramalla* Sars, 1907; *Landrumius* Park, 1983; *Lophothrix* Giesbrecht, 1895; *Macandrewella* Scott, 1909; *Mixtocalanus* Brodsky, 1950; *Neoscolecithrix* Canu, 1896; *Parascaphocalanus* Brodsky, 1955; *Pseudoamallothrix* Vyshkvartzeva, 2000; *Puchinia* Vyshkvartzeva, 1989; *Racovitzanus* Giesbrecht, 1902; *Scaphocalanus* Sars, 1900; *Scolecithricella* Sars, 1902; *Scolecitrichopsis* Vyshkvartzeva, 2000; *Scolecithrix* Brady, 1883; *Scolecocalanus* Farran, 1936; *Scopalatum* Roe, 1975; *Scottocalanus* Sars, 1905; *Xantharus* Andronov, 1981 and *Undinothrix* Tanaka, 1961.

The genus *Neoscolecithrix* s.l. (*Neoscolecithrix* Canu, 1896 and *Cenognatha* Bradford-Grieve, 2001) is recently placed in Scolecitrichidae (Vyshkvartzeva 2000; Ohtsuka & al. 2003; Boxshall & Halsey 2004).

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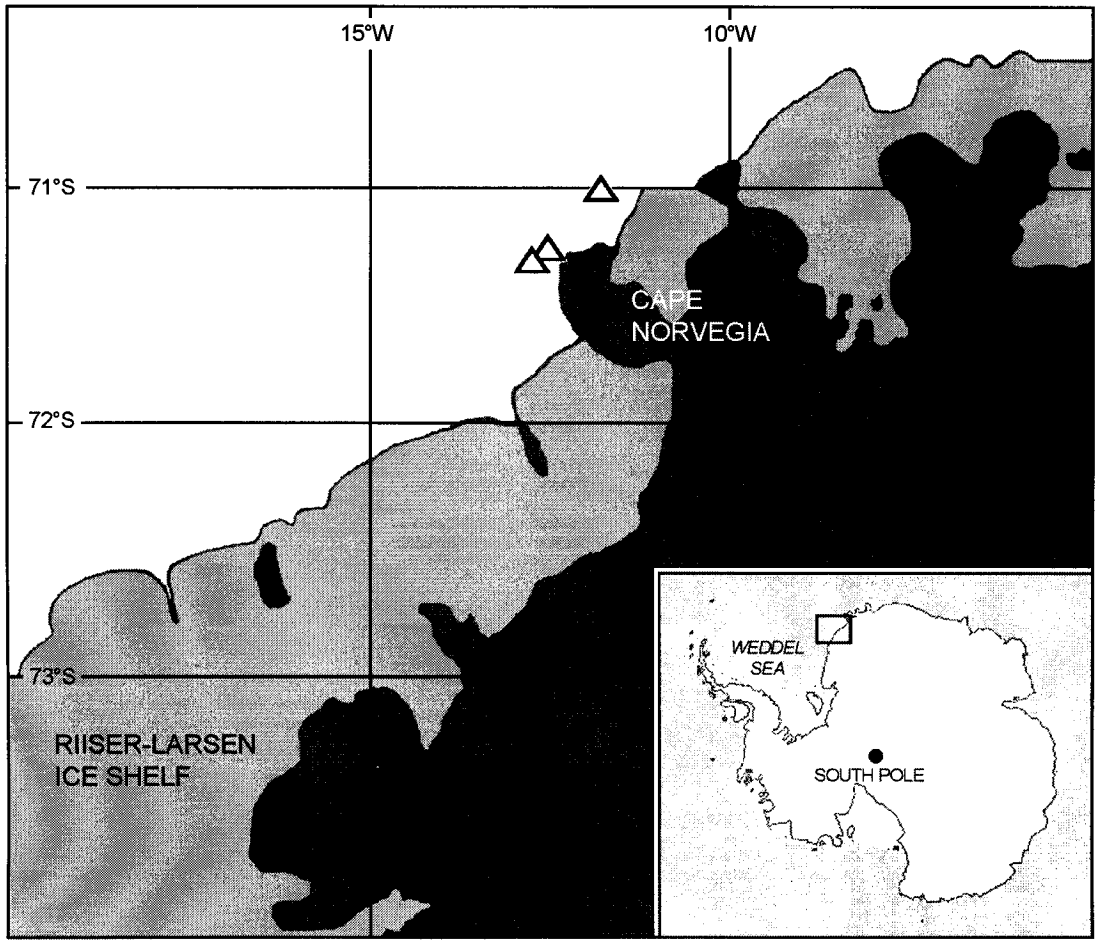


Fig. 1. Localities of specimens of *Plesioscolecithrix juhlae* gen. et sp. nov. collected in the Weddell Sea (marked as triangles) during RV *Polarstern* cruise ANT XIII/3, the first cruise within the Coastal Seas: Ecology of the Antarctic Sea Ice Zone (CS EASIZ) programme.

However, its earliest attribution to Tharybidae (Bradford & al. 1983) was nearly simultaneously suggested by Bradford-Grieve (2001).

MATERIAL AND METHODS

Hyperbenthic (benthopelagic) copepods were collected by an epibenthic sledge (EBS) from the Cape Norvegia area of the high Antarctic Weddell Sea (Southern Ocean) ice shelf at depths of 167–254 m (Fig. 1). Two females and one male scolecitrichid specimens were found in three samples collected at three stations of the RV *Polarstern* cruise ANT XIII/3 (1996) during the first cruise of the CS EASIZ (Coastal Seas: Ecology of the Antarctic Sea Ice Zone) programme. All specimens were fixed in *Ca* 5% neutralized formalin immediately after capture, and then transferred to 70% ethanol. For further study under microscope they were dissected and stained in Chlorazol Black E. All figures were prepared using a camera lucida. Abbreviations for the terms are as follows: Pd1–Pd5, first–fifth pedigerous somites; A1, antennule; A2, antenna; Md, mandible; Mdp, mandibular palp; Mx1, maxillule; Mx2, maxilla; Mxp, maxilliped; P1–P5, swimming legs of first–fifth pair; one seta and one aesthetask on a segment of A1 are designated as 1s + 1ae; "1?" indicates that a setal element was broken so that its identity on A1 could not be determined and only the scar at the location of its attachment was counted. Ramal segments of Mx2 are considered exopodal (Ferrari 1995) and the tip of Mx2

is considered as a complex of exopodal segments plus the sixth enditic lobe on the basis (Ferrari & Markhaseva 1996); Mxp syncoxa is considered having three praecoxal lobes and one coxal lobe (Ferrari & Ambler 1992; Martinez Arbizu 1997; Ferrari & Markhaseva 2000a, b; Ferrari & Ivanenko 2001).

Superfamily Clausocalanoidea Giesbrecht, 1892
Family Scolecitrichidae Sars, 1902
Plesioscolecithrix gen. nov.

Diagnosis

Cephalosome fused with Pd1, Pd4–5 separated. Rostrum present as bifurcate plate, rami tapering into filaments. A1 of 24 articulated segments in female, as well as a left one in male, right one in male 23-segmented. Mx2 exopod with seven sensory setae: three well-developed worm-like and four thin brush-like setae with very small brushes. Mx2 praecoxal endite with five sclerotized setae. Mxp with five setae at syncoxa, two of them sensory: one worm-like and one brush-like with small brush. P1 endopod proximal outer corner with chitinuous loop, distal outer corner produced into a sharp protrusion. P1–P4 without posterior surface spinulation. P1 exopodal segments 1–3 with a lateral spine each. Female P5 absent. Male P5 of primitive structure, with symmetrical coxo- and basipods; exopod three-segmented in both legs; endopods one-segmented, left one longer, reaching at least distal third of exopod 1; right endopod rudimentary, short, bud-like. Oral parts and swimming legs of P1–P4 nearly identical in both sexes and as described for type species. The following combination of apomorphic characters is typical for the genus: P1 endopod proximal outer corner with chitinuous loop and presence of only seven sensory setae at Mx2 exopod.

Etymology

The generic name is a combination of *plesios* (Greek, meaning near to) and the name of the scolecitrichid type genus *Scolecithrix*. Gender feminine.

Type species: *Plesioscolecithrix juhlae* sp. nov., by monotypy.

Plesioscolecithrix juhlae sp. nov. (Figs 2–38)

Holotype: Reg. N. (OL-2003.031). Female, total length 1.74 mm; RV *Polarstern* cruise ANT XIII/3 to the Eastern Weddell Sea, 71°18′S 12°17′W, Stn 39/008, collected by EBS at 167–171 m depth, 9 February 1996. Allotype: Reg. N. (OL-2003.032). Male, total length 1.48 mm; RV *Polarstern* cruise ANT XIII/3 in the Eastern Weddell Sea, 71°26′S 13°42′W, Stn 39/007, collected by EBS at 223–224 m depth, 7 February 1996. Paratype: Reg. N. (OL-2003.033) one female, total length 1.70 mm; RV *Polarstern* cruise ANT XIII/3 in the Eastern Weddell Sea, 71°40′S 12°42′W, Stn 39/005, collected by EBS at 239–254 m depth, 6 February 1996.

All types are deposited at the copepod collection of the AG Zoosystematik und Morphologie at the Carl von Ossietzky Universitaet, Oldenburg, Germany.

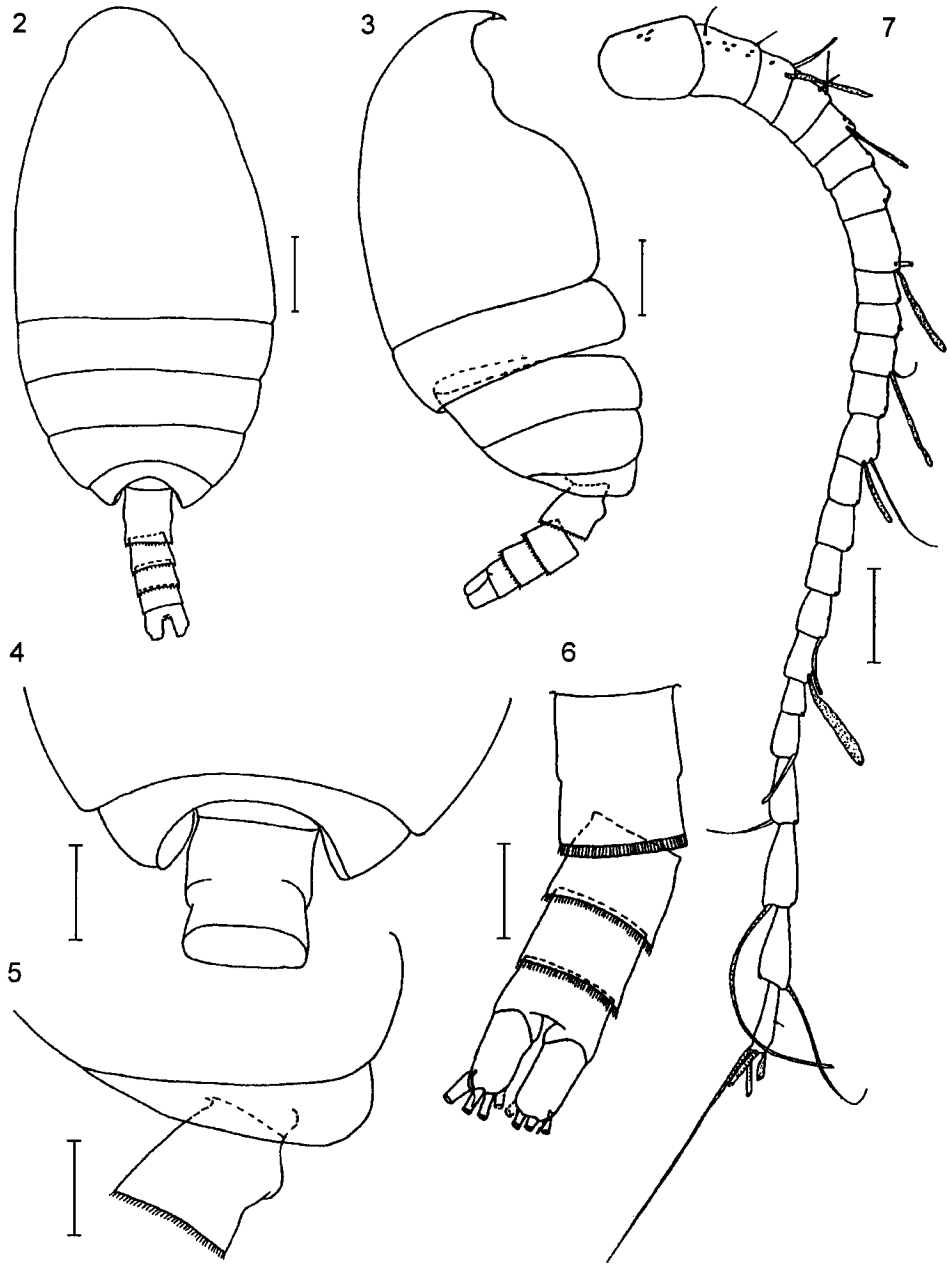
Female

Total length 1.70–1.74 mm. Prosome 3.0–3.5 times as long as urosome. Cephalosome and Pd1 fused, Pd4–5 separate (Figs 2–5). Posterior corners of prosome rounded in lateral view and somewhat triangularly rounded in ventral and dorsal view. Rostrum (Figs 10, 11) a well-developed bifurcated plate, rami closely arranged, tapering into soft filaments. Genital double-somite in dorsal view barrel-shaped, symmetrical (Figs 2, 6); its shape slightly varying in lateral view (Figs 12, 13), supplied with round, black knob, which probably serves in closing the copulatory pore (Figs 13, 14). Genital double-somite and urosomites 2 and 3 with thin denticles along the posterior margins (Fig. 6). Anal somite well developed, slightly shorter than urosomite 3. Caudal rami (Figs 6, 15) symmetrical, with six setae: four long thick distally, one dorsal and one ventral.

A1 of 24 articulated segments, reaching the posterior part of Pd3 (Fig. 7). A1 setal elements are mostly broken off. Therefore, an exact composition of setal elements for every segment cannot be allocated. However, their number according to the places of their attachment from segment 1 to segment 24 are as follows: 3?, 2s + 6?, 1s + 1ae + 1?, 2s, 1ae + 2?, 2?, 3?, 1s + 1ae + 2?, 1?, 1?, 1s + 1ae + 1?, 2?, 1s + 1ae + 1?, 1?, 1?, 1?, 1ae + 1?, 1 ae + 1?, 1?, 1s, 1s + 1?, 1s + 1?, 1s + 1?, 4s + 1ae.

A2 coxa with one seta (Fig. 16), basis with two setae. Exopod indistinctly (the second segment being incompletely divided) seven-segmented, 1.4 times as long as endopod. Exopod segments 1–2 lacking setae, segments 3–6 with one long distal seta each, segment 7 with one medial seta in proximal part and three terminal setae. Endopod segment 1 with one seta, segment 2 with eight outer and six inner setae.

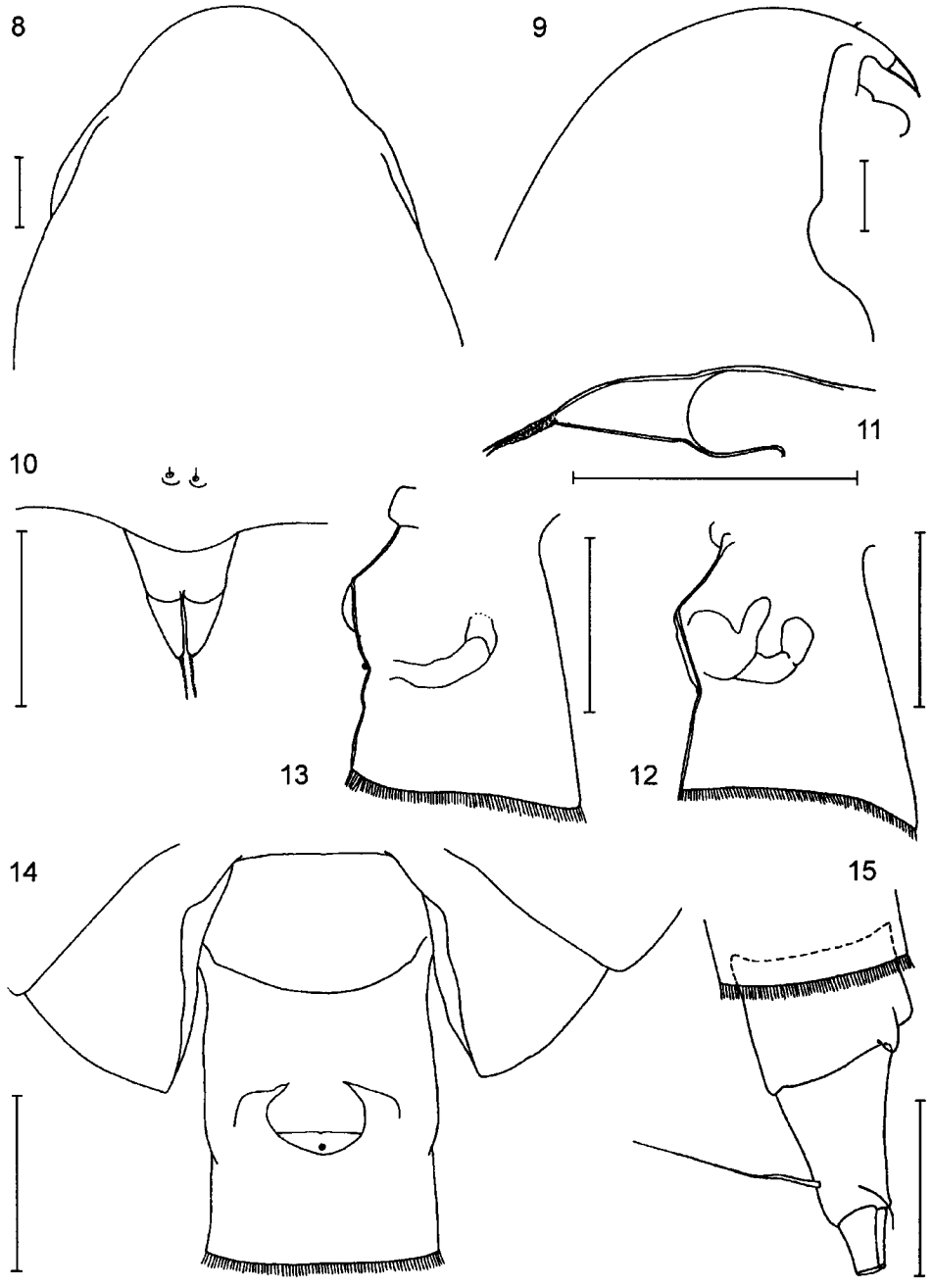
Md basis with three setae (Fig. 17). Endopodal segment 1 with two setae, segment 2 with nine setae. Coxal gnathobase with three deeply incised teeth,



Figs 2–7. *Plesioscolecithrix juhlae* gen. et sp. nov. Female. 2. General view. 3. General right lateral view. 4. Pedigerous somites 4–5 and genital double-somite, dorsal view. 5. Pedigerous somites 4–5 and genital double-somite, right lateral view. 6. Urosome, dorsal view. 7. Antennule. Figure 2 after paratype; Figs 3–7 after holotype. Scale bars: 0.2 mm for Figs 2, 3; 0.1 mm for Figs 4–7.

remaining teeth smaller; one spinulose dorsal seta and four spinules in the middle of the cutting edge.

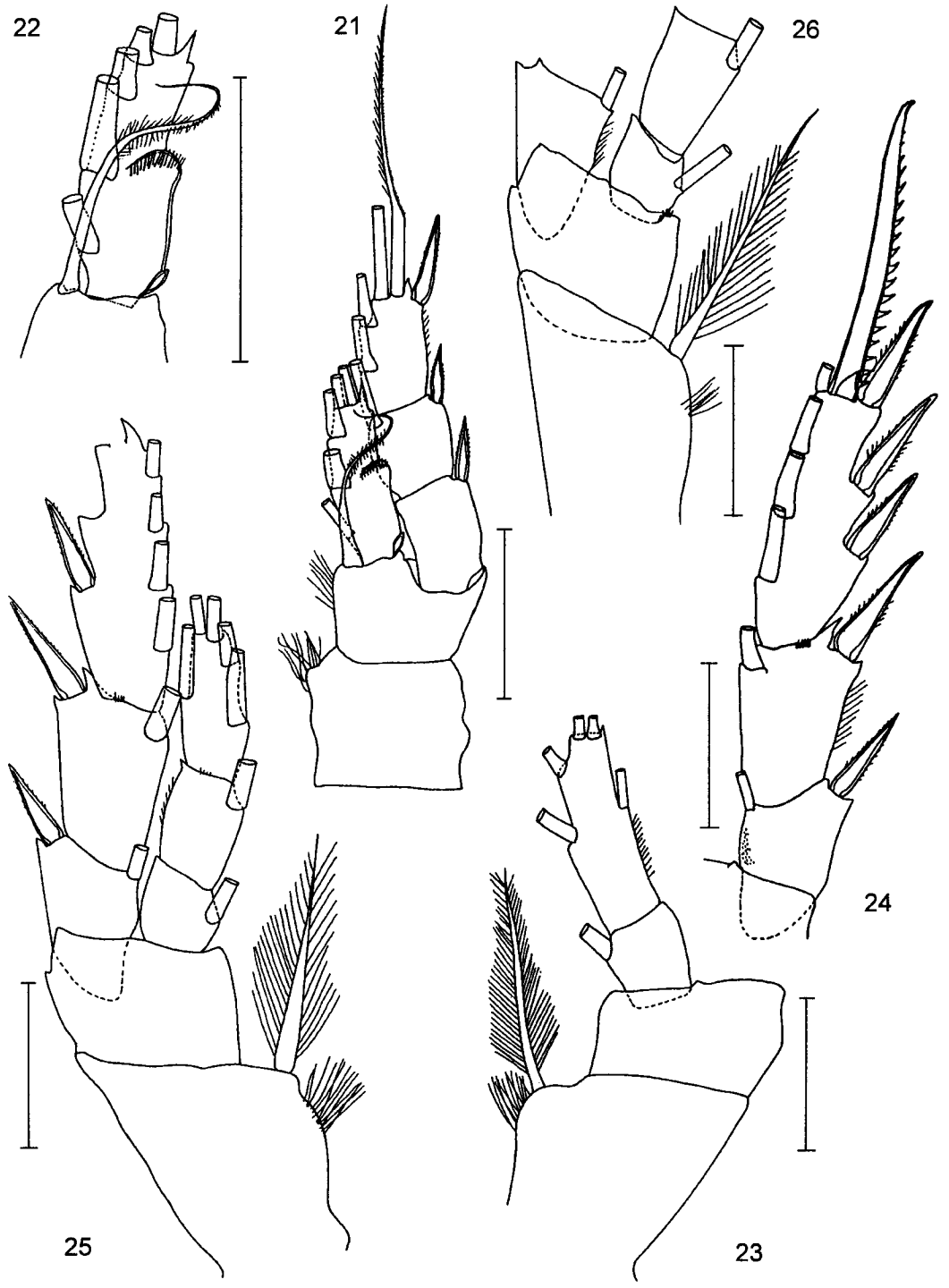
Mx1 praecoxal arthrite (Fig. 18) with nine terminal, four posterior (not figured) and one anterior setae, coxal endite with two setae, proximal and distal basal endites with four setae each, endopod segments fused with seven setae, exopod with six setae, coxal epipodite with seven long and two shorter setae.



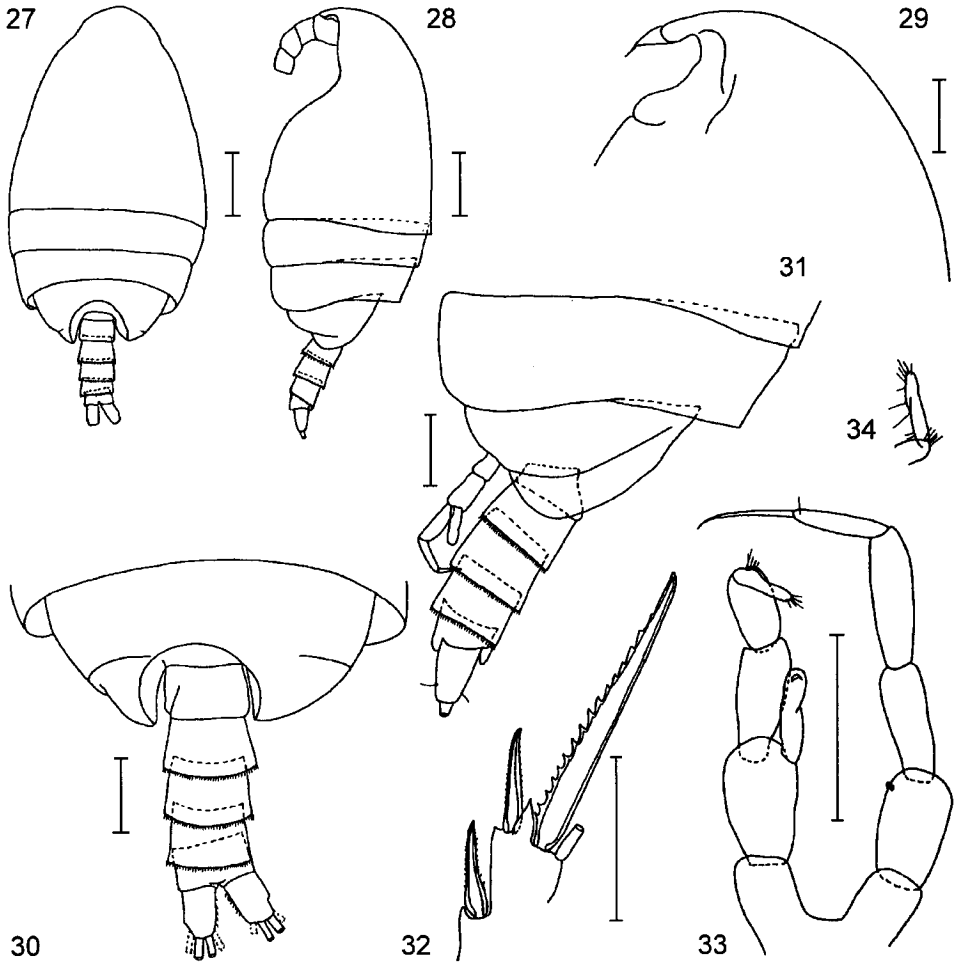
Figs 8–15. *Plesioscolecithrix juhlae* gen. et sp. nov. Female. 8. Cephalosome, dorsal view. 9. Cephalosome, lateral view. 10. R, dorsal view. 11. R, lateral view. 12, 13. Genital double-somite, left lateral view. 14. Pedigerous somite 5 and genital double-somite, ventral view. 15. Anal somite and caudal rami, left lateral view. Figures 8–10, 12 after holotype; Figs 11, 13–15 after paratype. Scale bars: 0.1 mm.

Mx2 (Fig. 19) proximal praecoxal endite with five setae, distal praecoxal endite and both coxal endites with three setae each (on distal coxal endite one seta is transformed into spine), basal endite with the following setal elements: one spine, one seta and two worm-like sensory setae (one sensory seta partly sclerotized).

Figs 16–20. *Plesioscolecithrix juhlae* gen. et sp. nov. Female, holotype. 16. Antenna. 17. Mandible. 18. Maxillule. 19. Maxilla. 20. Maxilliped. Scale bars: 0.1 mm.



Figs 21–26. *Plesioscolecithrix juhlae* gen. et sp. nov. Female. 21. Swimming legs of first pair. 22. Endopod of swimming legs of first pair. 23. Coxopod, basipod and endopod of swimming legs of second pair. 24. Exopod of swimming legs of second pair. 25. Swimming legs of third pair. 26. Coxopod, basipod, exopod segment 1, endopod segments 1–2 of swimming legs of fourth pair. Figures 21, 22 after paratype; Figs 23, 25, 26 after holotype. Scale bars: 0.1 mm.



Figs 27–34. *Plesioscolecithrix juhlae* gen. et sp. nov. Male, paratype. 27. General dorsal view. 28. General left lateral view. 29. Ce, left lateral view. 30. Pedigerous somites 3–5 and urosome, dorsal view. 31. Pedigerous somites 3–5 and urosome, lateral view. 32. Exopod 3, terminal part of the segment. 33. Swimming legs of fifth pair. 34. Exopod segment 3 of left swimming leg of fifth pair. Scale bars: 0.2 mm for Figs 27, 28; 0.1 mm for other figures.

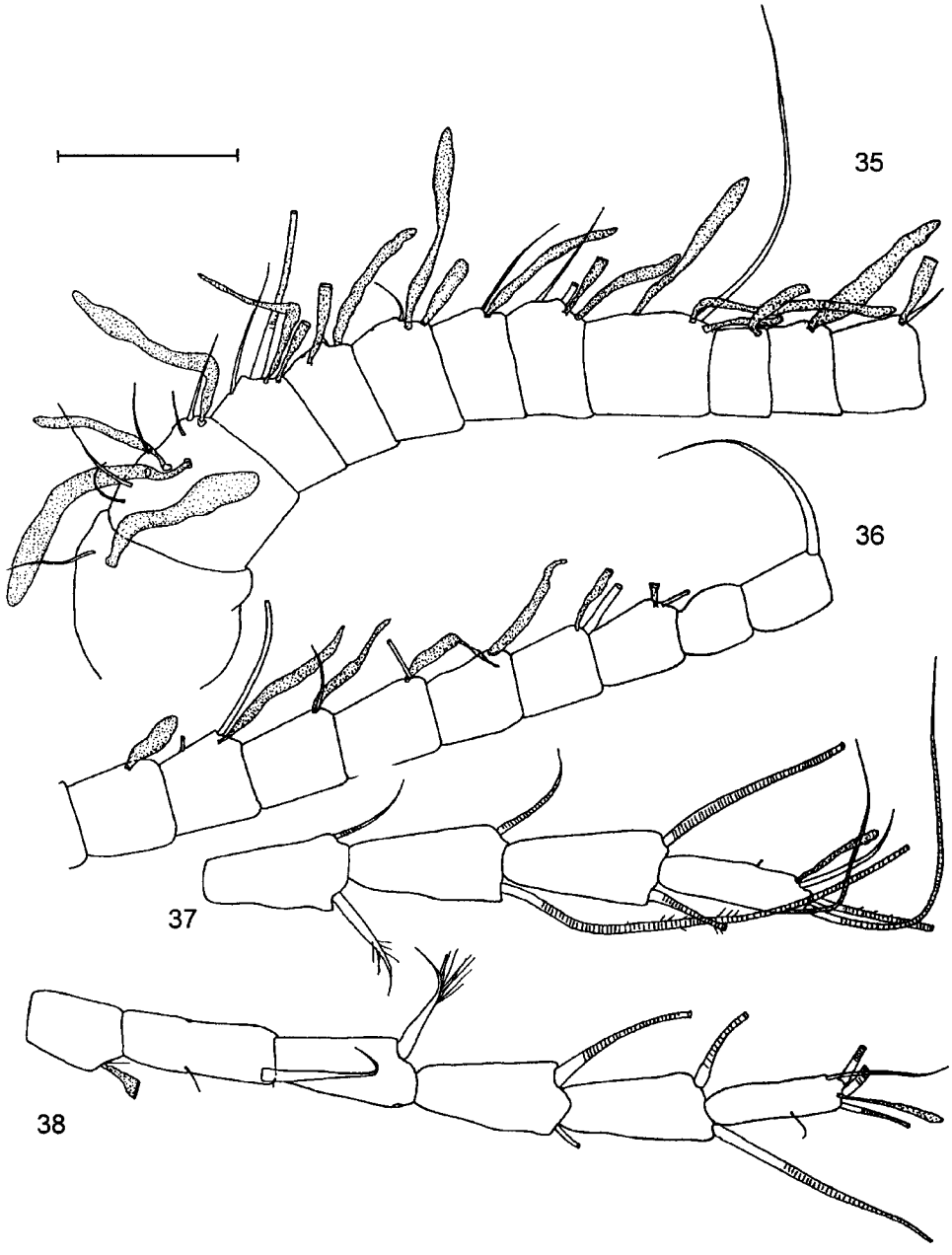
Mx2 exopod with seven sensory setae: three worm-like and four thin brush-like setae (two long and two short), the latter with small brushes.

Praecoxa of Mxp syncoxa (Fig. 20) with one long sclerotized seta on proximal lobe; one short thin sclerotized seta and one worm-like sensory seta on middle lobe, and one sclerotized seta plus one thin brush-like sensory seta with small brush on distal lobe. Coxal lobe of the syncoxa of Mxp with three sclerotized setae and denticles nearby. Mxp basis with three setae in its middle and two setae distally, and spinule field in its proximal part. Mxp endopod of five articulated segments with four, four, three, three + one, and four setae.

P1–P4 segmentation and setation as for the family. P1 (Figs 21, 22) endopod with outer lobe ornamented with spinules, distal lateral corner produced into sharp protrusion, and with chitinuous loop proximally; exopod segments 1–3 with lateral spine, that on segment 3 longest. Segment 2 of P2 endopod, as well as segment 3 of P3 endopod, with outer distal corner produced into triangular protrusion. However, not so well developed as protrusion on P1 endopod segment 1. Terminal spine of P2 with 17 denticles, the one of P3 broken; segments 2–3 of exopod and segment 3 of endopod of P4 broken (Figs 23–26). P5 absent.

Male

Total length 1.48 mm. Prosome 3.1 times as long as urosome. Body shape similar to that of female (Figs 27,



Figs 35–38. *Plesioscolecithrix juhlae* gen. et sp. nov. Male, paratype. 35. Left antennule, articulated segments 1–11. 36. Left antennule, articulated segments 12–20. 37. Left antennule, articulated segments 21–24. 38. Right antennule, articulated segments 18–23. Scale bars: 0.1 mm.

28), but posterior part of prosome more ovoid. Pd4–5 incompletely separated (Figs 30, 31). Rostrum as in female. Left A1 of 24 articulated segments, right A1 of 23 segments (segments 19–20 fused), reaching Pd5. Setation of left A1 (Figs 35–37) from segment 1 to segment 24 as follows: 1s + 1ae, 6s + 4ae, 2s + 2ae, 2? + 2ae, 2? + 2ae, 1s + 1ae, 2s + 2ae, 1s + 3ae, 1ae, 1ae, 2? + 1ae, 1ae, 2s + 1ae, 1s + 1ae, 1s + 1ae, 1ae, 1s + 1ae, 1s + 1ae, 0, 1s, 2s, 2s, 2s, 5s + 1ae. Right A1 (Fig. 38) differs from left A1 in: segment 1 with

1ae + 2?, segment 5 with 1s + 2ae, segment 8 with 3ae + 2?, segment 17 with 1ae + 2?, segments 19–20 fused with 2s + 1? Oral parts well developed, as in female, with the following minor deviations in setation: Mx1 coxal epipodite with seven long plus two short setae (apparently in female two short setae broken); Mxp endopod segment 3 with four setae. P1–P4 more or less identical to those in female, except terminal spine of P2 exopod segment 3 with 13 denticles, that of P3 with 16 denticles. P5 biramous (Figs 33, 34), of simple structure: coxo- and basipods almost symmetrically developed, exopod three-segmented, with segments of nearly cylindrical shape. Left leg exopod segment 2 with hairs distally and segment 3 with rare hairs along medial margin and distally. Right exopod segment 3 with spine as long as the segment itself. Both endopods one-segmented. Left endopod reaching distal third of exopod segment 1, right endopod rudimentary as a small bud.

Etymology

The species name is dedicated to Dr Hilde Juhl who takes care of the MONOCULUS library at the Universitaet Oldenburg. She is the cheerful helping hand behind so many copepod students' activities both domestic and abroad.

DISCUSSION

Plesioscolecithrix juhlae gen. et sp. nov. exhibits a combination of primitive and derived scolecitrichid characters. It is suggested that this is one of the most primitive genera among the family Scolecitrichidae, due to a combination of the following plesiomorphies:

(1) Pedigerous somites 4 and 5 are separated completely (female) or incompletely (males). In the major part of Scolecitrichidae they are fused. However, in the type species of the family *Scolecithrix danae* they are separated (Park 1983; Bradford & al. 1983).
(2) Male oral parts are not reduced in comparison with those of the female, and in this respect are like the Tharybidae. Oral parts of scolecitrichid males are usually reduced.
(3) Mx2 proximal praecoxal endite with five setae. A new species shares this number with *Xantharus renatehaassae* Schulz, 1998, *Grievella shanki* Ferrari & Markhaseva, 2000, *Falsilandrumius bogorovi* Vyshkvartzeva, 2001 and *Landrumius antarcticus* Park, 1983; the remaining scolecitrichids typically have three (sometimes four) setae.
(4) Mx2 brush-like sensory setae are small and thin, with four very small brushes, that could be considered as an intermediate stage in the transformation from worm-like to brush-like setae (Nishida & Ohtsuka 1997).
(5) Male P5 of simple structure; P5 coxo- and basipods are nearly symmetrical. In the majority of scolecitrichids, the basis of the right leg is strongly swollen and much shorter than that of the left, which is narrow and elongate. The most primitive scolecitrichid P5 is described for *Xantharus formosus* Andronov, 1981 as biramous with three-segmented exopods, one-segmented endopods and nearly symmetrical coxo- and basipods (Andronov 1981).

Apomorphies for *Plesioscolecithrix juhlae* sp. nov. are:

(1) Absence of P5 in the female. This is atypical for the Scolecitrichidae, but reported for species of the following scolecitrichid genera: *Scaphocalanus* (Park 1982), *Scolecithrix* (Park 1983; Bradford & al. 1983), and a few species of *Macandrewella*.
(2) Presence of only seven sensory setae on Mx2 exopod. Plesiomorphic for Scolecitrichidae is apparently nine setae (Ferrari & Markhaseva 2000a, b; Vyshkvartzeva 2001; Ohtsuka & al. 2003).
(3) P1 endopod proximal outer corner with a chitinuous loop, which is a thickening of the cuticle.
(4) P1 endopod, P2 second endopod segment and P3 third endopod segment outer distal corners are produced into sharp protrusions identical in shape and development to that of *Scolecithrix* spp. (Park 1983; Bradford & al. 1983).
(5) Presence of two setae on the distal praecoxal lobe of Mxp syncoxa. The plesiomorphic state for scolecitrichids is three setae, observed for *Xantharus renatehaassae*, *Grievella shanki*, *Falsilandrumius bogorovi* and *Landrumius antarcticus* (Ferrari & Markhaseva 2000b).

This new genus shows similarities with *Xantharus*: short antennules in both sexes; oral parts not reduced in the male; at least three deeply incised teeth of gnathobase of mandible; male biramous P5 of simple structure. It differs in the number and composition of sensory setae, which is three worm-like and four brush-like (three worm-like, five brush-like and one sclerotized in *Xantharus renatehaassae*), the presence of two setae on the distal praecoxal lobe of Mxp syncoxa (three setae in *Xantharus renatehaassae*), the absence of P5 in the female (present in *Xantharus*).

The new genus shares the possession of sensory setae both on the Mx2 exopod and the syncoxa of the Mxp with a group of clausocalanoidean families Diaixidae,

Parkiidae, Phaennidae, Tharybidae and Scolecitrichidae. The number and composition of sensory setae on the Mx2 and Mxp remain as the key characters for the definition of these families. The number of sensory setae on the Mx2 exopod of the new species (three worm-like and four brush-like) does not fit the diagnosis of any family of this group. The typical condition for the Scolecitrichidae is the presence of three worm-like and five brush-like sensory setae (Bradford 1973; Bradford & al. 1983; Vyshkvartzeva 2001). Nevertheless, there are deviations from the above-mentioned typical number and typical composition of the sensory setae on the Mx2 exopod in scolecitrichids. Among these deviating species are *Racovitzanus antarcticus* Giesbrecht, 1902, which differs in the composition of sensory setae (four worm-like and four brush-like), as redescribed by Park (1983), or in both, the composition and reduced number of sensory setae as in *R. levis* Tanaka, 1961 (four worm-like and three brush-like). Another example of deviations from the typical armament of the Mx2 exopod, which is eight setae (three worm-like plus five brush-like), are scolecitrichids with a higher number of nine setae than diagnosed for the family. Such examples are represented by *Xantharus renatehaassae* Schulz, 1998, which differs in the number of sensory setae (nine setae in total, composed of three worm-like, five brush-like plus one small slender seta), or by species differing both in number and composition of these setae. Among the latter are *Grievella shanki* Ferrari & Markhaseva, 2000, *Falsilandrumius bogorovi* Vyshkvartzeva, 2001 and *Landrumius antarcticus* Park, 1983, which have the Mx2 exopod with three worm-like and six brush-like setae.

The examples given above show the uncertain situation with the observed number and composition of sensory setae on the Mx2 exopod in scolecitrichids, a character which has been considered as the key character for the diagnosis of Scolecitrichidae. Many scolecitrichid species await redescriptions and the family diagnosis is expected to be amended. However, the new genus fits the existing diagnosis of the family (Bradford 1973; Bradford & al. 1983; Bradford-Grieve & al. 1999; Vyshkvartzeva 2001) and is tentatively placed into the Scolecitrichidae.

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