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Two new species of *Oncaea* (Copepoda: Poecilostomatoida) from the Red Sea and a redescription of *O. atlantica* Shmeleva

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Abstract. Two new species of planktonic copepods are described: *Oncaea rufa* and *O. platysetosa*. The former is characterised by the long setae of the fifth leg, the latter by the numerous modified setae on the appendages and caudal rami. *Oncaea atlantica* which is closely related to *O. platysetosa*, is redescribed from new material, also collected in the central and northern Red Sea.

Introduction

Small copepods of the genus *Oncaea* Philippi are common members of oceanic plankton communities from surface waters to depths exceeding 5000 m and from polar to tropical latitudes. The genus comprises 68 known species, more than two-thirds of which have been described since 1965 (see review in Malt, 1983). Most *Oncaea* species are <0.5 mm in body length (Krišnić and Malt, 1985) and, as many oceanic regions have yet to be sampled with fine mesh nets, their distributions are poorly known.

During cruise 29 of the RV *Valdivia* in the Red Sea opening and closing nets with a mesh of 0.1 mm were fished and many small oncaeids were caught (Böttger, 1985). Two new species are described, based on females caught in the vicinity of the Atlantis II Deep. Also *O. atlantica* Shmeleva is redescribed from material caught in the same area as it has been inadequately described and is closely related to one of the new species.

Description of species

Oncaea rufa n.sp.

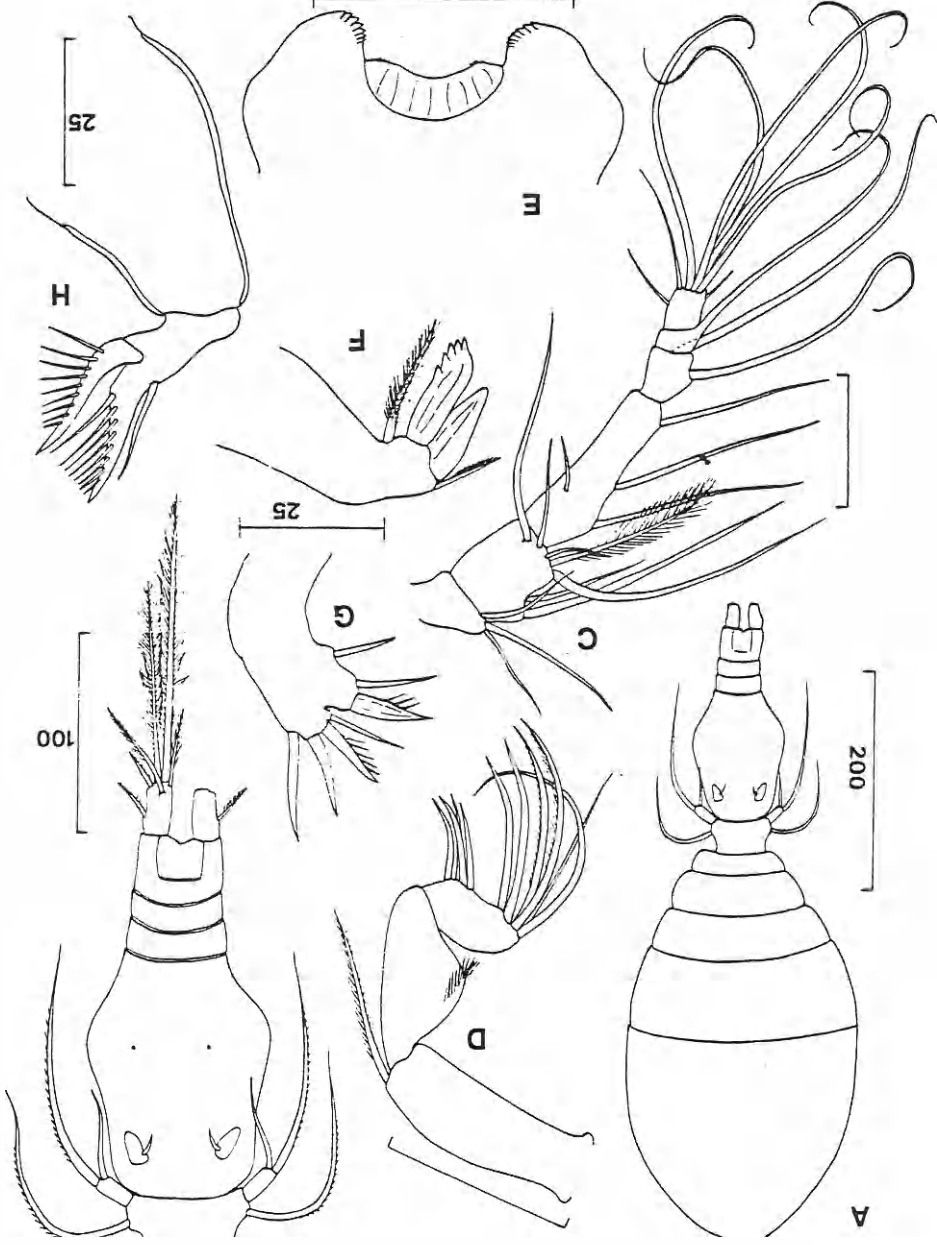
Adult female holotype body length 0.60 mm, paratype length 0.62 mm, other paratype damaged. Body (Figure 1A) comprising 5-segmented prosome and 5-segmented urosome; ratio of prosome to urosome length 1.7:1.0. Proportional lengths of the urosome somites (Figure 1B) and caudal rami 14:50:7:7:13:10. Genital complex 1.3 times longer than wide, with maximum width just posterior to the mid-level; lateral margin of genital complex sinuous anterior to level of maximum width, tapering posteriorly. Genital apertures located either side of midline, on dorsal surface in anterior third of complex. Dorsal surface of genital complex with a pair of integumental pores about at the level of maximum width. Caudal rami (Figure 1B) – 1.8 times longer than wide; armed with a lateral seta situated in proximal half of lateral margin, a long dorsal seta and four distal margin plumose setae of varying lengths.

Antennule (Figure 1C) 6-segmented, relative lengths of segments measured along posterior non-setiferous margin 9:22:42:11:5:11; armature elements I–3, II–7, III–4, IV–2, V–1, VI–8. Antenna (Figure 1D) 3-segmented with long first segment bear-

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ing single plumose seta at inner distal angle, second segment subtriangular with a patch of setules on outer margin, third segment shorter than second, bearing a proximal group of four and a distal group of six setae on the inner margin. Labrum (Figure 1E) bilob-

Fig. 1. *Oncaea rufa* n.sp., female. A, holotype, dorsal; B, paratype urosome, dorsal; C, antennule, anterodorsal; D, antenna, anterior; E, labrum, ventral; F, mandible, anterior; G, maxillule, anterior; H, maxilla, anterior. Scale bars 50 μ m unless otherwise indicated.



ed, with serrated margin on lobes either side of medial incision and a striated membrane lining the incision. Mandible (Figure 1F) unsegmented, bearing four distal elements, two setae and two blades, one of which is toothed. Maxillule (Figure 1G)

Fig. 2. *Oncaea rufa* n.sp., paratype female. A, maxilliped, anterior; B, leg 1, anterior; C, leg 2, anterior; D, leg 3, anterior; E, leg 4, anterior. All scale bars 50 μ m.

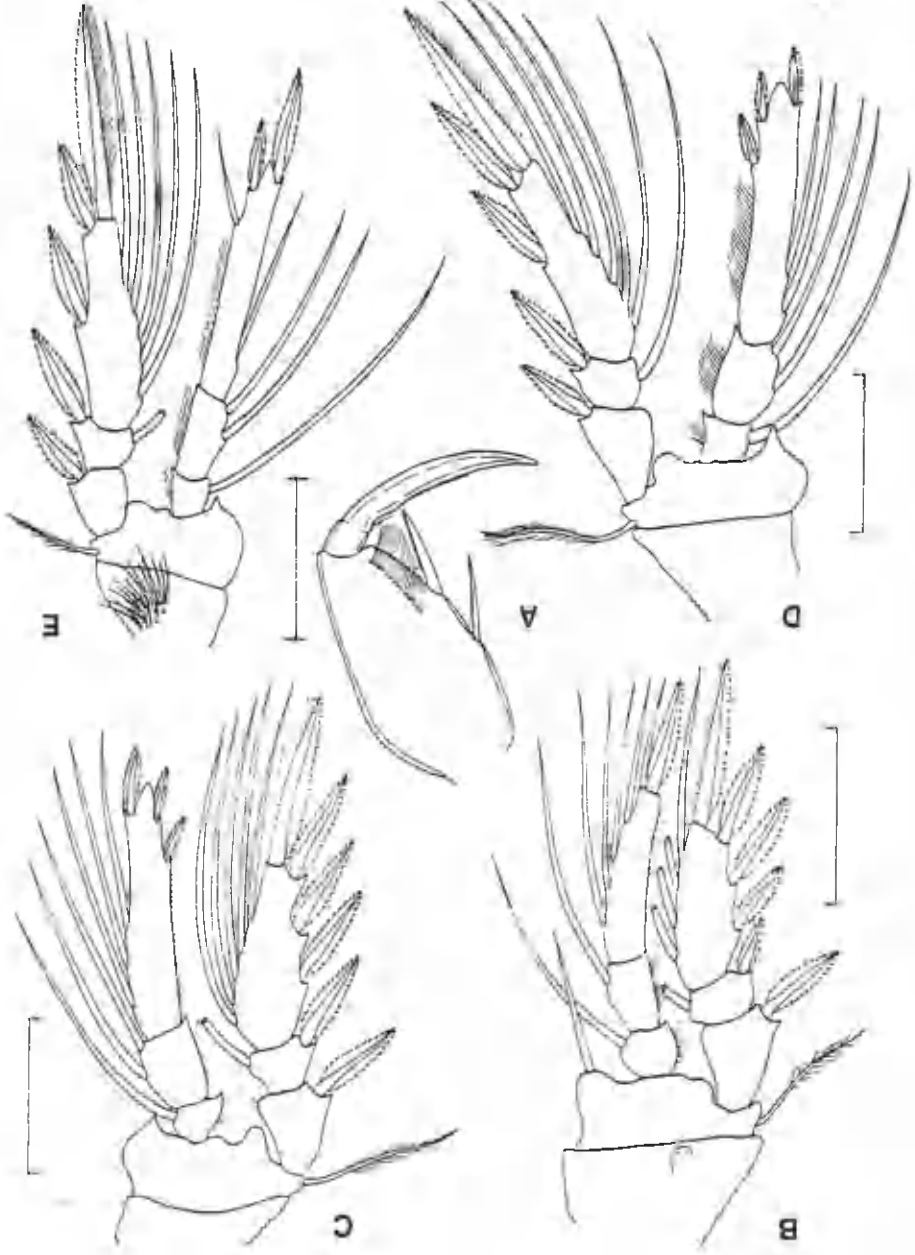


Table I.

	Coxa	Basis	Endopod	Exopod
Leg 1	0-0	1-1	0-1; 0-1; 0. I, 5	1-0; 1-1; III. 1. 4
Leg 2	0-0	1-0	0-1; 0-2; I, II, 3	1-0; 1-1; III. 1. 5
Leg 3	0-0	1-0	0-1; 0-2; I, II, 2	1-0; 1-1; II. 1. 5
Leg 4	0-0	1-0	0-1; 0-2; I, II, 1	1-0; 1-1; II. 1. 5

reduced to a bilobed process bearing three elements on inner lobe and four on outer. Maxilla (Figure 1H) 2-segmented, basal segment unarmed, second segment produced into an apical process armed with long spinules unilaterally and bearing a slender seta and a stout spinulate seta. Maxilliped (Figure 2A) 4-segmented, robust second segment armed with two inner margin setae which are equal in length. The slender proximal seta bears a single row of fine spinules, as does the stout distal seta. A fringe of long pinnules lies between the distal seta and the terminal claw. Third segment small, unarmed. Terminal claw stout, armed with a basal spinule and a row of fine spinules along the proximal part of the concave margin.

Swimming legs 1-4 biramous (Figures 2B-E), with 3-segmented rami: armature as shown in Table I.

Coxa of first leg with swelling on anterior surface. coxa of fourth leg with patch of long setules on anterior surface. Lateral margins of all endopod segments armed with rows of pinnules. Terminal spines on exopods approximately equal to third exopod segment in length. Endopods of legs 2-4 each with a conical process at its apex, between the serrated apical spines. Fifth leg (Figure 1B) comprising a long seta on body surface and a cylindrical segment ~2.5 times longer than wide; bearing a short apical seta and a long apical seta which extends back as far as the posterior margin of the genital complex. Both the seta on the somite and the long seta on the segment are curved and armed with outer margin spinules. Leg 6 represented by the operculum closing off each genital aperture; armed with a single short spine.

Material examined

Three females were taken in a multiple opening and closing net fished at depths of 250-300 m and 300-350 m at 21°22'50"N 38°05'39"E in the Central Red Sea during cruise 29 of the RV *Valdivia*. At this station (172) the temperature at 250-300 m was 21.7°C, the salinity 40.5‰, and the oxygen concentration <1 ml O₂ l⁻¹. The material was fixed in 4% formaldehyde-seawater solution, buffered with hexamethylene tetramine, dissected and examined in lactophenol. All drawings were made with the aid of a camera lucida. The holotype female and one paratype are stored in the British Museum (Natural History), registration numbers 1985.465 and 466 respectively.

Remarks

The new species is similar to *O. dentipes* Giesbrecht, *O. minuta* Giesbrecht and *O. similis* Sars in size, in the armature formula of the swimming legs, in the proportional lengths of the urosome somites and caudal rami, and in the possession of conical projections on the tips of the endopods of legs 2-4 (Giesbrecht, 1892; Sars, 1918). It can be readily distinguished from these and all other known *Oncaea* species by the

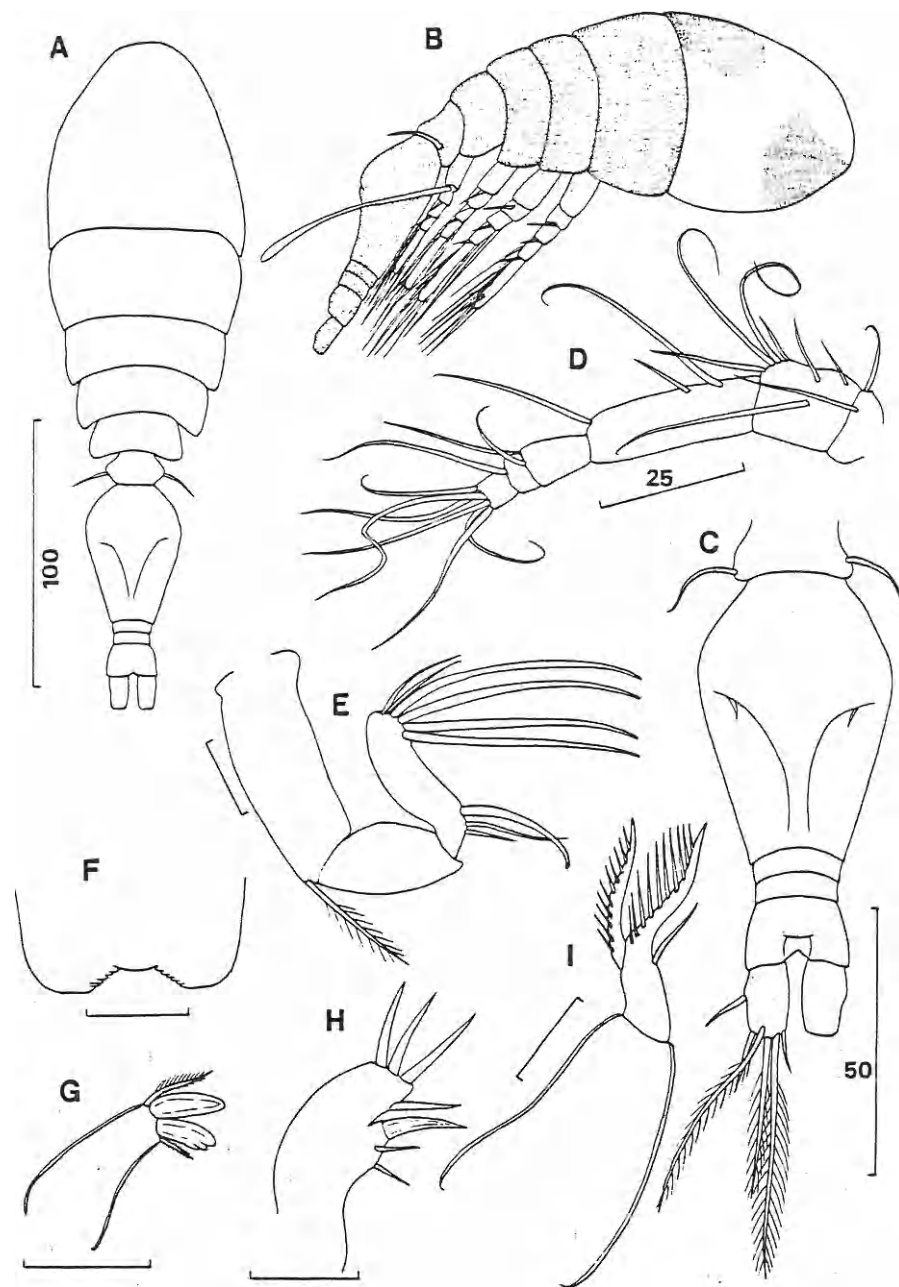
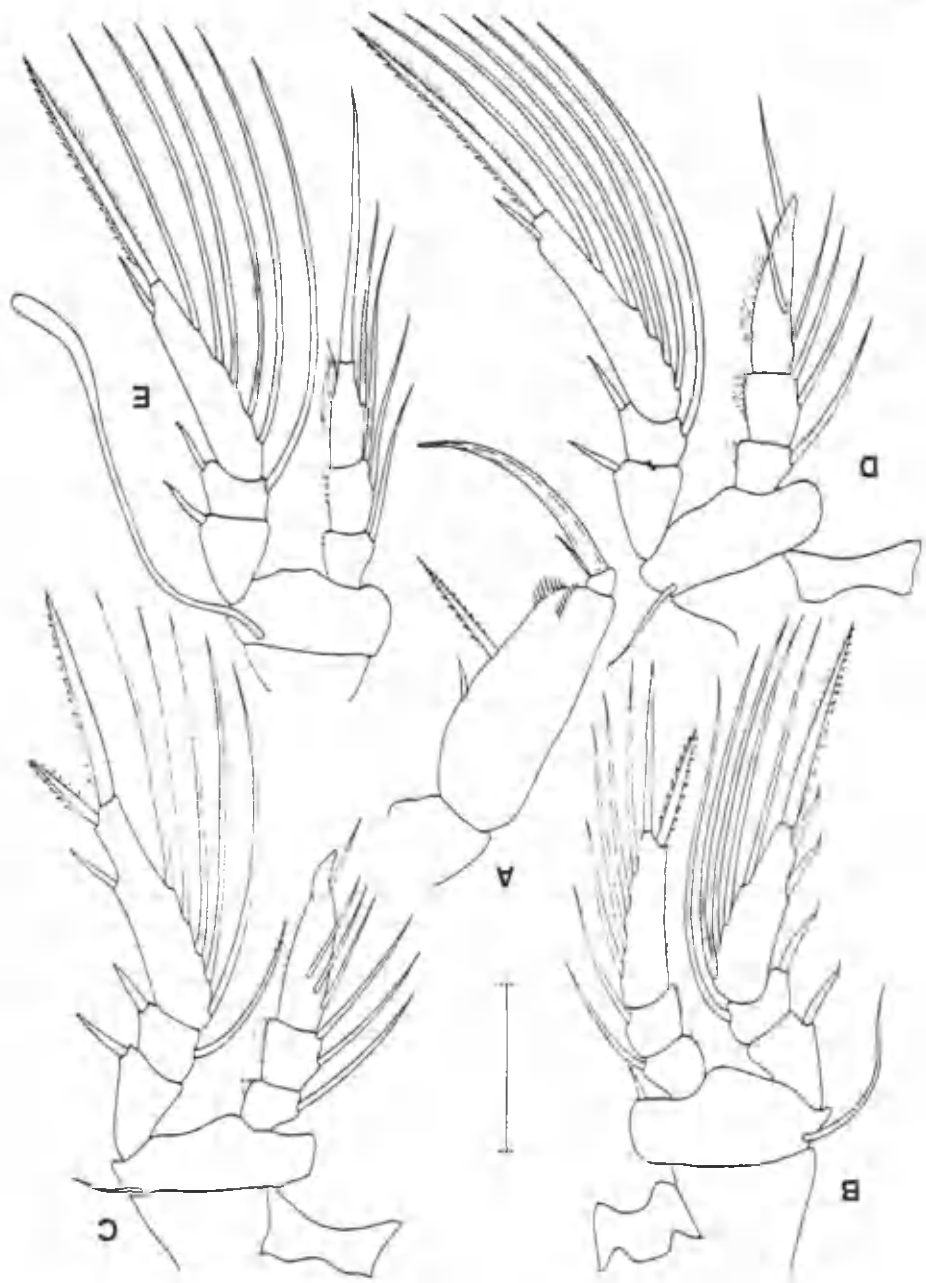


Fig. 3. *Oncaea atlantica* Shmeleva, female. A, dorsal; B, lateral view with orange-red pigmented areas indicated by stippling; C, urosome, dorsal; D, antennule, anteroventral; E, antenna, anterior; F, labrum, ventral; G, mandible, anterior; H, maxillule, anterior; I, maxilla, anterior. Scale bars 10 µm unless otherwise indicated.

configuration of the fifth leg, by the extreme anterior location of the female genital apertures, and by the shape of the genital complex. The new species is unique in having a seta on the fifth leg long enough to reach the posterior margin of the genital com-

Fig. 4. *Oncaea atlantica* Shmeleva, female. A, maxilliped, anterior; B, leg 1, anterior; C, leg 2, anterior; D, leg 3, anterior; E, leg 4, anterior. All scale bars 25 μ m.

O. rufa occurred in the central Red Sea in small numbers at depths in excess of 200 m. plankton samples. This character enables the species to be identified without dissection whilst sorting



The species was also found in slightly higher numbers at similar depths in the northern Red Sea, above the Kebir Deep (24°44'N 36°15'E).

Oncaea atlantica Shmeleva, 1967

Adult female (Figure 3A) body length 0.25 mm; comprising 5-segmented prosome and 5-segmented urosome; ratio of prosome to urosome length 1.4:1.0. Entire body surface pitted, including caudal rami. Proportional lengths of urosome somites (Figure 3C) and caudal rami 14:52:4:4:12:14. Genital complex 1.4 times longer than wide, with maximum width anterior to the midlevel; lateral margins tapering posteriorly from widest point. Genital apertures located either side of midline on dorsal surface of complex, about at midlevel. Genital complex concave posterolaterally on both sides, with raised central and anterior parts. Caudal rami (Figure 3C) ~ 1.6 times longer than wide; armed with a lateral seta situated in proximal half of margin, a long dorsal seta and four distal setae of varying lengths.

Antennule (Figure 3D) 6-segmented, relative lengths of segments measured along posterior non-setiferous margin 7:21:44:15:5:8; armature elements I-2, II-7, III-3, IV-2, V-1, VI-6. Antenna (Figure 3E) 3-segmented with long first segment bearing single plumose seta at inner distal angle, second segment subtriangular, shorter than third; third segment armed with a proximal group of one stout and two slender setae, and a distal group of two slender and four long, stout setae on the inner margin. Labrum (Figure 3F) bilobed, with serrated margin on lobes either side of medial incision. Mandible (Figure 3G) unsegmented, bearing two setae and two blades distally, one of which is toothed. Maxillule (Figure 3H) reduced to a bilobed process bearing three elements on inner and four on outer lobe. Maxilla (Figure 3I) 2-segmented; basal segment unarmed, second segment produced into an apical process armed with long spinules unilaterally, and bearing a slender seta and a stout spinulate seta. Maxilliped (Figure 4A) 4-segmented, robust second segment armed with a short proximal seta, a long serrate distal seta and a distal row of spinules on its inner margin. Third segment unarmed; fourth forming a long terminal claw armed with a basal spinule. Swimming legs 1-4 biramous (Figures 4B-E), with 3-segmented rami: armed as far as tip of caudal ramus when viewed laterally (Figure 3B). Terminal exopod spine on legs 1 and 2 about as long as third segment, that on legs 3 and 4 markedly longer than segment. Endopod of legs 2 and 3 with modified apex to third segment consisting of an offset apical lobe and a subapical seta. Fifth swimming leg represented by a single seta on the surface of the somite (Figure 3C). Leg 6 represented by the operculum closing off the female genital openings, armed with a short spine (Figure 3C).

	Coxa	Basis	Endopod	Exopod
Leg 1	0-0	1-1	0-1; 0-1; 1.5	1-0; 1-1; II, 1, 4
Leg 2	0-0	1-0	0-1; 0-2; 1.3	1-0; 1-1; II, 1, 5
Leg 3	0-0	1-0	0-1; 0-2; 1.2	1-0; 1-1; I, 1, 5
Leg 4	0-0	1-0	0-1; 0-2, 1, 1	1-0; 1-1; I, 1, 5

Table II.

Material examined

Four females were caught in an opening and closing net fished at depths of 50–100 m at 21°26.11'N 38°04.27'E in the Central Red Sea during cruise 29 of the RV *Valdivia*. At this station (177) the temperature at 50–100 m was ~24–25°C and the salinity 40‰. The material is stored in the BM(NH), Registration numbers 1985.467–470.

Remarks

O. atlantica was described from four females and a male collected in the southwestern Atlantic (15°S 26–28°W) at a depth of 100–200 m (Shmeleva, 1967). This is the only published record of this species and the mouthparts were not described for either sex. As noted by Shmeleva (1967) most parts of the body are a bright orange colour, as indicated by the stippled areas on Figure 3B. The new material conforms to the original description of the female in general size and shape, in the spine and seta formula of the swimming legs, in the reduction of leg 5 to a single seta, and in the basic arrangement of the spines and setae on the antennae and maxillipeds. There are minor differences (e.g. extra small setae on the antennae compared with Shmeleva's description) but these are attributed to difficulties in dissecting and observing these minute copepods.

One specimen carried an egg sac on the right side of the genital complex; it contained a single large egg, ~40 µm in diameter, which was lost during handling. In the vicinity of Atlantis II Deep *O. atlantica* was found regularly in small numbers from the surface to ~100 m. A few specimens were caught in the northern Red Sea, above Kebnt Deep.

O. platysetosa n.sp.

Holotype adult female (Figure 5A) body length 0.25 mm; body lengths of two paratypes 0.24 and 0.25 mm. Body comprising 5-segmented prosome and 5-segmented urosome; ratio of prosome to urosome length 1.4:1.0. Entire body surface pitted, including the caudal rami and labrum. Proportional lengths of urosome somites (Figure 5C) and caudal rami 11:50:6:6:13:13. Genital complex 1.4 times longer than wide, with maximum width about at midlevel; lateral margins convex anterior to shoulders, concave posteriorly. Genital apertures located either side of midline, just posterior to level of shoulders. Caudal rami (Figure 5C) ~1.7 times longer than wide; armed with a short lateral seta situated about midway along margin and a short outer distal angle seta; dorsal seta, inner distal angle seta and both posterior setae flattened and oar-shaped, with red coloration when caught.

Antennule (Figure 5D) 6-segmented, relative lengths of segments measured along posterior non-setiferous margin 5:19:36:19:8:13; armature elements I–3, II–6, III–3, IV–2, V–1, VI–6; one seta on segment I, two on segment II and one on segment IV were flattened and aesthetasc-like. Antenna (Figure 5E) 3-segmented; first segment with plumose seta at inner distal angle; second unarmed, shorter than third; third with proximal group of one stout and two slender seta, distal group of one slender and four stout setae on the inner margin. Labrum (Figure 5F) bilobed, with pitted surface. Mandible (Figure 5G) unsegmented, bearing two setae and two blades distally. Maxillule (Figure 5H) reduced to a bilobed process bearing three elements on inner and four on outer lobe. Maxilla (Figure 5I) 2-segmented; second segment produced into an apical

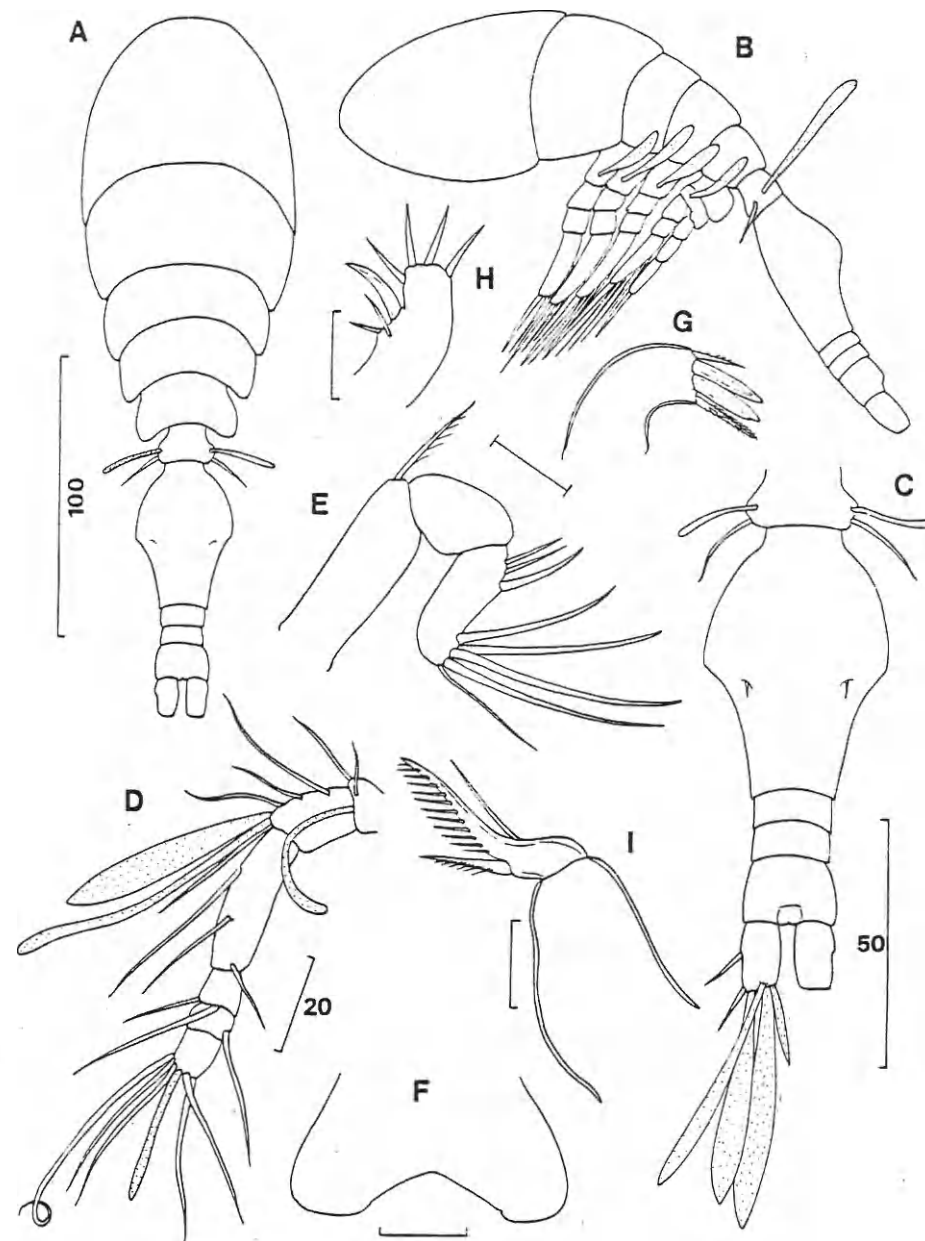
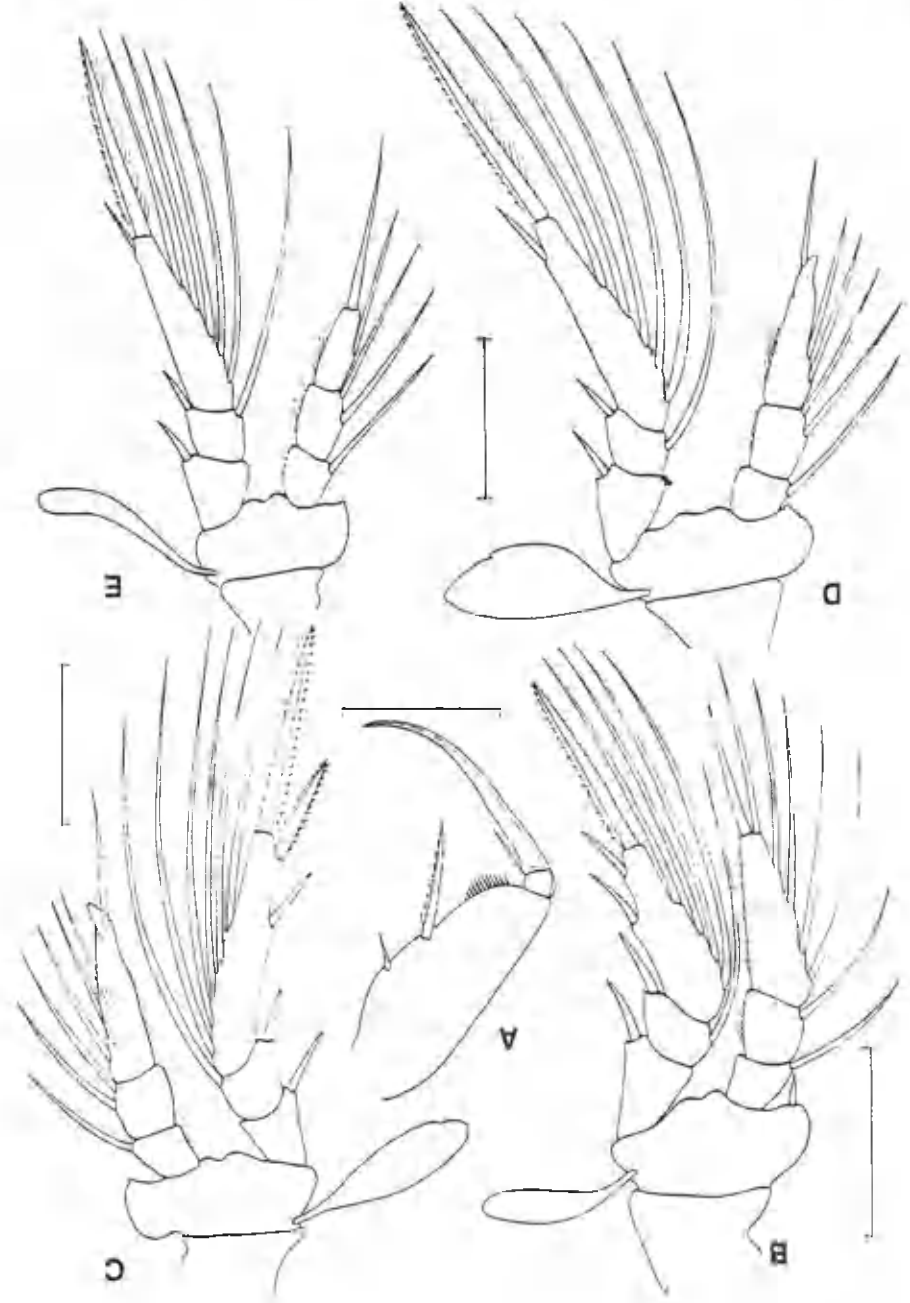


Fig. 5. *Oncaea platysetosa* holotype female. A, dorsal; B, lateral view showing orientation of modified setae; C, urosome, dorsal; D, antennule, anteroventral; E, antenna, anterior; F, labrum, ventral; G, mandible, anterior; H, maxillule, anterior; I, maxilla, anterior. Scale bars 10 µm unless otherwise stated.

process armed with long spinules unilaterally, and bearing a slender seta and a stout spinulate seta. Maxilliped (Figure 6A) 4-segmented, robust second segment armed with a short proximal seta, a long serrate seta and a row of pinnules on its inner margin.

Fig. 6. *Oncaea pluviosa* holotype female. A, maxilliped, anterior; B, leg 1, anterior; C, leg 2, anterior; D, leg 3, anterior; E, leg 4, anterior. All scale bars 25 µm.



shaped and dorsolaterally directed (Figure 5B). Terminal exopod spines about as long as terminal segments on all legs. Endopod of legs 2 and 3 with modified apex to third segment, consisting of an offset apical lobe and a subapical seta. Fifth swimming leg (Figure 5C) represented by a long, flattened dorsal seta (Figure 5B) and a slender ventral seta. Leg 6 represented by the operculum closing off the genital apertures, armed with a short spine (Figure 5C).

Material examined

Holotype female collected in an opening and closing net fished between 100 and 150 m depth at 21°26'N 38°04'E in the central Red Sea during cruise 29 of the RV *Valdivia*. The temperature was 22–23°C and the salinity 40.5‰. Three paratype females were collected at the same station in the 50–100-m horizon, characterized by a sharp thermo-halocline at which the temperature fell from 27.5 to 23°C and salinity increased from 39.7 to 40.3‰. The holotype and three paratypes are stored in the BM(NH). Registration numbers 1985.500 and 1986.435–437 respectively.

Remarks

The new species is very similar to *O. atlantica* as redescribed above. The size and shape of the body, and the numbers of armature elements on the appendages are almost the same in these species. The new species differs from *O. atlantica* in the possession of so many modified oar-shaped or club-shaped setae on the swimming legs, caudal rami and antennules. *O. atlantica* possesses a single modified seta on the basis of leg 4, the new species has one on the basis of each leg. Another difference is the presence of two setae, one of which is long and club-shaped, representing leg 5 on the first urosomal somite. A particularly distinctive feature of the new species is oar-shaped, red-colored setae on the caudal rami. These enable the species to be recognised in plankton samples without dissection, as no other *Oncaea* has been reported with such setae.

O. pluviosa was common in the central area of the Red Sea, occurring in the water column between the surface and 450 m. The population appeared to be concentrated in the 0–100-m depth horizon. In the northern Red Sea it was found irregularly.

Discussion

The presence of modified oar-shaped or club-shaped setae on the appendages and caudal rami of *Oncaea* species has not been reported before. They were not only found on *O. atlantica* and *O. pluviosa* as described above, but also on female *O. vodorjanskii* that Shmeleva and Delalo (1965) caught in the same series of samples from the Red Sea. The outer seta on the basis of both the first and second swimming legs was oar-shaped in *O. vodorjanskii*. These modified setae were not illustrated by Shmeleva and Delalo (1965) in their original description of this species nor were they found by Kršinic and Mait (1985) in their recent redescription of Mediterranean material. It is possible that there is intraspecific variation in setal morphology as Nishida (1985) found a modified club-shaped seta on the swimming legs of some specimens of the planktonic cyclopoid *Oithona setigera* (Dana) but a typical tapered seta on others. *O. atlantica*,

O. platysetosa and *O. vodjanitskii* are closely related, each having a modified apex on the endopod of swimming legs 2 and 3. *O. minima* Shmeleva also shares this character and these four species form a well-defined group within the genus *Oncaea*.

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SHORT COMMUNICATION

Mature antarctic krill (*Euphausia superba* Dana) grown from eggs in the laboratory

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Abstract. Fertilized eggs obtained from female krill in Antarctic waters were transported to the Australian Antarctic Division in Tasmania. The eggs were successfully developed to larval, juvenile, subadult and finally mature adult stages in the laboratory. Under experimental conditions of unlimited food supply, at 0°C and in complete darkness, the length of the life cycle from egg to egg was 3 years.

The Antarctic krill (*Euphausia superba*) is a key organism in discussions about the conservation of marine living resources in the Southern Ocean (Tranter, 1982; Laws, 1983), but study of this animal has long been hampered by logistic difficulties of access to the pack ice zone of the Southern Ocean. Because it is difficult to continue field sampling throughout a whole year and because field sampling programmes yield biological and ecological data of limited accuracy, experimental study of live krill has been proposed (Mackintosh, 1972; Mauchline, 1980). To date, the feasibility of experiments on live krill has only been tested using specimens collected in the field (Mackintosh, 1967; Clarke, 1976; McWhinnie *et al.*, 1979; Murano *et al.*, 1979; Ikeda *et al.*, 1985).

In late December 1982, fertilized eggs were collected from gravid female krill during *Nella Dan*'s cruise to Prydz Bay, Antarctica. The eggs were brought back to the laboratory coldroom of the Australian Antarctic Division near Hobart, Tasmania. Hatched larvae were fed a mixture of the diatom *Phaeodactylum tricornutum* cultured at 10°C and newly hatched *Artemia* nauplii, and successfully developed to the final larval stage (furcilia 6 stage) (Ikeda, 1984). To grow the larvae further, *Phaeodactylum* was used as a staple food (2×10^5 cells l^{-1} , or 2000 $\mu g C l^{-1}$), supplemented by various diatoms including the Antarctic crysophycean *Phaeocystis pouchetii* cultured by Dr S. Blackburn of CSIRO Marine Laboratories, Hobart. Throughout the experiment temperature (0°C) and light (complete darkness) were kept constant. Twelve juvenile krill just moulted from furcilia 6 stage were kept individually in glass bottles. As their size increased, specimens were transferred to larger bottles (up to 10 l), and seawater (~34 ‰ salinity) was changed once a week. When changing seawater, fresh food was added. The bottles were checked daily for moults. Three (coded as B10, B11 and B12) out of 12 juveniles grew to the mature adult stage in three years (Figure 1). From the examination of secondary sexual characters (petasma for males and thelycum for females) attached to the moults, it became clear during late 1983 and early 1984 that B12 was male and B10 and B11 were females. Both petasma and thelycum acquired adult shape

